rcfmc Revista Científica da Faculdade de Medicina de Campos
ISSN 2965-6575

Rev. Cient. Fac. Med. Campos, v. 20, n. 2, p. 52-61, jul./dez. 2025
doi: 10.29184/1980-7813.rcfmc.1275.vol.20.n2.2025
Faculdade de Medicina de Campos
https://revista.fmc.br/ojs/index.php/RCFMC

Case Report

Brachial plexus communications and their relationships to Thoracic Outlet Syndrome

Comunicações do plexo braquial e suas relações com a Síndrome do Desfiladeiro Torácico

Murilo Cardoso Sales[1], Marlana Ribeiro Monteiro[2], Mairkon Almeida Soares[2]

1 Medical Student, Faculdade de Medicina de Campos, Campos dos Goytacazes, Rio de Janeiro, Brazil
2 Professor, Faculdade de Medicina de Campos, Campos dos Goytacazes, Rio de Janeiro, Brazil
Corresponding Author: Murilo Cardoso Sales
Contact: murilomamusca@gmail.com

Keywords:
Brachial Plexus.
Median nerve.
Musculocutaneous nerve.
Thoracic Outlet Syndrome.

Palavras-chave:
Nervo mediano.
Nervo Musculocutâneo.
Plexo Braquial.
Síndrome do Desfiladeiro Torácico.

ABSTRACT

The brachial plexus presents a complex anatomical organization of a tangle of nerves, with frequent variations that may have relevant clinical implications, such as the findings of Thoracic Outlet Syndrome (TOS). This study combined anatomical dissection and literature review to explore these variations and their similar implications in TOS. An upper limb of a male cadaver, preserved in a 10% formaldehyde solution, was dissected in the anatomy laboratory of the Campos Medical School. During dissection, nerve anastomoses were identified, such as the communication between the musculocutaneous and median nerves in the axillary region. These anatomical changes may predispose to neurovascular compressions. The study reinforces the importance of detailed knowledge of anatomical variations to improve diagnostic, anesthetic, and surgical interventions.

RESUMO

O plexo braquial apresenta uma complexa organização anatômica, caracterizada por um emaranhado de nervos, com frequentes variações que podem ter implicações clínicas relevantes, como, por exemplo, nos achados da Síndrome do Desfiladeiro Torácico (SDT). Este estudo combinou a dissecção anatômica e a revisão da literatura para explorar essas variações e suas implicações na SDT. Foi dissecado um membro superior de um cadáver masculino, conservado em solução de formol a 10%, no laboratório de anatomia da Faculdade de Medicina de Campos. Durante a dissecção, identificaram-se anastomoses nervosas, como a comunicação entre os nervos musculocutâneo e mediano na região axilar. Essas alterações anatômicas podem predispor a compressões neurovasculares. O estudo reforça a importância do conhecimento detalhado das variações anatômicas para o aprimoramento de intervenções diagnósticas, anestésicas e cirúrgicas.

Received on:
04/30/2025
Accepted on:
07/05/2025
Published on:
12/31/2025

INTRODUCTION

Thoracic Outlet Syndrome (TOS) is a group of disorders resulting from compression of neurovascular structures as they pass through the thoracic outlet, an area located between the neck, the upper thorax, and the axillary region. This compression may affect the brachial plexus, the subclavian artery, and/or the subclavian vein, leading to different clinical manifestations depending on the structure involved[1–3].

Thoracic Outlet Syndrome is classified into three main subtypes: neurogenic, venous, and arterial. Venous TOS occurs due to compression of the subclavian vein and may cause swelling, pain, and cyanosis of the affected arm[4]. Arterial TOS involves compression of the subclavian artery, resulting in symptoms such as pallor, coldness, and pain in the upper limb[4]. Neurogenic TOS is the most common form and involves compression of the brachial plexus, leading to symptoms such as pain, paresthesia, and weakness in the upper limbs[5].

The brachial plexus is composed of the anterior rami of the spinal nerve roots from segments C5 to T1 of the spinal cord[6]. The anterior rami of the C5 and C6 nerve roots join to form the upper trunk; the C7 root forms the middle trunk; and the C8 and T1 roots form the lower trunk[7]. Each trunk divides into an anterior and a posterior division. The posterior divisions of all three trunks unite to form the posterior cord. The union of the anterior divisions of the upper and middle trunks forms the lateral cord, whereas the anterior division of the lower trunk constitutes the medial cord[7]. The major nerves of the brachial plexus arise from these cords: the posterior cord gives rise to the axillary and radial nerves; the lateral cord forms the musculocutaneous nerve and the lateral root of the median nerve; and the medial cord forms the ulnar nerve and the medial root of the median nerve[7,8]. Finally, the lateral and medial roots of the median nerve unite to form the median nerve proper.

The brachial plexus provides the sensory and motor innervation of the upper limb[6,8] and is susceptible to anatomical variations, such as nerve anastomoses, which lead to deviations from the standard anatomical pattern of motor and sensory innervation. These communications, which are highly variable, may interfere with the pattern of anesthetic blockade of the nerve plexus[9]. It is known that certain drugs produce reversible blockade of nerve impulses by inhibiting sodium channels, such as local anesthetics, which may be administered within or in close proximity to nerves[9,10]. In addition, these substances may produce misleading movements, as they can mimic and mask the loss of original motor function, resulting in errors in diagnosis and in the evaluation of clinical outcomes[11–13].

Although the brachial plexus has been extensively studied, the diversity of its anatomical variations continues to generate controversy in the literature[6–8]. Classical descriptions do not always correspond to anatomical findings, underscoring the ongoing need for investigation[11,14,15]. Such variations may lead to an increased predisposition to compression of neurovascular structures[11].

With advances in medical technology, improvements in traditional dissections of fresh cadavers have been complemented, or even replaced, by alternative methods, such as the use of three-dimensional models and the dissection of preserved cadavers[1,16,17]. These new approaches not only address ethical and logistical concerns but also expand the understanding of anatomy, enabling the study of individual variations in an accessible and reproducible manner[18].

Using dissection techniques in preserved cadavers, this study aims to deepen the understanding of anatomical variations of the brachial plexus, in addition to associating these findings with a review of the literature related to

Thoracic Outlet Syndrome. By mapping nerve pathways and bifurcations, this study seeks to provide data that may assist surgeons and clinicians in daily practice, for example by minimizing the risk of complications during medical interventions.

The research was conducted using the left upper limb of an adult human male cadaver, fixed and preserved in a 10% formalin solution. The cadaver belonged to the Multidisciplinary Anatomy Laboratory of the Faculdade de Medicina de Campos. In accordance with Brazilian Law No. 8,501 of November 30, 1992, which regulates the use of unclaimed cadavers for study or scientific research purposes, the material was used in compliance with current legislation. The study was reviewed and approved by the Research Ethics Committee of the Faculdade de Medicina de Campos under protocol number 81269724.7.0000.5244.

Beginning in the supraclavicular region and ending at the cubital fossa, a straight incision was made in the anterior compartment of the arm, following the anterior midline. Both the skin and subcutaneous tissue were reflected medially and laterally. To expose the entire musculature, the fasciae were removed. Tenotomy of the pectoralis major and minor muscles was performed, and the clavicle was sectioned to allow full exposure of the brachial plexus, enabling identification of the medial and lateral cords. Dissection followed the course of the median and musculocutaneous nerves, proceeding from proximal to distal, with verification of the presence of possible nerve communications. These steps were undertaken to ensure complete visualization of the musculocutaneous nerve and the median nerve throughout their trajectories in the upper limb.

The instruments used to assist the procedure were a Farabeuf retractor, No. 3 and No. 4 scalpel handles, nylon suture threads, No. 15 and No. 22 scalpel blades, surgical gloves, straight-point surgical scissors, blunt-point surgical scissors, anatomical forceps, toothed forceps, and a needle holder.

The number of branches arising from each nerve was counted, as well as their distribution throughout the upper limb. In addition, the blood vessels and their respective branches and tributaries were examined at the axillary level. At the end of the anatomical dissection, the observations were documented using digital photographs.

It should be noted that, to complement the study, a literature review was conducted addressing anatomical variations of the brachial plexus and Thoracic Outlet Syndrome, including their clinical and diagnostic implications. The search was carried out using data from the Scientific Electronic Library Online (SciELO) and the Latin American and Caribbean Literature on Health Sciences (LILACS) databases. The keywords used were: communication between the median and musculocutaneous nerves, thoracic outlet syndrome, and neurovascular compression.

As inclusion criteria, review articles and case reports published in full text, in Portuguese or English, and accessible through the consulted platforms were considered, covering the period from 2005 to 2024. Exclusion criteria included duplicate studies, restricted-access publications, and those not directly related to the objective of the study, as well as studies using animal models, academic theses, or opinion articles. All studies whose eligibility could not be determined based solely on the title and abstract were excluded from full-text assessment. Studies written in languages other than Portuguese or English were excluded due to the authors' language proficiency.

Figure 1 illustrates the article search and selection process. Initially, 175 articles were identified; however, after applying all filters, only 7 articles were deemed eligible for the study. Following full-text review, 6 articles met the inclusion and exclusion criteria and addressed aspects related to the study topic.

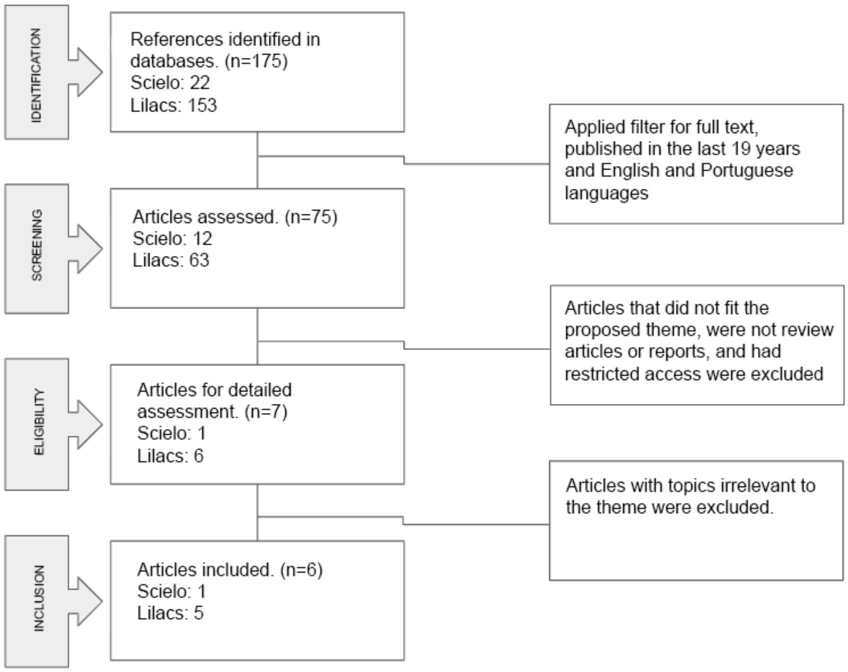

Figure 1. Flowchart of article selection for Thoracic Outlet Syndrome and nerve communications.

CASE REPORT

Following dissection of the left axillary region, it was possible to identify a series of visible neurovascular structures, in addition to relevant findings of neural communication in the proximal third of the arm. It was observed that the musculocutaneous nerve, after piercing the coracobrachialis muscle, bifurcated into two branches: one branch coursed toward the median nerve, piercing the coracobrachialis muscle again, while the other branch positioned itself near the biceps brachii muscle and continued into the forearm as the lateral cutaneous nerve of the forearm. This finding demonstrates an important anatomical variation in the communication between the musculocutaneous and median nerves. **Figure 2** illustrates the dissection with multiple detailed views of the brachial plexus.

The dissection also allowed visualization of the axillary artery and the subclavian artery, as well as important branches of the second and third portions of the axillary artery, such as the thoracoacromial artery and the subscapular artery (external mammary), respectively. It is noteworthy that, at the axillary level, the subclavian vein and the axillary vein were also identified, along with one of its tributaries, the cephalic vein, in addition to the axillary lymphatic plexus. **Figure 3** enabled visualization of the remaining vascular structures of the axillary region. The cords of the brachial plexus were also clearly highlighted during dissection, particularly the medial and lateral cords.

The dissection also allowed visualization of the axillary artery and the subclavian artery, in addition to highlighting important branches of the second and third portions of the axillary artery, such as the thoracoacromial artery and the subscapular artery (external mammary), respectively. It is noteworthy that, at the axillary level, the subclavian vein and the axillary vein were also identified, along with one of its tributaries, the cephalic vein, as well as the axillary lymphatic plexus. **Figure 3** enabled visualization

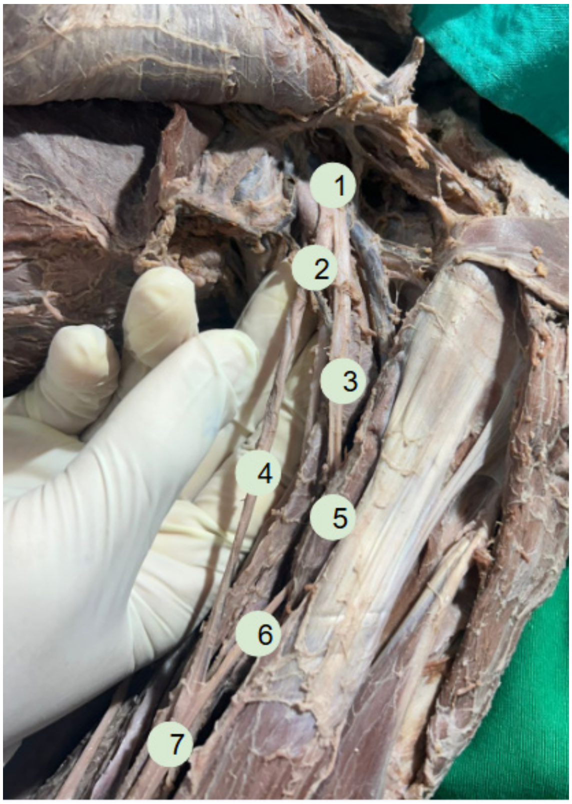

Figure 2. Dissection of the left brachial plexus showing: 1 – lateral cord; 2 – lateral root of the median nerve; 3 – musculocutaneous nerve; 4 – median nerve; 5 – coracobrachialis muscle; 6 – branch of the musculocutaneous nerve (variation); 7 – neural anastomosis between the musculocutaneous and median nerves.

Figure 3. Detailed dissection of the left axillary region showing: 1 – axillary vein; 2 – cephalic vein; 3 – subclavian vein; 4 – axillary artery; 5 – subscapular artery (external mammary), a branch of the third portion of the axillary artery; 6 – thoracoacromial artery, a branch of the second portion of the axillary artery; 7 – axillary lymphatic plexus.

of the remaining vascular structures of the axillary region. The cords of the plexus were also clearly identified during dissection, particularly the medial and lateral cords[25]. These structures pass through narrow spaces, such that muscular alterations and bony deformities may lead to their compression[21]. Among the main causes of this condition are structural abnormalities, such as the presence of cervical ribs or anomalous fibrous bands, hypertrophy or excessive tension of the scalene muscles, as well as trauma or repetitive microtrauma associated with prolonged arm elevation movements[21,23-26]. **Table 1** presents a detailed description of the causes of Thoracic Outlet Syndrome.

Additionally, the anatomical variations observed, such as accessory branches or alterations in the communications among the nerves of the brachial plexus, represent findings that are rarely described in the literature and may predispose to nerve compression[25,26]. These uncommon anatomical variants altered the mechanical and biological balance of the thoracic outlet, increasing the risk of neurovascular compression.

In addition to the anatomical dissection, a literature review was conducted to contextualize the findings observed at the Multidisciplinary Anatomy Laboratory of the Faculdade de Medicina de Campos. The initial search

Table 1. Causes Associated with Thoracic Outlet Syndrome.

CAUSES	DESCRIPTION
Cervical ribs	Presence of additional or ectopic ribs that may compress vessels and nerves within the thoracic outlet.
Anomalous fibrous bands	Fibrous tissue strands that may restrict the thoracic outlet space, leading to neurovascular compression.
Hypertrophy or tension of the scalene muscles	Increased volume or excessive tension of the scalene muscles may reduce the space available for the brachial plexus and vessels.
Trauma or repetitive microtrauma	Injuries caused by repetitive movements or cumulative trauma over time, such as activities involving prolonged arm elevation.
Accessory branches of the brachial plexus	Presence of additional nerve branches or variations in nerve communications, affecting neural transmission and predisposing to compression.
Alterations in nerve communications	Modifications in the nerves of the brachial plexus, leading to anatomical changes that may favor neurovascular compression.

Adapted from: Masocatto, *et al*, 2019[19].

identified 175 articles, of which 6 were included after application of the eligibility criteria. These studies primarily addressed anatomical communications between the musculocutaneous and median nerves, as well as the clinical implications of these variations in Thoracic Outlet Syndrome[21-26].

Among the reviewed articles, Ballesteros *et al.*[22] (2015) and Lamônica *et al.*[25] (2015) stand out for presenting a detailed classification of anastomoses between the musculocutaneous and median nerves, which directly aligns with the anatomical finding of the present study. In contrast, Masocatto *et al.*[21] (2019), Silvestri *et al.*[24] (2005), and Silva Filho *et al.*[26](2021) discuss the etiology of Thoracic Outlet Syndrome with emphasis on structural variations, such as cervical ribs, reinforcing the argument that anatomical alterations are predisposing factors for neurovascular compression, particularly in the axillary region.

DISCUSSION

Difficulty in preserving structures and study limitations

Medical technology has enabled improvements in traditional dissection methods using fresh cadavers, which have been complemented by alternative techniques or even replaced in some contexts[1]. Currently, the use of three-dimensional models and the dissection of formalin-fixed cadavers has become more common[1,17,18]. However, despite these advances, it is important to acknowledge that certain anatomical structures, particularly those that are more fragile or delicate, may be lost or become more difficult to preserve under these conditions. This occurs due to changes caused by chemical fixation with formalin and by tissue manipulation, which may affect the fidelity and visibility of specific anatomical features, such as smaller blood vessels, peripheral nerves, and finer connective tissues[1].

The present study was limited by the use of only a single dissected upper limb, which does not allow generalization of the findings. Therefore, future studies with larger sample sizes may complement these data and strengthen the association between anatomical variations and Thoracic Outlet Syndrome.

Communication between the musculocutaneous and median nerves

The anastomotic finding identified at the Anatomy Laboratory of the Faculdade de Medicina de Campos is consistent with reports in the literature, as it predominantly occurs unilaterally rather than bilaterally[20]. Furthermore, a predominance of the left side has been reported in previous studies, which is consistent with the finding observed in the laboratory. The communication between a branch of the musculocutaneous nerve, after it re-enters the more distal portion of the coracobrachialis muscle, and the median nerve is described in the literature as a highly prevalent variation among musculocutaneous nerve alterations[20].

According to Sirico *et al.*[12] (2019), the prevalence of communications between the musculocutaneous and median nerves ranges from 15% to 43% across different populations, with a higher occurrence of Le Minor type I, in which the musculocutaneous nerve gives off branches to the median nerve after piercing the coracobrachialis muscle[12].

Compression of the musculocutaneous nerve is rare; however, this condition may occur due to abnormal hypertrophy of the coracobrachialis muscle, as well as improper arm positioning during sleep, since the coracobrachialis serves as a passage point for the musculocutaneous nerve[19,20]. Consequently, the clinical signs may resemble those found in carpal tunnel syndrome and even Thoracic Outlet Syndrome[19].

In addition, reports indicate a significant prevalence of these communications, highlighting the need to contextualize the clinical relevance of this finding. The presence of an anastomosis may affect patterns of motor and sensory innervation, interfering with clinical diagnosis, anesthetic nerve blocks, and surgical procedures[20]. For this reason, such variations may mimic symptoms of Thoracic Outlet Syndrome or even mask neurological signs of other neuropathies[12]. From a surgical perspective, awareness of these variations is essential to avoid iatrogenic injury, particularly during procedures such as thoracic outlet decompression or repair of brachial plexus injuries[20].

Signs and symptoms of Thoracic Outlet Syndrome

Thoracic Outlet Syndrome shows a higher prevalence in women, particularly between 20 and 50 years of age, which has been attributed to anatomical and hormonal differences, as well as occupational patterns, with a higher frequency in activities involving arm elevation[21].

Thoracic Outlet Syndrome may present with neurological, arterial, and even venous symptoms[19]. Neural compression in TOS can lead patients to develop a range of symptoms, with pain being one of the most predominant. In these patients, pain is described as tingling or burning in nature, may vary in intensity, and often has an imprecise localization[19]. The most commonly painful areas include the lateral region of the head and neck; the region of the rhomboid muscles (major and minor) and the suprascapular region; as well as the lateral aspect of the upper limb and the dorsal surface of the hand (between the first and second fingers), in addition to the nuchal region, the medial aspect of the upper limb, and the fourth and fifth fingers. It should be noted that these patients may also present with muscle weakness and trophic changes, such as muscle atrophy[19].

Vascular compressions are less common but present a wide variety of semiological clinical signs and may involve either venous or arterial vessels. Venous compression causes a sensation of heaviness due to edema, in addition to venous engorgement, cyanosis, pain, and increased skin temperature[19]. In contrast, arterial symptoms may include Raynaud phenomena, as well as ischemia, gangrene, fatigue, pain, pallor, and ulcers[19].

Diagnosis of Thoracic Outlet Syndrome

To confirm the diagnostic hypothesis of Thoracic Outlet Syndrome, a detailed medical history and a comprehensive physical examination are essential. Physical examination of a patient with TOS includes inspection, palpation, and percussion, in addition to the performance of special maneuvers[22]. During inspection, symmetry of the musculature in the thoracic outlet region, the patient's body habitus, and the presence of bulging, signs of ischemia, and deformities are assessed.

During palpation, pulsatility, sensitivity, mobility, and tissue consistency are evaluated; in addition, the presence of bruits or thrills is investigated. To complete the physical examination, percussion of the supraclavicular fossa is performed to assess the presence of pain, known as Tinel's sign[2,19].

Special tests and maneuvers, such as the Wright maneuver, Roos test, and Adson maneuver, may be performed to support the diagnostic hypothesis[22]. However, it should be emphasized that none of these maneuvers alone is confirmatory for the diagnosis of Thoracic Outlet Syndrome, as they may also assist in the identification of other diseases and syndromes. The maneuver with the highest reliability is the Adson maneuver, which consists of instructing the patient to turn the head toward the affected side while maintaining neck extension, combined with abduction and slight extension of the arm. During this movement, arterial pulsation on the same side is assessed and is considered positive when there is a reduction or absence of the pulse[22,23].

Treatment of Thoracic Outlet Syndrome

Initially, clinical management of Thoracic Outlet Syndrome aims primarily to relieve the patient's symptoms. This includes measures such as the use of simple analgesics, muscle relaxants, anxiolytics, and anti-inflammatory drugs, as well as the application of warm compresses to the thoracic outlet region and the recommendation of rest[22,23]. Patients are also advised to follow the principles of lifestyle medicine, including weight reduction when necessary, adoption of healthy lifestyle habits, modification of occupational activities to avoid arm hyperabduction, avoidance of carrying heavy objects or shoulder bags, and strengthening of the shoulder girdle muscles. In cases of venous involvement, therapeutic management may include anticoagulation and thrombolytic therapy[23].

When clinical treatment is insufficient to achieve symptom relief, surgical intervention is indicated and is required in approximately 15% of cases. The main surgical techniques aim to decompress the involved anatomical structures, including resection of the anterior scalene muscle, the first rib, a cervical rib, or fibrous bands responsible for compression of the neurovascular bundle[2,23].

Among the described surgical approaches, the transaxillary approach stands out as historically the most commonly used due to being less invasive and more cosmetically acceptable, although it has limitations regarding vascular visualization. The supraclavicular approach provides broad exposure of the vascular structures and the brachial plexus and is often preferred for resection of the scalene muscles, the first rib, and cervical ribs. Infraclavicular approaches and anterior or posterior thoracoplasty techniques are less commonly employed. It should be noted that the posterior approach, in particular, is rarely used due to the high associated morbidity and the formation of extensive scarring[2,23].

It can therefore be concluded that detailed knowledge of anatomical variations and nerve anastomoses of the brachial plexus is of fundamental importance in considerations related to Thoracic Outlet Syndrome. When associated with atypical anatomical findings, such as communication between the musculocutaneous and median nerves, these factors may increase the predisposition to neurovascular compression, especially in anatomically vulnerable regions such as the axillary region, resulting in signs and symptoms that may mimic Thoracic Outlet Syndrome.

In this context, an in-depth understanding of these variations not only supports differential diagnosis but also enhances medical practice, contributing to greater safety in surgical and anesthetic procedures.

Furthermore, the importance of integrating traditional anatomical dissection approaches with modern methods, such as the use of three-dimensional models, is emphasized in order to expand the precision, reproducibility, and scope of anatomical studies. In this way, the present work establishes a foundation for future investigations and contributes to medical education and to clinical practice grounded in refined anatomical knowledge.

AUTHOR CONTRIBUTIONS

MCS was responsible for the conception and design of the study, data analysis and manuscript writing. MRM and MAS performed the final revision of the text. All authors read and approved the final manuscript version and agree to take responsibility for its content.

CONFLICT OF INTEREST

We wish to confirm that there are no known conflicts of interest associated with this publication and that no significant financial support has influenced its results.

DECLARATION REGARDING THE USE OF GENERATIVE AI

The authors declare that generative artificial intelligence tools (such as ChatGPT, Grammarly, Deepseek, etc.) were not used in the manuscript. However, the editorial board made the decision to utilize ChatGPT, an AI language model developed by OpenAI, for the translation of this manuscript from the original language, Portuguese, to English.

REFERENCES

1. Vieira PR. A Utilização do Cadáver para Fins de Estudo e Pesquisa Científica no Brasil. Rev Bras Educ Médica [Internet]. agosto de 2001 [citado 18 de novembro de 2025];25(2):60–3. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100 55022001000200060&tlng=pt
2. Silva Filho ERD, Dalio MB, Santarosa MB, Oliveira TF, Ribeiro MS, Joviliano EE. Tratamento cirúrgico da forma arterial da síndrome do desfiladeiro torácico associado à costela cervical. J Vasc Bras [Internet]. 2021 [citado 18 de novembro de 2025];20:e20200106. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1677 54492021000100609&tlng=pt
3. Panther EJ, Reintgen CD, Cueto RJ, Hao KA, Chim H, King JJ. Thoracic outlet syndrome: a review. J Shoulder Elbow Surg [Internet]. novembro de 2022 [citado 18 de novembro de 2025];31(11):e545–61. Disponível em:https://linkinghub.elsevier.com/retrieve/pii/S1058274622006097
4. Zurkiya O, Ganguli S, Kalva SP, Chung JH, Shah LM, Majdalany BS, et al. ACR Appropriateness Criteria® Thoracic Outlet Syndrome. J Am Coll Radiol [Internet]. maio de 2020 [citado 18 de novembro de 2025];17(5):S323–34. Disponível em: https://linkinghub.elsevier.com/retrieve/pii/S1546144020301174
5. Dengler NF, Pedro MT, Kretschmer T, Heinen C, Rosahl SK, Antoniadis G. Neurogenic thoracic outlet syndrome. Dtsch Ärztebl Int [Internet]. 28 de outubro de 2022 [citado 18 de novembro de 2025]; Disponível em: https://www.aerzteblatt.de/10.3238/arztebl.m2022.0296
6. Cunha MRD, Dias AAM, Brito JMD, Cruz CDS, Silva SK. Anatomical study of the brachial plexus in human fetuses and its relation with neonatal upper limb paralysis. Einstein São Paulo [Internet]. 22 de janeiro de 2020 [citado 18 de novembro de 2025];18:eAO5051. Disponível em: https://journal.einstein.br/article/anatomical-study-of-the-brachial-plexus-in-human-fetuses-and-its-relation-with-neonatal-upper-limb-paralysis/
7. Costabeber I, Almeida GMD, Becker M, Silveira AFD, Martini DT. Fascículos do plexo braquial: um estudo morfológico. Rev Bras Anestesiol [Internet]. dezembro de 2010 [citado 18 de novembro de 2025];60(6):608–13. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-70942010000600007&lng=pt&nrm=iso&tlng=en
8. De Moraes FB, Kwae MY, Da Silva RP, Porto CC, Magalhães DDP, Paulino MV. Aspectos clínicos de pacientes com lesão traumática do plexo braquial após tratamento cirúrgico. Rev Bras Ortop [Internet]. setembro de 2015 [citado 18 de novembro de 2025];50(5):556–61. Disponível em: https://linkinghub.elsevier.com/retrieve/pii/S010236161500051X
9. Araújo DRD, Pinto LDMA, Braga ADFDA, Paula ED. Formulações de anestésicos locais de liberação controlada: aplicações terapêuticas. Rev Bras

Anestesiol [Internet]. setembro de 2003 [citado 18 de novembro de 2025];53(5). Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-70942003000500014&lng=pt&nrm=iso&tlng=pt

10. Rocha APC, Kraychete DC, Lemonica L, Carvalho LRD, Barros GAMD, Garcia JBDS, et al. Dor: aspectos atuais da sensibilização periférica e central. Rev Bras Anestesiol [Internet]. fevereiro de 2007 [citado 18 de novembro de 2025];57(1):94–105. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-70942007000100011&lng=pt&nrm=iso&tlng=pt
11. Caetano EB, Vieira LÂ, Cavalheiro CS, Razuk Filho M, Almargo MAP, Caetano MF. ANATOMIC STUDY OF THE NERVOUS COMMUNICATION BETWEEN THE MEDIAN AND MUSCULOUCUTANEOUS NERVE. Acta Ortopédica Bras [Internet]. agosto de 2016 [citado 18 de novembro de 2025];24(4):200–3. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-78522016000400200&lng=en&tlng=en
12. Sirico F, Castaldo C, Baiocchato V, Marino N, Zappia M, Montagnani S, et al. Prevalence of musculocutaneous nerve variations: Systematic review and meta-analysis. Clin Anat [Internet]. março de 2019 [citado 18 de novembro de 2025];32(2):183–95. Disponível em: https://onlinelibrary.wiley.com/doi/10.1002/ca.23256
13. Fregnani JHTG, Macéa MIM, Pereira CSB, Barros MD, Macéa JR. Absence of the musculocutaneous nerve: a rare anatomical variation with possible clinical-surgical implications. Sao Paulo Med J [Internet]. setembro de 2008 [citado 18 de novembro de 2025];126(5):288–90.Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-31802008000500009&lng=en&tlng=en
14. Nascimento SRR, Ruiz CR, Pereira E, Andrades L, Souza CCD. Rara variação anatômica do nervo musculocutâneo – Relato de caso. Rev Bras Ortop [Internet]. maio de 2016 [citado 18 de novembro de 2025];51(3):366–9. Disponível em: https://linkinghub.elsevier.com/retrieve/pii/S0102361615001733
15. Barone R, D'Amico AG, Di Lorenzo N, Di Grado GL, Matranga E, Spinoso G, et al. Anastomosis between Median and Musculocutaneous Nerve: Presentation of a Very Rare Anatomical Variation in Comparison to Classical Divisions. Anatomia [Internet]. 19 de junho de 2022 [citado 18 de novembro de 2025];1(1):68–74. Disponível em: https://www.mdpi.com/2813-0545/1/1/7
16. Vieira JE, Akamatsu FE, Jácomo AL. Ensino da anatomia: dissecção em associação com a tecnologia no curso de Medicina. Rev Bras Educ Médica [Internet]. 2023 [citado 18 de novembro de 2025];47(2):e072. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-55022023000200801&tlng=pt
17. Boff TC, Scaramussa AB, Christianetti M, Rossi RC, Silva DTDRE. uso da tecnologia no ensino da anatomia humana: revisão sistemática da literatura de 2017 a 2020. Med Ribeirão Preto [Internet]. 11 de dezembro de 2020 [citado 18 de novembro de 2025];53(4):447–55. Disponível em:https://www.revistas.usp.br/rmrp/article/view/169288
18. Costa GBFD, Costa GBFD, Lins CCDSA. O cadáver no ensino da anatomia humana: uma visão metodológica e bioética. Rev Bras Educ Médica [Internet]. setembro de 2012 [citado 18 de novembro de 2025];36(3):369–73. Disponível em: http://www.scielo.br/scielo.php?scrip=sci_arttext&pid=S0100-55022012000500011&lng=pt&tlng=pt
19. Masocatto NO, Da-Matta T, Prozzo TG, Couto WJ, Porfirio G. Síndrome do desfiladeiro torácico: uma revisão narrativa. Rev Colégio Bras Cir [Internet]. 2019 [citado 18 de novembro de 2025];46(5):e20192243. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-69912019000500302&tlng=pt
20. Ballesteros LE, Forero PL, Buitrago ER. Comunicação entre os nervos musculocutâneo e mediano no braço: estudo anatômico e implicações clínicas. Rev Bras Ortop [Internet]. setembro de 2015 [citado 18 de novembro de 2025];50(5):567–72. Disponível em: https://linkinghub.elsevier.com/retrieve/pii/S0102361614002872
21. Li N, Dierks G, Vervaeke HE, Jumonville A, Kaye AD, Myrcik D, et al. Thoracic Outlet Syndrome: A Narrative Review. J Clin Med [Internet]. 1o de março de 2021 [citado 18 de novembro de 2025];10(5):962. Disponível em: https://www.mdpi.com/2077-0383/10/5/962
22. Francisco MC, Yang JH, Barella SM, Francisco FC, Natour J, Fernandes ADRC. Estudo por imagem da síndrome do desfiladeiro torácico. Rev Bras Reumatol [Internet]. outubro de 2006 [citado 18 de novembro de 2025];46(5). Disponívelem:http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0482-50042006000500009&lng=pt&nrm=iso&tlng=pt
23. Lamônica A, Engelhorn CA, Balbino NB, Engelhorn ALDV. Identification of diagnostic maneuvers positive for arterial compression in symptomatic or asymptomatic individuals who engage in regular weight training. J Vasc Bras [Internet]. março de 2015 [citado 18 de novembro de 2025];14(1):68–77. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1677-54492015000100068&lng=en&tlng=en