ACCURATE TRANSLATION OF TERMS IN ORTHOPEDICS AND BIOMECHANICS

Precisão na tradução dos termos em ortopedia e biomecânica

Anderson Fernando Souza*[1]; Giovan Luis Dalmagro[2]; André Luis do Valle De Zoppa[3]

*Corresponding Author: Anderson Fernando de Souza, Avenida Luiz de Camões, 2090, Conta Dinheiro, Lages, SC, Brazil. CEP: 88520-000.
E-mail: anderson.sji@hotmail.com

Cite as: SOUZA, A. F. DALMAGRO, G. L.; ZOPPA, A. L. do V. de. Accurate translation of terms in orthopedics and biomechanics. **Journal of Continuing Education in Veterinary Medicine and Animal Science of CRMV-SP**, São Paulo, v. 24, e38792, 2026. DOI: https://doi.org/10.36440/recmvz.v24.38792.

Como citar: SOUZA, A. F.; DALMAGRO, G. L.; ZOPPA, A. L. do V. de. Precisão na tradução dos termos em ortopedia e biomecânica. **Revista de Educação Continuada em Medicina Veterinária e Zootecnia do CRMV-SP**, São Paulo, v. 24, e38792, 2026. DOI: https://doi.org/10.36440/recmvz.v24.38792.

Article submitted to the similarity matching system
iThenticate

Abstract

Bone biomechanics is an interdisciplinary field that requires precise terminology to avoid misunderstandings and misinterpretations. However, many technical terms in English are often translated incorrectly into Portuguese. This article aims to present the English-Portuguese translation of the main terms used in biomechanical studies in the field of orthopedics.

Keywords: Biomechanics; translation; technical terms; stress; strain.

Resumo

A biomecânica óssea é um campo interdisciplinar que exige precisão terminológica para evitar mal-entendidos e erros de interpretação. No entanto, muitos termos técnicos em inglês são frequentemente traduzidos de maneira incorreta para o português. Este artigo tem por objetivo apresentar a tradução inglês-português dos principais termos utilizados em estudos biomecânicos na área da ortopedia.

Palavras-chave: Biomecânica; tradução; termos técnicos; *stress*; *strain*.

1 Researcher, Department of Veterinary Medicine, Center for Agroveterinary Sciences, Santa Catarina State University, Lages, SC, Brazil.

2 Master's Student, Department of Mechanical Engineering, Federal University of Santa Catarina, Florianópolis, SC, Brazil.

3 Full Professor, Department of Surgery, School of Veterinary Medicine and Animal Science, University of São Paulo, São Paulo, SP, Brazil.

Introduction

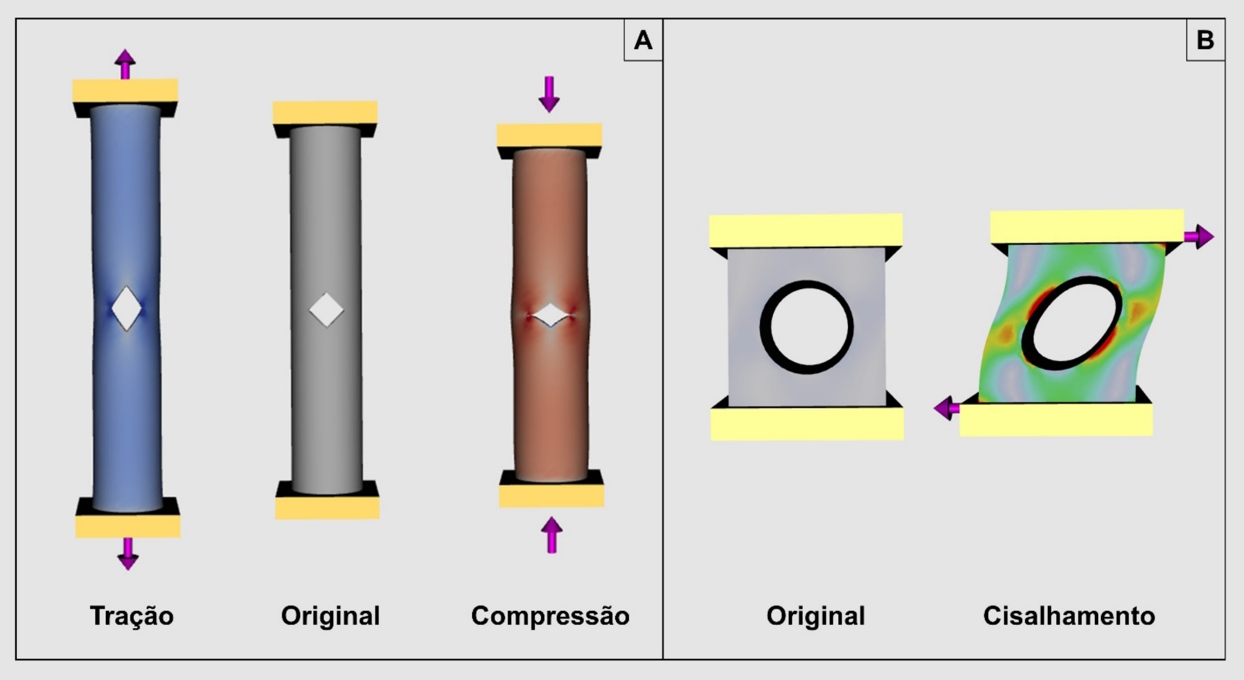
Bone biomechanics is a fundamental field for understanding the mechanical behavior of bone tissue under different loading conditions and has been extensively studied in light of its applications in orthopedics and trauma. Most of the available literature on this topic, as well as a large proportion of relevant scientific publications, is written in English, leading non-native professionals and researchers to rely on translation tools to achieve a deeper understanding of the concepts addressed in scientific texts. The publication of studies in a standard language—English—represents a significant advantage for the academic community, as it unifies the language used by researchers worldwide.

In this context, terminological accuracy is essential for effective scientific communication and for ensuring the replicability and reproducibility of experiments, as well as the comparability of results. Incorrect translations of technical terms from English into Portuguese may lead to misunderstandings and misinterpretations of concepts. Therefore, this text aims to clarify the correct translations of some terms widely used in bone biomechanics and frequently found in scientific literature, contributing to terminological standardization in Portuguese-language publications.

The concepts presented are based on Cordey (2000), Turner and Burr (1993), Guede, González and Caeiro (2013), Callister Jr. and Rethwisch (2016), and Nordin and Frankel (2021):

- Stress = *tensão* (σ). Instantaneous load or force applied to a material divided by its original cross-sectional area—prior to any deformation. It is a scalar quantity and may be classified as tensile, compressive, or shear. Unit: pressure (Pa). The term *estresse* is an incorrect literal translation;
- Strain = *deformação* (ε). Change in the dimensions of a specimen. Using the word strain directly in Portuguese texts alongside deformation may lead to confusion. Another commonly used term in Portuguese is elongation, which also refers to deformation under tensile loading, in which the material elongates at the expense of a reduction in cross-sectional area. It is not uncommon to find texts referring to deformation in the elastic regime as elasticity and in the plastic regime as plasticity. Unit: dimensionless (coefficient);
- Tension = *tração* (F). Refers to the force that stretches or pulls a material (Figure 1A). The term *tensão* is an incorrect literal translation. Unit: force (N);
- Compression = *compressão* (F). Refers to the force that compresses or crushes a material (Figure 1A). Unit: force (N);
- Shear stress = *tensão de cisalhamento* (τ). Force applied to cause or tend to cause relative sliding between two adjacent parts of the same body in a direction parallel and opposite to their plane of contact (Figure 1B). Unit: pressure (Pa);
- Shear strain = *deformação por cisalhamento* (γ). This term is often mistakenly associated with shear stress. It is the equivalent of strain within the context of shear (Figure 1B). Unit: dimensionless (coefficient);
- Shear modulus = *módulo de cisalhamento* (G). Ratio of shear stress to shear strain. It is analogous to Young's modulus but within the context of shear. Unit: pressure (Pa).

Figure 1 – Schematic illustration showing a cylindrical body with a rectangular void at its center in its original state (no stress applied) and under tension and compression (A), and a schematic illustration of a block with a circular void at its center in its original state (no stress applied) and under shear (B)



Source: Souza, Dalmagro and Zoppa (2026). Adapted from the Osapp Platform.

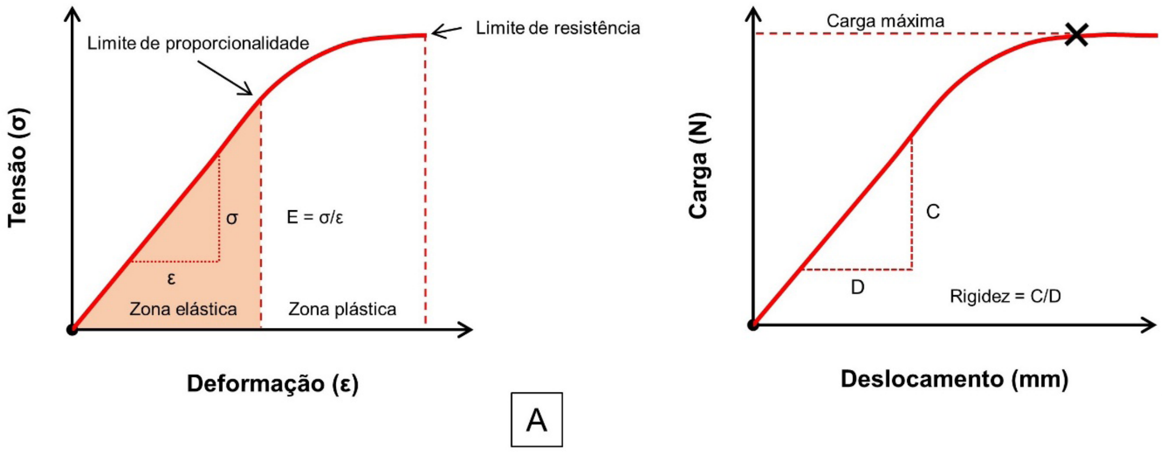
Note: In A, color intensity reflects the magnitude of stress (blue = tension and red = compression). Stress concentrators can be observed at the lateral edges of the defect (darker shades). It should be noted that deformation under axial compression generates not only compressive stresses but also tensile stresses, whose resultant is shear stress. Under tension, both compressive and tensile stresses are also observed, resulting in shear. In B, red areas indicate high stress and green areas indicate low stress. These figures were adapted from resources available on the Osapp platform.

- Young's Modulus = *módulo de Young* (E). Ratio between stress and strain when deformation is entirely elastic; it is also a measure of a material's stiffness. The term "modulus of elasticity" is also correct (Figure 2A). Unit: pressure (Pa).
- Poisson's Ratio = *coeficiente de Poisson* (ν). For elastic deformation, it is the negative ratio between lateral and axial strains resulting from the application of axial stress. This coefficient relates to Young's modulus to the shear modulus. The term *razão de Poisson* is an incorrect literal translation. Unit: dimensionless (coefficient);
- Yield Strength ou Yield point = *limite de escoamento* (σe). Stress requires a very small but defined amount of plastic deformation. Due to the difficulty in precisely determining this point in the stress–strain diagram during instrumented testing, the proportional limit is often adopted without compromising the concept, this is the point at which the linear proportionality between stress and strain ends. It defines the elastic region of the material. Beyond this point, the material undergoes plastic or permanent deformation (Figure 2A). Unit: pressure (Pa).
- Ultimate Strength = *limite de resistência* (σr). Maximum stress level that a material can withstand under uniform plastic deformation (Figure 2A). In ductile metallic materials under tensile testing, this limit separates uniform plastic deformation from localized plastic deformation (necking), which leads to material failure that may be catastrophic. It is important to note that in compression there is no ultimate strength limit, as necking does not occur, and therefore the fracture mode differs from that observed in tension. Unit: pressure (Pa).
- Stress riser = *concentrador de tensão*. Geometric features such as sharp corners, defects (voids, fissures, or cracks), or any structural discontinuity—internal or superficial—where externally

applied stress becomes concentrated (Figure 1A). This phenomenon may be associated with the weakest link theory, in which a material will fail at its weakest point, i.e., at the largest stress concentrator present. The term stress concentration is equivalent. The radius and size of the concentrator are critical factors. In the case of a crack, the radius is much smaller than that of a sharp corner, thus requiring less stress to propagate and cause failure. The concentration factor is measurable by a material property known as fracture toughness (KIC), which corresponds to the energy a material can absorb before fracturing in the presence of a stress concentrator. Unit: Pa.m1/2.

- Stiffness = *rigidez*. Resistance of a material to deformation. It is represented in the load–displacement diagram by the slope of the curve in its linear (elastic) region and is determined by the strength of the chemical bonds between atoms in the material (Figure 2B). The term "rigidity" is also synonymous. Unit: N/mm.
- Displacement = *deslocamento*. Movement of a body in the direction of the applied force. In mechanical testing, it may refer to the displacement of the actuator or crosshead of the testing machine and is used as a simple and indirect way to infer the deformation of the tested specimen (Figure 2B). Unit: length (mm).

Figure 2 – Example of a stress–strain diagram (A) and a load–displacement diagram (B) of a generic bone segment subjected to axial compression



Source: Souza, Dalmagro and Zoppa (2026).

Note: Both types of data generate similar graphs from different datasets. E: Young's modulus; D: displacement; C: load.

- Dislocation = *discordância* (⊥). Linear crystalline defect that affects the arrangement of atoms in the crystal lattice. This defect is found in all materials with a crystalline structure. The literal translation *deslocamento* is incorrect for this term. Unit: number of dislocations per unit area ($\#\cdot m^{-2}$);
- Resilience = *resiliência* (Ur). Total energy or work absorbed by a specimen in the elastic regime during a tensile test. Unit: energy per volume ($J\cdot m^{-3}$);
- Toughness = *tenacidade* (Ut). Total energy or work absorbed by a specimen during a tensile test. The term toughness is used in a wide range of contexts. Unit: energy per volume ($J\cdot m^{-3}$).

Final considerations

The adoption of uniform terminology for biomechanics applied to orthopedics is essential to avoid misinterpretations in studies across the English–Portuguese interface, thereby promoting precise communication among researchers and professionals. Accordingly, the importance of initiatives aimed at consolidating and disseminating appropriate translations is reinforced, strengthening both clinical practice and academic development in the field of biomechanics. &

References

CALLISTER JUNIOR; W. D.; RETHWISCH, D. G. **Ciência e engenharia de materiais**: uma introdução. 9. ed. Rio de Janeiro: LTC, 2016.

CORDEY, J. Introduction: basic concept and definitions in mechanics. **Injury**, v. 31, Suppl. 2, p. 1-13, 2000. DOI: https://doi.org/10.1016/S0020-1383(00)80039-X.

GUEDE, D.; GONZÁLEZ, P.; CAEIRO, J. R. Biomechanics and bone (1): basic concepts and classical mechanical trials. **Revista de Osteoporosis y Metabolismo Mineral**, v. 5, n. 1, p. 43-50, 2013. DOI: https://dx.doi.org/10.4321/S1889-836X2013000100008.

NORDIN, M.; FRANKEL, V. H. **Basic biomechanics of the musculoskeletal system**. 5th ed. Baltimore: Lippincott Williams & Wilkins, 2021.

TURNER, C. H.; BURR, D. B. Basic biomechanical measurements of bone: a tutorial. **Bone**, v. 14, n. 4, p. 595-608, 1993. DOI: https://doi.org/10.1016/8756-3282(93)90081-K.

T Received: April 11, 2025. Approved: November 28, 2025.

CRediT Author Statement

- **Acknowledgments:** Not applicable.
- **Funding:** This article did not receive any financial support.
- **Conflicts of interest:** The authors declare that there are no conflicts of interest.
- **Ethical approval:** Due to the nature of the article, review by an ethics committee was not required.
- **Data and materials availability:** No datasets were generated for this study.
- **Author contributions:** SOUZA, A. F.: study conception, literature review, and manuscript drafting. DALMAGRO, G. L. and ZOPPA, A. L. do V. de.: critical revision of the manuscript. All authors approved the final version of the manuscript.

A publication of

Conselho Regional de Medicina Veterinária do Estado de São Paulo