

Prevalence of Croatian Muscle Terms in University Textbooks

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Abstract

In Croatian anatomical terminology, Latin terms for muscles are deeply rooted, as opposed to the proposed domestic equivalents, which are part of the efforts to standardize domestic medical terms. This paper analyzes the prevalence of Croatian terms for muscles in university textbooks in the field of anatomy published in the last 10 years.

Keywords

Latin terms, Croatian equivalents, muscles, university textbooks

1. Introduction

Anatomy is the first exact medical field dating back to the ancient period, which is why its terminology stems from Greek and later Latin [1]. Latin has been the foundation of this terminology, ensuring precision and consistency across different languages. Terms in Latin are internationally recognized and hold the status of standardized international terminology for their clarity and universality [2]. Latin is still used in anatomical terminology because it is a dead, and thus not evolving, language, that does not exclusively belong to one country or people [3].

Building upon this foundation of Latin-based terminology, the classification of muscle terminology follows specific categories that further ensure precision and clarity in anatomical descriptions. These categories include action (*Levator scapulae*), attachment (*Mylohyoid*), characteristic (*Semimembranosus*), direction of fibres (*Rectus femoris*), eponym (*Sphincter of Oddi*), function (*Masseter (to chew)*), location (*Brachialis*), meaning (*Cremaster (suspender)*), numerical (*First lumbrical*), position (*Serratus anterior*), shape (*Quadratus lumborum*), simile (*Latissimus dorsi*), size (*Peroneus longus*), structure (*Gracilis*) [4].²

While Latin has historically dominated this field, modern efforts have focused on incorporating localized terminology to make medical language more accessible and culturally relevant for medical experts and laypeople. Studies have been conducted in various languages, including Croatian, comparing the prevalence of medical terminology in the native language versus Latin. In the Croatian context, it is worth highlighting the work of Kocijan, Di Buono, and Mijić [5], who proposed a model designed with NooJ for analyzing medical terminology that uses dictionaries and morphological grammars to identify Latinisms and Croatinized terms. To name a few other examples, Lysanets and Bieliaieva [6] analyzed the use of Latin terminology in medical case reports; Bujalkova and Džuganová [7] compared Latin and English corpora of medical terminology, highlighting both similarities and differences between them; Sokolova [8] conducted an analysis of

1st International Workshop on Terminological Neologism Management (Neoterm 2025), June 18, 2025, Thessaloniki, Greece

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² This study does not analyze whether Croatian muscle terminology reflects these categories, but this aspect could be explored in future research.

the Latinization of anatomical terminology in Russian and English, offering a classification of Russian and English anatomical terms based on their similarity to Latin equivalents.

Regarding attempts to replace loanwords with native terms, Ladan [9] discusses so-called *zamjedbenice*, which he lists alongside loanwords. He highlights that while some have become firmly established in usage, others still face uncertainty if and when they will be accepted.

However, physicians mostly adopt original terms, while linguists specialize in studying and adapting medical terminology. Despite attempts to create Croatian terms that would be more understandable to the general population, these efforts remain isolated and have generally not gained widespread acceptance [10]. One of the consequences is that patients are often left confused after conversations with their doctor, unsure whether they understood the meaning of what the doctor said. For example, while the Croatian term *mišić dugi opružać prstiju stopala* ('long extensor of the toes') is the recommended term in the Croatian terminology database Struna [11], it is rarely used in communication, whether oral or written. Instead, doctors are more likely to use the Latin equivalent *extensor digitorum longus*, explaining that it is the muscle responsible for extending the toes, to make the term more understandable [2]. It is worth noting that the Croatian term *mišić dugi opružać prstiju stopala* – as recommended by the national terminology database Struna – already conveys this function in a transparent and comprehensible manner. This raises the question of whether the continued preference for Latin terminology stems from its perceived professional authority or tradition rather than from actual communicative clarity.

This has led to the development of Croatian equivalents for anatomical terms, providing linguistically adapted alternatives to long-established Latin terminology. One key aspect of understanding anatomical terminology is the role of terminological variation, which bridges Croatian and Latin muscle terms, ensuring their alignment and broader comprehensibility. Terminological variation is considered an almost inherent feature of medical language because differences in the level of expertise among participants in communication require linguistic adaptation of terms [12, 2]. While Latin terms such as *musculus biceps* remain standardized and globally recognized within the academic community, Croatian equivalents, like *dvoglavi mišić* 'two-headed muscle', enable localization and adaptation to specific linguistic contexts. This Croatian term is the descriptive and straightforward form that highlights the meaning of the term, which follows from Sager's [13] claim that the main purpose of terms is to facilitate communication in a specific field and the transfer of knowledge. This type of variation enhances communication among medical professionals from different linguistic backgrounds and supports the standardization of terminology in university and clinical publications. While the introduction of Croatian muscle terms represents a step towards linguistic inclusivity, their adoption and usage in education and professional practice remain underexplored.

This paper analyzes the prevalence of Croatian muscle terminology within academic literature, focusing specifically on the contexts in which Croatian terms appear in university anatomy textbooks published in the past 10 years. The analysis focuses on how these terms are distributed across the structural components of the textbooks – such as headings, subheadings, main text – and examines to what extent these terms have been adopted, as well as the challenges of their practical implementation in a domain historically dominated by Latin.

2. Methodology

The Croatian terms for muscles were obtained from the *Anatomical Glossary with a Croatian-English-Latin Dictionary* (2015)³, and a table of Latin terms and Croatian equivalents was created.⁴ Croatian terms that are translations or adaptations of Latin terms have been excluded (e.g., *mišić soleus*, *mišić pronator*, *mišić sfinkter*, *mišić supinator*). The glossary is aligned with *Nomina Anatomica*, an internationally recognized standard for human anatomical nomenclature. This standard succeeds the *Terminologia Anatomica*, a parallel listing of Latin terms and their English equivalents that designate the structures of the human body, published in 1998 by the Federative Committee on Anatomical Terminology (FCAT) and approved by the International Federation of Associations of Anatomists (IFAA) [3]. *Terminologia Anatomica* ensures standardization globally, yet discrepancies persist in the implementation of localized terms. The 2nd edition of this standard (TA2) was published online in 2019 and has been approved by the IFAA General Assembly.⁵ The Anatomical Glossary included 1,338 Croatian anatomical terms, many designed to complement or replace Latin-derived terms. Among these, Croatian terms for muscles represent a significant subset, offering linguistically localized alternatives that align with the structure and function of anatomical nomenclature.

In the next step, a corpus of university textbooks in the field of anatomy published in the past ten years was collected, in which the presence of Croatian muscle terms was manually validated.⁶ These publications were selected because this timeframe reflects the ongoing efforts to modernize and standardize Croatian anatomical terminology, along with efforts to integrate Croatian terms into the professional and academic language. By focusing on these recent publications, the study captures the dynamic nature of language evolution and the integration of newly coined terms that may replace or complement the traditional Latin-based nomenclature.

The analysis has focused on the field of muscles for several reasons. First, since muscles are a fundamental component of medical education and practice, their terminology is frequently used, providing ample material to assess the acceptance and practicality of Croatian alternatives within the professional community. Second, Croatian terms for muscles are not widely used, making it valuable to investigate their acceptance in university textbooks. The limited use of Croatian terms for muscles highlights a potential gap between the standardized terminology and its adoption in professional and academic contexts.

This study relies on a qualitative, context-based analysis of academic textbooks rather than a quantitative corpus-based approach.⁷ Relevant textbook sections were manually examined to assess the contextual use and visibility of Croatian versus Latin muscle terminology.

3. Results

In Croatian university anatomical publications, Latin and Croatian terminology coexist, reflecting a dynamic interplay between scientific tradition and contemporary academic conventions. The analysis of muscle terminology in these texts reveals various trends and discrepancies in the choice of terms, indicating the broader influence of context, established academic norms, and the

³ In Croatia, efforts to standardize anatomical terminology in the national language culminated in projects such as *HRANAFINA – Croatian Anatomical and Physiological Terminology*, conducted in 2012 and 2013 and funded by the Croatian Science Foundation under the program *Building Croatian Professional Terminology* (STRUNA). Its primary goals were the systematic development of Croatian anatomical and physiological terminology in collaboration with relevant experts in specific fields and the promotion of the use of Croatian anatomical and physiological terminology in spoken and written forms. The project resulted in the creation of the comprehensive resource *Anatomical Glossary with a Croatian-English-Latin Dictionary* [14].

⁴ The Appendix contains a table listing the Croatian and Latin terms for muscles from the *Anatomical Glossary*, which we identified in all university textbooks used as sources.

⁵ Many changes have been introduced to modernise the part of the terminology concerning the muscular system. The word *musculus* is omitted for those terms that reflect the muscle function (*masseter*, *supinator*). For example, in the TA2, the terms *extensor* and *flexor* were replaced by the terms *extensorius* and *flexorius* [15].

⁶ A list of textbooks is available in the Sources.

⁷ Given the extensive length and structural heterogeneity of university textbooks, compiling a fully searchable corpus was beyond of this study.

pedagogical goals aimed at university students. These findings illustrate the complex factors influencing the selection of Croatian and Latin anatomical terms in medical education.

While some patterns emerge regarding when Latin terms are used, when Croatian terms are applied, and when both appear together, inconsistencies remain. Notably, Croatian muscle terms are predominantly found in titles and subtitles, often without their Latin equivalents (e.g., *trbušni mišići* 'abdominal muscles', *mišići ramenog obruča* 'shoulder muscles', *mišići nadlaktice* 'upper arm muscles', *međurebreni mišići* 'intercostal muscles'). This suggests that Croatian terms are considered sufficient in certain contexts, particularly regarding broader anatomical groups. However, when muscles are classified or described in greater detail, Latin terminology is preferred, reflecting its long-standing role in the international scientific community. An example of this is the classification of back muscles as *autohtoni mišići leđa* 'musculi dorsi proprii', where Latin terms are used for further specification (*mm. interspinales*, *mm. intertransversarii*, *m. erector spinae*, *mm. transversospinales*).

Interestingly, a variant is often found where the Croatian term is listed first, followed by its Latin equivalent in parentheses. For example, the Croatian term *dvoglavi mišić* is used first, acknowledging the established Latin term *biceps* in parentheses, which is much more widely known and used in the global medical literature. This form of bilingual presentation highlights the effort to introduce Croatian terminology while retaining the familiarity of Latin terms, ensuring clarity for readers accustomed to the international nomenclature.

In the case of individual muscles, Latin terms are almost universally used. Examples such as *musculus orbicularis oculi*, *musculus orbicularis oris*, *musculus buccinator*, and *musculus risorius* are listed with their Latin terms as primary designations. Nevertheless, there are instances where both Latin and Croatian terms are presented together. For instance, *mišić zapirac* (*musculus sphincter*), *kružni mišić* (*musculus orbicularis*), *četverokutni mišić* (*musculus quadratus*), *ravni mišić* (*musculus rectus*), *plosnati mišić* (*musculus planus*), and *poprečotnasti mišić* (*m. transversospinalis*) demonstrate a bilingual approach to describing muscle structure. However, exceptions also exist, where only Croatian terms are used. For example, *potključni mišić* and *mali prsni mišić* are listed solely in Croatian, bypassing the Latin equivalents *subclavius* and *pectoralis minor*.

When examining muscle groups, Croatian terms are again more commonly used. Terms such as *trbušni mišići* 'abdominal muscles', *mišići ramenog obruča* 'shoulder muscles', *mišići nadlaktice* 'upper arm muscles', and *međurebreni mišići* 'intercostal muscles' are frequently seen in educational and clinical contexts. However, the classification of individual muscles within these groups is typically provided in Latin. For example, in the context of abdominal muscles, Latin terms such as *musculus rectus abdominis* or *musculus obliquus externus abdominis* are more commonly used in detailed descriptions.

The use of function-related terms such as *pregibač/flexor*, *ispružać/extensor*, and *odmicač/adductor* further underscores the complexity of bilingual terminology. While some textbooks adhere to the use of Croatian equivalents, others maintain the use of Latin terms. An example illustrating the use of Latin terms is the following sentence: *Tetiva za II. i IV. prst u svezi je s tetivama m. extensor indicis i m. extensor digiti minimi u središnjem i distalnom dijelu šake te na dorzumu prstiju*. 'The tendon for the 2nd and 4th fingers is connected to the tendons of the extensor indicis and extensor digiti minimi muscles in the central and distal parts of the hand, as well as on the dorsal side of the fingers'.

Furthermore, inconsistencies can also be found in the subtitles for muscle groups. While some headings are entirely in Croatian, such as *mišići ramena* 'shoulder muscles', *mišići nadlaktice* 'upper arm muscles', others incorporate Latin terms, such as *mišići podlaktice* 'forearm muscles', which includes the Latin equivalent *musculi antebrachii*.

Most of the Croatian muscle terms identified in the analysis correspond to the standardized translations of the Latin terms. Examples include *bočni mišić* (*musculus iliacus*), *dvoglavi mišić* (*musculus biceps*), *kružni mišić* (*musculus orbicularis*), *mišić zapirac* (*musculus sphincter*), and *mišić pregibač* (*musculus flexor*).

In addition, the comparative examination of selected Croatian university textbooks reveals both similar and differing practices in the use of Croatian and Latin muscle terminology. A general pattern emerges in which Latin nomenclature dominates in core anatomical descriptions, particularly for specific muscle terms, while Croatian terminology is more prevalent in section titles, group names, or introductory overviews. This is evident in several textbooks, including *Anatomia humana* (Jašovec, 2018) and *Anatomija: Osnove građe tijela čovjeka* (Jašovec, 2018), where muscle groups are consistently named in Croatian, while individual muscle terms appear almost exclusively in Latin. Only a few exceptions are noted (e.g. *potključni mišić* for *musculus subclavius*, or *mali prsni mišić* for *musculus pectoralis minor*). Textbooks such as *Anatomija* (Rotim, 2017) demonstrate a more deliberate integration of Croatian terms. *Priručni anatomske atlas* (2023) presents a middle ground, with initial chapters displaying both Croatian and Latin terms side by side, particularly in image captions and illustrations. However, as the text progresses, Croatian terms appear only in subheadings or are omitted altogether, with Latin terminology prevailing in the main narrative. In *Anatomija čovjeka* (Marušić & Grković, 2024), the influence of the latest *Terminologia Anatomica* (2020) is evident, with systematic inclusion of both Croatian and Latin terms in section titles and throughout discussions. However, the degree of Croatian-Latin integration varies significantly. Some textbooks treat Latin as the default, occasionally supplemented with Croatian (Jašovec), while others (Rotim, Marušić) show a more consistent effort to promote Croatian terminology, often placing it in primary position.

However, some discrepancies were noted across all textbooks with terms that diverge from the *Terminologia Anatomica* (TA). For instance, *musculus iliocostalis* is known as *bočno-rebreni mišić*, which is not a standard translation in TA. Similarly, *musculus semitendinosus* is listed as *polutetivni mišić*, a term not used in the TA.

In some cases, Croatian terms fail to fully capture the appearance, function, location, or location of the muscles, which may lead to misunderstandings or hinder the widespread adoption of these terms within the scientific community. This suggests that Croatian muscle terminology is still undergoing refinement and standardization to ensure greater consistency and clarity. The dual usage of Croatian and Latin terms reflects the strong influence of international anatomical standards and ongoing efforts to integrate Croatian terminology into academic discourse. However, the persistent inconsistencies highlight the challenges in fully integrating and standardizing Croatian terminology within medical discourse.

4. Conclusion

The findings underscore the complexity of integrating localized terminology into an internationally standardized framework. The use of Croatian terms in academic publications reflects ongoing efforts toward linguistic adaptation, yet inconsistencies in their usage reveal the absence of clear guidelines or a unified approach. This highlights the importance of further refining and promoting Croatian anatomical terms to preserve linguistic identity and enhance consistency in education and professional communication.

Although a certain degree of tolerance for Latin is necessary in medical terminology, it is crucial to prioritize the development of a structured medical lexicon in which Croatian terms are the primary choice [16]. Investigating the acceptance of Croatian muscle terms in university textbooks can shed light on factors influencing their integration, such as educational practices, cultural preferences, and the perceived utility of Croatian equivalents compared to Latin terms.

Overall, it can be concluded that Croatian terms for muscles are used in university textbooks and are largely consistent with established anatomical norms. The presence of these terms in scientific literature, medical education, and clinical practice signals their growing integration. While Latin terms continue to dominate in certain contexts, particularly for international consistency, Croatian muscle terms have been successfully adopted and standardized across various academic and professional settings.

This research provides initial insights into the patterns of terminological preference and usage, offering a basis for more systematic, corpus-driven studies in the future. To build on these findings,

future research should focus on conducting surveys among practitioners to evaluate the adoption and practical utility of Croatian muscle terms in educational and clinical environments. Additionally, a more comprehensive study based on a fully aligned glossary and corpus-based methodology could be a valuable next step to deepen the understanding of how Croatian muscle terms are integrated into professional practice.

Acknowledgements

This work has been funded by the European Union NextGenerationEU within the project *Semantic Frames in the Croatian Language*.

Declaration on Generative AI

During the preparation of this work, the author(s) used GPT-4 in order to: Grammar and spelling check. After using these tool(s)/service(s), the author(s) reviewed and edited the content as needed and take(s) full responsibility for the publication's content.

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Croatian Terminology Database Struna. struna@ihjj.hr

Appendix

Table 1. Croatian and Latin Muscle Terms Identified in All Selected University Textbooks, Based on the *Anatomic Glossary with a Croatian-English-Latin Dictionary* (2015)

Croatian term	Latin equivalent
mišići glave	musculi capitis
leđni mišići	musculi dorsi
trbušni mišići	musculi abdominis
mišići ruku	musculi membri superioris
nožni mišići	musculi membri inferioris
dvoglavi mišić	musculus biceps
donji ravni mišić	musculus rectus inferior
gornji ravni mišić	musculus rectus superior
bočni mišić	musculus iliacus
bočno-rebreni mišić	musculus ilicostalis
trbušni mišići	musculi abdominis
međurebreni mišići	musculi intercostali
autohtoni mišići leđa	musculi dorsi proprii

dvoglavi mišić	musculus biceps
troglavi mišić	musculus triceps
četveroglavi mišić	musculus quadriceps
kružni mišić	musculus orbicularis
mišić odmicač	musculus abductor
mišić primicač	musculus adductor
mišić obrtač	musculus rotator
mišić opružać	musculus extensor
mišići uške	musculi auriculares
vanjski kosi trbušni mišić	musculus obliquus externus abdominis
veliki prsni mišić	musculus pectoralis major
mali prsni mišić	musculus pectoralis minor
potključni mišić	musculus subclavius
ravni trbušni mišić	musculus rectus abdominis
troglavi nadlaktični mišić	musculus triceps brachii
međupoprečni mišići	musculi intertransversarii
nadlaktični mišić	musculus brachialis
crvasti mišići šake	musculi lumbricales manus
međukoštani dlanski mišići	musculi interossei palmares
četveroglavi natkoljениčni mišić	musculus quadriceps femoris
mišići prsnoga koša	musculi thoracis
kratki mišić odmicač ručnoga palca	musculus abductor pollicis brevis
kratki mišić pregibač ručnoga palca	musculus flexor pollicis brevis