RONALDO ARAÚJO ABREU

ROMBOESPLENIOESCAPULAR TRIANGLE: RELATIONSHIP OF THE DORSAL SCAPULA ARTERY WITH THE DORSAL SCAPULA NERVE AND ACCESSORY NERVE

Doctoral Thesis presented to the Postgraduate Course in Medicine. Area of Concentration in Cardiology and Cardiovascular Surgery (Approval 576/91 – CFE – MEC) of the Cardiovascular Foundation São Francisco de Assis – ServCor.

Belo Horizonte

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ADVISOR: Prof. Dr. Otoni Moreira Gomes

COORIENTATOR: Prof. Dr. Melchior Luiz Lima

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Cataloging: Central Library Professor Antônio

A162t

Abreu, Ronaldo Araújo.
Romboesplenioescapular Triangle [manuscript]: relationship of the dorsal scapular artery with the dorsal scapular nerve and accessory nerve / Ronaldo Araújo Abreu. – Belo Horizonte, 2015.
119f. : il.

Bibliography : f. 93 - 106.
Thesis (doctorate) - Cardiovascular Foundation São Francisco de Assis - ServCor, Postgraduate Course in Medicine, Area of Concentration in Cardiology and Cardiovascular Surgery, 2015.

Advisor: Prof. Dr. Otoni Moreira Gomes. .
Coorientator: Prof. Dr. Melchior Luiz Lima.

1. 1. Anatomy; 2. Accessory nerve; 3. Superficial Muscles of the Back; 4. Paraspinal muscles; 5. Peripheral nerves .I. Gomes, Otoni Moreira. II. Lima, Melchior Luiz. III. Cardiovascular Foundation São Francisco de Assis. IV. Title. V. Title: Relationship between the dorsal scapular artery and the dorsal scapular nerve and accessory nerve .

What makes a man walk and his spirit is his faith, which is like the electric current that runs through a wire or nerve, which we can feel, but it is impossible to see.

Ronaldo Araújo Abreu

"Anatomy is the doctor's torch and should illuminate his first steps. Before you want to redirect the right path of lost nature, you should know that it follows the course when delivered smoothly to your movements; it is necessary to know that the organs used for the execution establish correspondences with each other, and that changes occur through the action of passions and the progress of life. The hands that move across surfaces must be able to distinguish without hesitation the parts that are hidden under the thickness and, handling the painful steel scalpel, accurately chart the way forward to be useful and beneficial. The study is long, tedious are its elements and sometimes frightening are its working tools; but at each step taken a new interest develops, which expands the circle of ideas, and increases the pleasure of being alive, because certainly no one has ever watched impassively the organ that beats in his chest or that supports his thinking. ”

Marc-Antoine Petit – 1795

Acknowledgments

I want to initially thank **God the Father** for allowing me to achieve this ultimate goal of my academic life, and for saving my life after a tragic car accident.

To the esteemed **Cardiovascular Foundation São Francisco de Assis – SERCOR – Verdade é Jesus**, for maintaining the renowned Post-Graduate Course in Cardiovascular Surgery, represented by Professor Dr. Otoni Moreira Gomes, my many thanks.

To professor **Dr. Otoni Moreira Gomes** for all the dedication, affection and Christian love given to me during the orientation of my thesis. Your immense and recognized knowledge and dedication to medical research are and will be my role model.

To **Professor Dr. Melchior Luiz Lima** for the friendship, kindness, affection and brotherly love shown to me throughout this long journey. I thank you for having welcomed me into your home and to your lovely wife for having dedicated her time to me.

To the affectionate friend, whom I learned to like and respect, **Dr. José Fernando Roberte Nunes** for taking his precious time to help me with this work to conclude my thesis.

To my beloved family for everything they represent in my life. To my parents for teaching me love and respect for life. To my dear father – **Dr. Jayme Andrette Abreu** (*in memoriam*) for being the example of a complete doctor that I always wanted to be throughout my life. To my beloved wife – **Dr. Marlêda Ferreira Duarte** and my two children, **Rodrigo Otávio** and **Ronaldo Duarte**, who were able through their love to help and understand me in this arduous and difficult journey.

To professor **Dr. Benedito Aparecido de Toledo,** my “academic father,” for all the sincerity, love and affection dedicated to my academic training and my life as an anatomist.

To Professor **Dr. Nilson S. Ferreira** and Professor **Érika A. Miranda**, my former students, at the Governador Valadares School of Dentistry (UNIVALE - FOG), who provided all administrative and material support for this thesis.

To **Dr. Eli Nogueira**, Director of the Faculty of Medicine of UNEC - CARATINGA (FAMEC) for authorizing the use of the Anatomy laboratory and allowing the development of the work of this thesis at FAMEC.

To Professor **Dr. Raul Rabelo** (in memoriam), Coordinator of the Medicine Course at UNINCOR-BH and Professor **Dr. Luciano Resende M. de Souza** for the support, kindness and authorization to carry out this work on the premises of the Faculty of Medicine of UNINCOR -BH.

To Professor **Dr. Ronaldo de Sousa** (in memoriam) and **Dr. Ubiratan de Castro**, President of UNIVAÇO, for the respect and affection shown during the years of work at UNIVAÇO - IPATINGA (FAMEVAÇO).

To **Dr. Juliano Dantas de Menezes**, Coordinator of the Regulation Center of Macrorregional IPATINGA - SES - MG, for all administrative support allowing my release for the development of my thesis.

To **Dr. Rubens Almeida Castro** Municipal Secretary of Health of Coronel Fabriciano - MG for allowing my release for dedication to my thesis.

Our **Blessed Mother of God** who answered my wife's prayers and ensured the complete recovery of my health after 45 days in the ICU.

Summary

List of Abbreviations, Acronyms and Symbols

IAT	International Anatomical Terminology
TREE	Romboesplenioescapular Triangle
OV	Omovertebral Bone
UNINCOR – BH	University of Três Corações – Campus BH
UNIVALE – FOG	University Vale do Rio Doce – Faculty of Odontology
UNIVAÇO	University Center of Vale do Aço
UNEC	University Center of Caratinga

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Abstract

Introduction: The use of geometric description of anatomical regions has historical, medical and surgical support and is important for the precise location of anatomical structures. This is useful for both the theoretical study of human anatomy as well as the practice of anatomical and surgical dissection. Triangles have gained a lot of evidence because they are delimited by few structures, facilitating their location. There are many of them, very important to medicine such as the cystichepatic (Callot), inguinal (Hesselbach) and femoral (Scarpa) triangles. This study describes the Romboesplenioescapular Triangle that is made up of the splenius capitis muscle, levator scapulae muscle and rhomboideus minor muscle and its medical-surgical importance. It is important to note that, to date, the Romboesplenioescapular Triangle has not been found or demonstrated in any anatomical or medical literature searched. The nomenclature follows the standards of the International Anatomical Terminology and does not use eponyms. **Objective:** To describe the Romboesplenioescapular Triangle, an anatomical geometric space, and its relation to the dorsal scapular artery, accessory nerve and dorsal scapular, and to consider its anatomical significance for medical and surgical applications. **Method:** Anatomical dissections were performed in 40 adult cadavers and 3 human fetuses, made available in the laboratories of Anatomy and Embryology at the Universities UNINCOR-BH, UNEC-CARATINGA, UNIVAÇO-IPATINGA, UNIVALE-GV-MG-dentistry. This study examined the relationship of the dorsal scapular artery with the dorsal nerve of the scapula and the accessory nerve within the Romboesplenioescapular Triangle. The cadavers and fetuses were divided into 2 groups according to the anatomical access to the Triangle. In Group 1, with 20 adult cadavers and 3 fetuses, with 46 sides dissected, access was achieved by folding the trapezius from medial or vertebral to lateral or scapular, and in Group 2, using 20 cadavers, with 40 sides dissected, access was by lateral or scapular folding to medial or vertebral. **Results**: The Romboesplenioescapular or Dorsal Scapularis Triangle was observed, on both sides of the upper dorsum, in all 40 dissected human cadavers and 3 fetuses. In the cadavers, the measurements found in relation to the triangle were: the base formed by the rhomboideus minor muscle presented measurements 3.4 to 4.0 (3.70 ± 0.30) cm; the lateral edge with its delineation formed by the levator scapulae presented measurements 8.3 to 9.0 (8.65 ± 0.35) cm; and the medial edge access formed by the splenius capitis muscle was 4.2 to 5.0 (4.60 ± 0.40) cm. Variations in the accessory nerve, not studied in fetuses, were found only in relation to its position near the levator scapulae, present on 72 sides (90%) covering dorsal and caudal in contact with the dorsal surface of the levator scapulae muscle. On 8 sides (10%) there was a displacement to a position out of the lateral edge of the levator scapulae muscle. On these same 8 sides (10%) it was observed that the dorsal nerve of the scapula was also displaced laterally along the lower lateral angle of the Romboesplenioescapular Triangle. Regarding the dorsal nerve of the scapula which was not studied in fetuses, it was observed that on 72 sides (90%) this nerve was found in the mid-lateral position within the Romboesplenioescapular Triangle. On 8 sides (10%) it was found laterally near the inferior lateral angle of the triangle next to the dorsal scapular artery. As to the origin of the dorsal scapular artery which was also not studied in fetuses, variations found were: on 42 sides studied (52.5%) this artery originated from the transverse cervical artery, a branch of the thyrocervical trunk; on 32 sides (40%) it originated directly from the subclavian artery. On 6 sides (7.5%) it originated directly from the suprascapular artery, but in all the cadavers and fetuses it occupied the angle of the Romboesplenioescapular Triangle. **Conclusion:** The anatomic description of the Romboesplenioescapular or Dorsal Scapularis Triangle proved that it is a defined anatomical space and structure that is present in all human bodies studied, regardless of gender or age. Its content which includes the dorsal scapular artery, the dorsal nerve of the scapula and its relationship with the accessory nerve proves its importance in medical and surgical practice.

Keywords: Anatomy; Accessory Nerve; Superficial Back Muscles; Paraspinal Muscles; Peripheral Nerves.

1. Introduction

Introduction

The description of geometric anatomical regions has historical and medical support and it's important for exact location of anatomical structures, which becomes useful both for the theoretical study of anatomy, as well as for the practice of dissection and the performance of surgeries. [1-9]

Thus, triangles have historically gained a lot of evidence because they are limited by few structures, in order to facilitate its location, and there are several important ones for medicine - for example, the triangles cystohepatic (Callot's triangle)[1], inguinal (Hesselbach triangle)[2] and femoral (Scarpa triangle)[3]. In the thoracic region, Bourgery[4] and Wrisberg[5] described vascular quadrilaterals in the upper thoracic region, with the purpose of allowing safe access to the great vessels of the chest. So did Farabeuf[6] when describing the triangle that correlates the hypoglossal nerve, the internal jugular vein, the facial vein or the thyrolinguofacial trunk with the internal carotid artery and the carotid bulb. Pirogoff[7] and Beclard[8] also did so when describing the relationship between the hypoglossal nerve and the lingual artery with the digastric and hyoglossus muscle. Thus, like Testut and Jacob[9] who described, in their book of Topographic Anatomy, a triangular space between the serratus posterior superior, the levator scapulae and the splenius, without specifying which splenius, and with muscles in different plane situations, such as the case of the serratus posterior superior that is in a deep position in relation to the others. These authors[9] cite as content small branches of the posterior scapular artery (dorsal scapular artery - IAT)[10] and muscle bundles of the sacrolumbar (semispinalis - IAT).[10]

This work describes the Romboesplenioescapular Triangle, as well as its importance. The nomenclature follows the current standard of International Anatomical Terminology (IAT)[10] which recommends not using eponyms for describing anatomical structures.

The Romboesplenioescapular Triangle is located ventrally and deeply to the cranial part of the trapezius muscle, and is formed by the muscles splenius capitis, levator scapulae and rhomboideus minor, being therefore covered dorsally by the trapezius muscle, and can be found in images throughout the anatomical literature searched, from Vesalius[11] to all the works of authors of 21st century human anatomy.[11-60] Its floor is formed cranially by two muscles: the scalenus posterior muscle laterally, and the splenius cervicis medially; and caudally through the serratus posterior superior muscle (Figure 1).

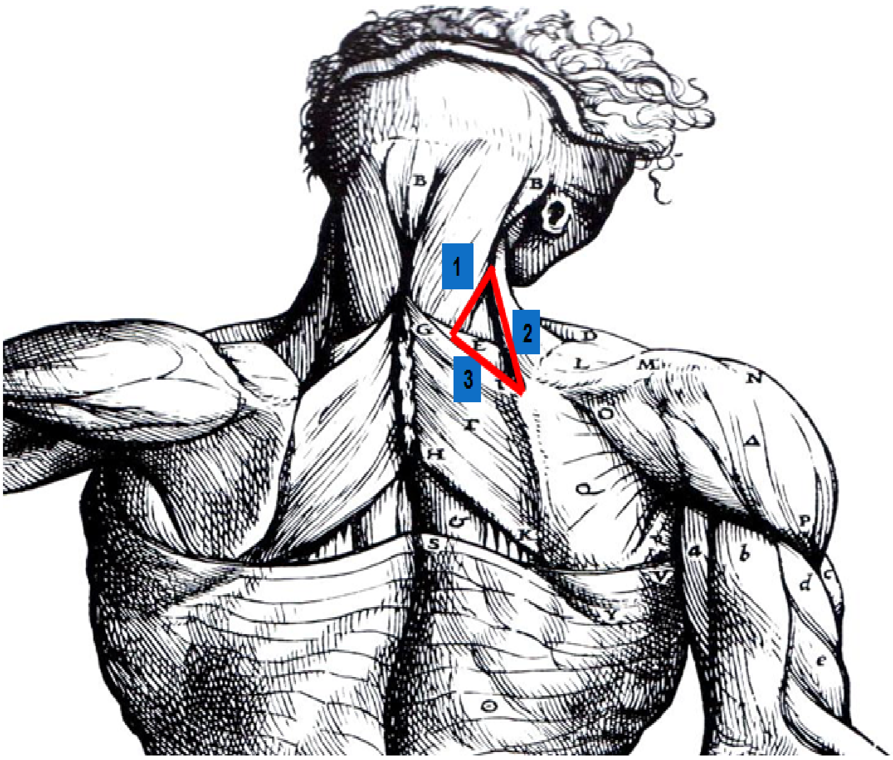

Figure 1 – *De Humani Corporis Fabrica* - Andreas Vesalius - Romboesplenioescapular Triangle in red lines. 1 - Splenius capitis, 2 - Levator scapulae, 3 - Rhomboideus minor

Source: Modified from Vesalius A. *De Humani Corporis Fabrica*. *Epitome Tabulae sex.* São Paulo: Ateliê Editorial; 2003[11]

The muscles that delimit its fixations (origin and insertion) are: 1) the splenius capitis that originates from the lower part of the nuchal ligament and in the spinous processes of the first four thoracic vertebrae, whose fibers follow an upper and lateral path, fixing on the mastoid process and on the rough surface of the occipital bone, just below the lateral third of the upper nuchal line; 2) the levator scapulae muscle that originates from the atlas, the axis and the third and fourth cervical vertebrae, whose fibers come together and take a lower and lateral path, fixing on the medial edge of the scapula, close to the upper angle; 3) the rhomboideus minor muscle that originates from the inferior nuchal ligament and from the spinous processes of the seventh cervical vertebra and first thoracic vertebra whose fibers go to the base of a smooth triangular surface, at the medial end of the scapula, just below the insertion of the levator scapulae muscle where they are inserted. The rhomboideus minor muscle is usually separated from the rhomboideus major muscle by an intermuscular space, but in some situations, such muscles may present themselves together[12-60]. The splenius capitis is innervated by dorsal branches of the second, third, and sometimes, of the fourth cervical spinal nerve.[12-60] The rhomboids and the levator scapulae muscle are innervated by the dorsal scapular nerve, originating from ventral branches of the fourth and fifth cervical spinal nerves.[12-60] These three muscles are supplied by branches of the dorsal scapular artery,[12-60] and the dorsal scapular artery and nerve are located within the Romboesplenioescapular Triangle described in this research.

The accessory nerve that crosses dorsally and superficially the Romboesplenioescapular Triangle has relations in the neck, in the anterior and lateral cervical triangle (IAT)[10] that some authors call posterior[61-88]. The accessory nerve has two central origins, a bulbar and a spinal one that form the bulbar and spinal roots of this nerve. The spinal root is formed by root filaments that originate and emerge from the first six cervical spinal segments and meet on the lateral face of the spinal cord, forming a common trunk that enters the skull through the foramen magnum. The bulbar root originates from the ambiguus nucleus (caudal part) that gives rise to root filaments that emerge through the posterior lateral groove of the bulb, meeting with the spinal root to form the trunk of the accessory nerve. The accessory nerve emerges from the skull along with the glossopharyngeal and vagus nerves and internal jugular vein through the jugular foramen. This nerve is divided in the jugular foramen into two branches: an internal one that joins the vagus nerve and is distributed with it; and an external one that emerges from the jugular foramen as an accessory nerve.[61-88] In the anterior cervical triangle, after emerging from the jugular foramen and crossing the internal jugular vein, often behind or less often in front, it maintains relations with the internal carotid artery, hyoid and digastricus muscle, which it passes beyond and then reaches the cranial portion of the sternocleidomastoid muscle, which it innervates. At this point, it punctures or emits branches to the cranial and deep portion of the sternocleidomastoid muscle, following an oblique and descending path in the posterior and dorsal direction.[61-88] It communicates with the second, third and fourth cervical nerves thus forming a nervous plexus (accessory-cervical plexus, not described in the IAT)[10] in the lateral (posterior) cervical triangle.[64-68] It crosses the posterior border of the sternocleidomastoid between the cranial third and the two caudal thirds, at the nerve point of the neck, together with branches of the cervical plexus (auricularis magnus, transversus cervical, supraclavicular and minor occipitalis nerve). It then proceeds in an oblique, caudal and dorsal direction, running obliquely through the lateral (posterior) cervical triangle accompanied by a chain of lateral and supraclavicular cervical lymph nodes. Some lymph nodes directly accompany the accessory nerve, and are called the lymph node chain of the accessory nerve located superficially on the deep cervical fascia. After leaving the neck, it penetrates the anterior edge of the trapezius, distributing and branching on the deep face of this muscle on the back.[61-88] It reaches the Romboesplenioescapular Triangle, then it crosses dorsally and superficially to the levator scapulae muscle on the back, traveling in a caudal direction until it penetrates and is distributed in the trapezius muscle, where it ends up branching to its caudal portion. The accessory nerve thus has a superficial and dorsal path to the inferior and lateral portion of the Romboesplenioescapular Triangle.

The dorsal scapular nerve arises from the roots of the fourth and fifth cervical nerve close to the corresponding intervertebral foramen, almost always together with the root of the long thoracic nerve. It crosses the scalenus medius and goes dorsally and caudally in the deep face of the levator scapulae, and its branches of origin can divide and perforate this muscle.[87-107] Then, after passing deeply to the levator scapulae, inside the Romboesplenioescapular Triangle (a path that is not described in the anatomical literature available), it travels towards the vertebral border of the scapula to penetrate the cranial portion of the rhomboideus minor. It supplies the rhomboideus minor and rhomboideus major and, in the company of branches of the dorsal scapular artery, gives one or more branches to the levator scapulae and can even cross it, giving branches to this muscle in this path.[87-107] This nerve is in a medial position, with an oblique direction from lateral to medial, within the Romboesplenioescapular Triangle.

The dorsal scapular artery (IAT)[10] (dorsal scapular, posterior scapular, deep branch of the transverse cervical or descending scapular artery)[108] can often originate in two or more arteries. It can originate from the transverse cervical artery, a branch of the thyrocervical trunk, from the thyrocervical trunk itself or directly from the subclavian. After its origin it runs in the cranial direction for a short distance, then bypasses the brachial plexus, being able to cross between the anterior and posterior divisions of the superior trunk, or between the superior and middle trunk, or also between the middle and inferior trunk. Then it follows dorsally and caudally towards the scapula and, at the edge of the levator scapulae muscle, divides into an ascending and descending branch. The ascending branch irrigates the levator scapulae, the cranial portion of the trapezius, the splenius capitis and neck and the deep portion of the semispinalis muscles. The descending branch emits a superficial branch directly to the trapezius, next to the medial or lateral edge of the levator scapulae (trapezius artery) that accompanies the accessory nerve and irrigates the middle and caudal part of the trapezius.[108-128] This descending branch, after emitting the trapezius branch, is directed as a deep branch and irrigates the rhomboids, serratus posterior superior, latissimus dorsi and inferior part of the trapezius.[108-128] The deep descending branch travels towards the upper angle of the scapula, thus passing close to the lateral angle of the Romboesplenioescapular Triangle, then crosses this angle and continues caudally anastomosing with the subscapular and suprascapular artery near the lower angle of the scapula. The dorsal scapular artery crosses the lateral angle of the Romboesplenioescapular Triangle.

The Romboesplenioescapular Triangle or Dorsal Scapularis Triangle has not yet been described or defined in the medical and anatomical literature, and its importance is related to the location of structures that pass superficially and inside. Crossing superficially and dorsally to the Romboesplenioescapular Triangle, there is the accessory nerve (XI cranial pair); crossing its lateral angle, already inside the triangle, there is the dorsal scapular artery. Also, inside the triangle, but in a mid-lateral position, the dorsal scapula nerve is located. In the researched literature, we find images of the muscle limits of the triangle, with their relationships and content also in images, but without any description or definition of it (Figures 2 and 3).[11-128]

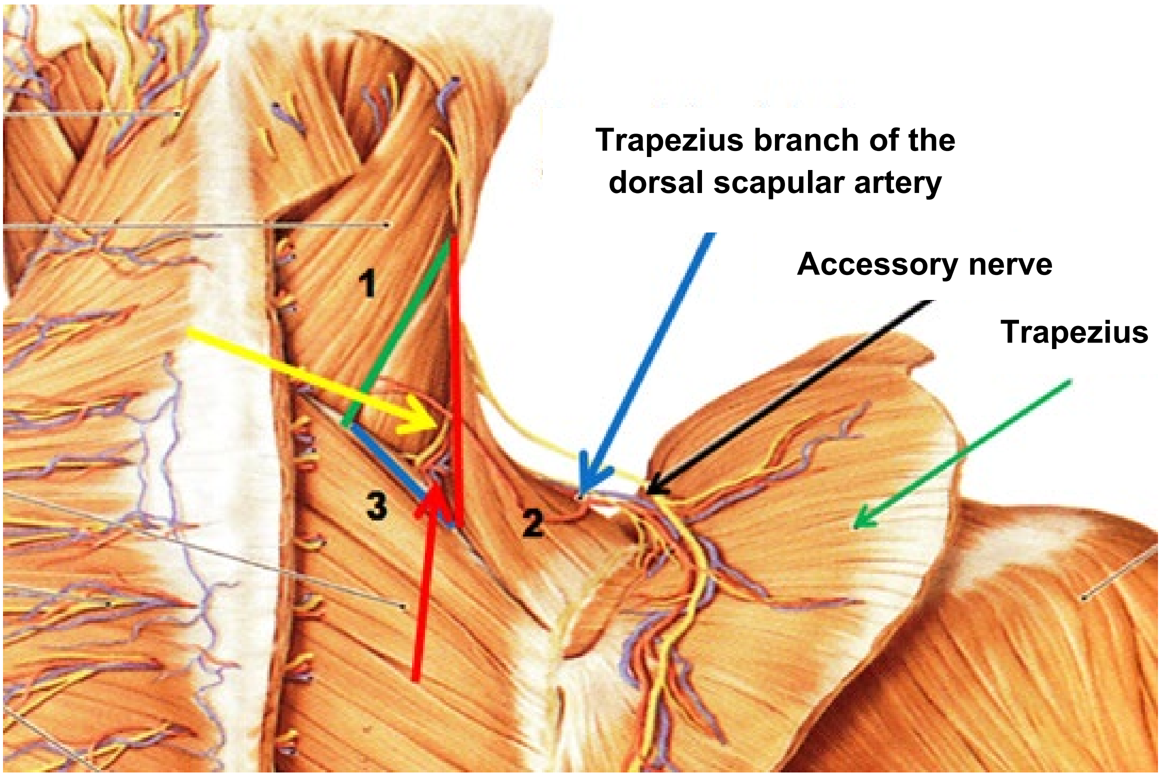

Figure 2 – Romboesplenioescapular Triangle, on the right side, delimited by lines: green line - medial edge, red line - lateral edge, blue line - base: 1- Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle. Yellow arrow - dorsal scapular nerve, red arrow - dorsal scapular artery, black arrow - accessory nerve, green arrow - trapezius muscle folded laterally

Source: Modified from Prometheus Texto y Atlas de Anatomia. 2ª ed. Madrid: Editorial Médica Panamericana; 2010[63]

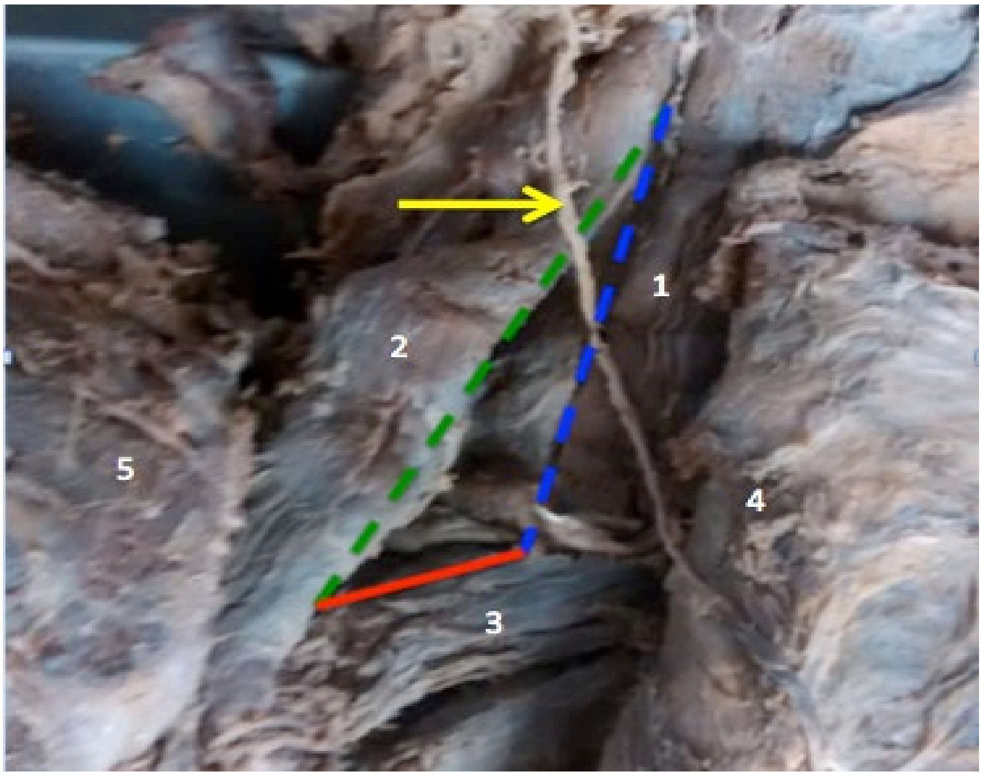

Figure 3 – Romboesplenioescapular Triangle, left side, delimited in the figure above by lines: dashed blue line - medial edge, dashed green line - lateral edge, continuous red line - base: 1- Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle, 4 - Trapezius muscle, 5 - Infraspinatus muscle (scapula). Yellow arrow - accessory nerve

Source: Photography of Cadaver 25 - left side – UNINCOR - BH

In embryogenesis of the muscles of this region of the thoracic or scapular extremity, we observe that these muscles derive from the proper outline of that same extremity, that is, from the myotomes of the cervical somites, and originate in the head, cervical and thoracic spine and fixate on the primitive bones scapular waist.[129-149]

The outline of the trapezius and sternocleidomastoid muscles can be seen in 7 mm embryos and appear in the caudal part of the occipital myotomes originating as a common outline of the cranial cervical myotomes. Thus, the innervation of these muscles is justified by the accessory nerve (spinal root) and by the cranial cervical nerves C2, C3, C4.[129-131]

The spinal portion of the primitive accessory nerve belongs to the border region between the head and trunk.[130,131] This region assimilates part of the trunk mesoderm and part of the region added to the trunk evolutionarily, called the cervical region.[130,131] The spinal root originates from somatic neurons from the primitive basal plate, future column or anterior horn, from the primitive spinal cord through spinal radicles, from C1 to C6, which emerge from the lateral funicular and join in a neural cord, which follows in upward direction to the primitive foramen magnum penetrating the skull, and joining with its bulbar root and penetrating the jugular foramen. This foramen is divided into two primitive branches. The internal branch joins the vagus nerve to emerge from the skull; along with it, the external branch emerges from the primitive jugular foramen as an accessory spinal nerve to innervate the sternocleidomastoid muscle and the trapezius[129-149].

The trapezius and sternocleidomastoid muscles originate from myotomes of the cranial cervical somites. The path of the accessory nerve in the neck is related to the considerable development of the primitive sternocleidomastoid and trapezius muscle masses and the caudal and ventral displacement of the sternocleidomastoid and caudal and dorsal trapezius. In embryos of 20 mm it is possible to perceive the differentiation and displacement, ventral and dorsal, of muscle masses and the accessory nerve. The ventral primitive branches of C2, C3, and C4 penetrate these muscular outlines precociously [129-149](Figure 4).

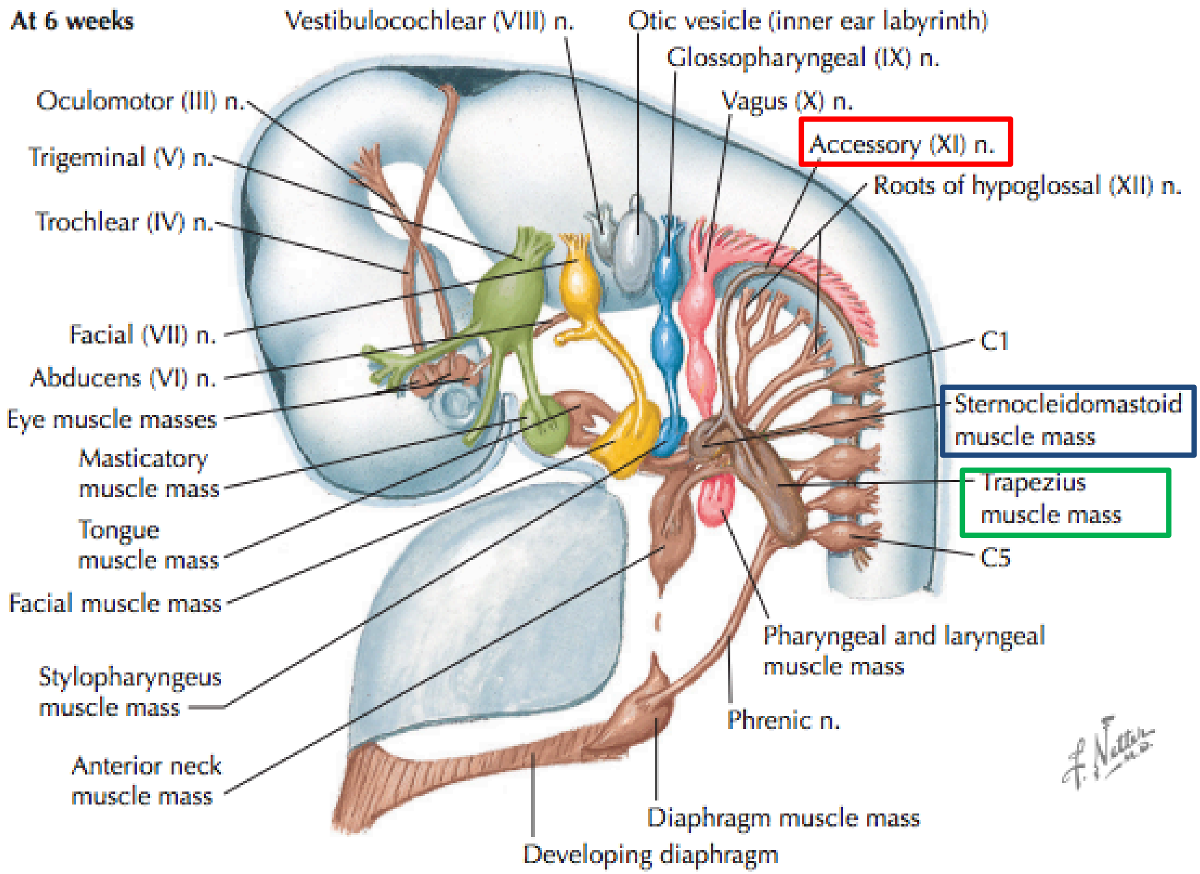

Figure 4 – Six-week-old embryo: accessory nerve - red rectangle; sternocleidomastoid muscle mass - blue rectangle; trapezius muscle mass - green rectangle

Source: Modified from Cochard LR. Atlas de Embriologia Humana de Netter. Porto Alegre: Artmed; 2003[129]

The levator scapulae muscle and rhomboids muscles, (minor and major), originate from myotomes of the middle cervical somites, from their hypoaxial division, (4th and 5th somite), hence the origin of their innervation of C4 ventral roots and C5 that penetrate myotomes as a dorsal nerve of the primitive scapula.[130,131] In 14 mm embryos, the primitive muscle mass of the levator scapulae and rhomboids are directed caudally and dorsally. The outline of the levator scapulae is fixed on the cranial cervical vertebrae and extends dorsally to the upper angle of the primitive scapula.[130,131] The outline of the rhomboid muscles is recognized in 14 mm embryos, and extends in the interval between the caudal cervical vertebrae and cranial thoracic vertebrae up to the scapula. The rhomboid muscles are attached to the 10 primitive spinous (spinal - IAT) processes, following laterally and extending to the medial edge of the scapula.[130,131]

The splenius capitis originates from cervical somites of its cranial and middle epiaxial division because it is an autochthonous muscle of the back, and unlike the levator scapulae and rhomboids, it receives innervation from dorsal branches of the primitive cranial spinal nerves of C2, C3, and C4.[130,131] The splenius outline of the head, which can already be seen in 14 mm embryos, is fixed in the primitive mastoid process and in the lateral part of the nuchal portion of the occipital bone, extending caudally to the posterior tubercles of the primitive spinous processes (spinal - IAT)[10] of the cervical and thoracic vertebrae located deeply to the trapezius and medially to the levator scapulae.[130,131]

In 20 cm fetuses we can already observe, with magnifying glasses, the formation of the Romboesplenioescapular triangular space. In 4-month-old fetuses it is possible to observe, with the naked eye, the Romboesplenioescapular Triangle, the same being easily exposed in 5 and 6-month-old fetuses[130-149] (Figures 5 e 6).

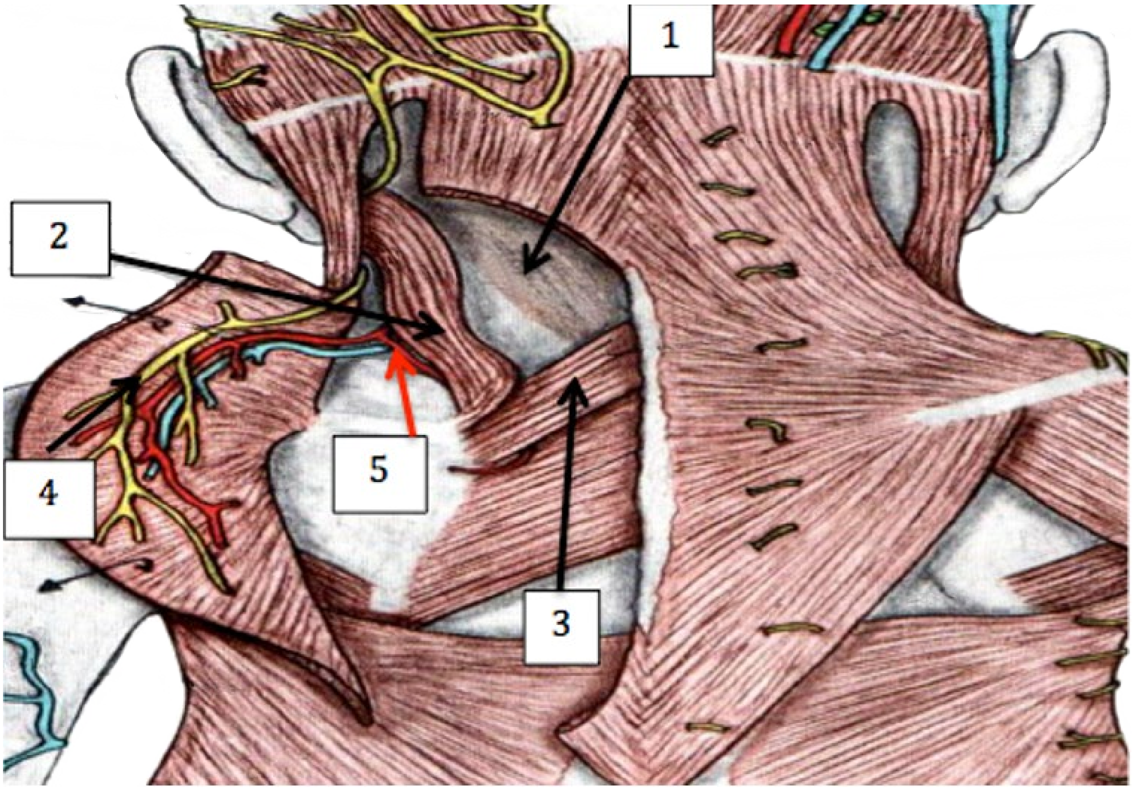

Figure 5 - Romboesplenioescapular Triangle in the newborn: 1- Splenius capitis, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle, 4 - Accessory nerve, 5 - Dorsal scapular artery

Source: Modified from Crelin ES. Anatomy of the Newborn An Atlas. Philadelphia: Lea & Febiger; 1969[133]

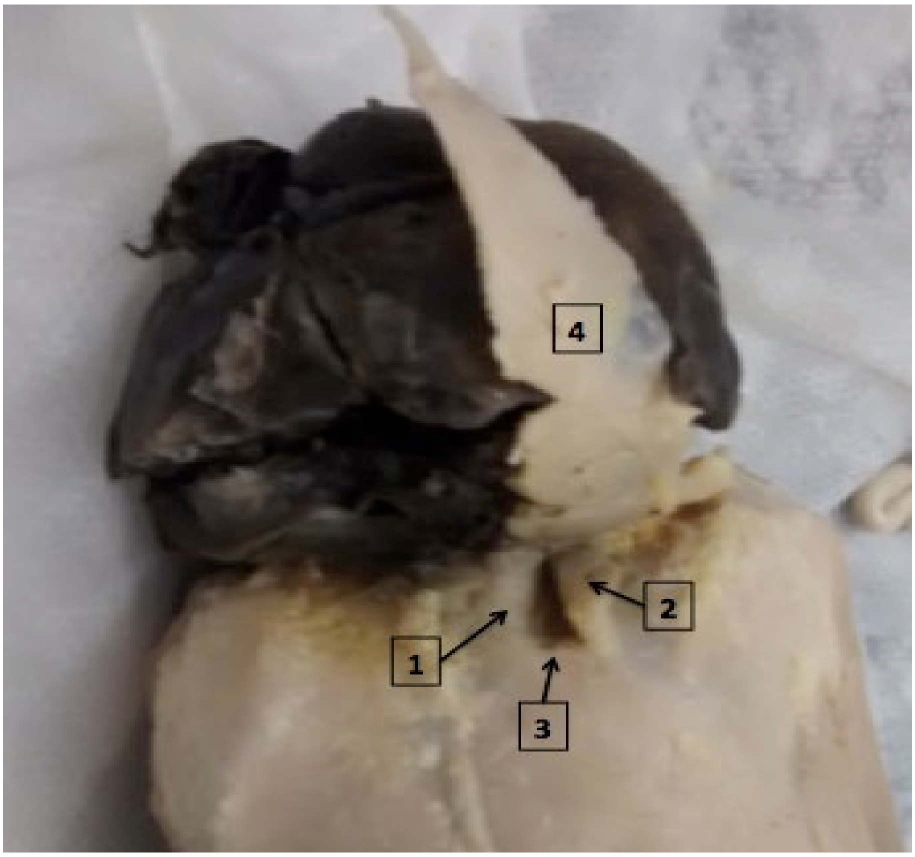

Figure 6 – Photography of anencephalic 6-month-old Fetus 41. Romboesplenioescapular Triangle: 1 - Splenius capitis muscle; 2 - Levator scapulae muscle; 3 - Rhomboideus minor muscle; 4 - Trapezius muscle folded laterally and cranially

Source: Photography of anencephalic 6-month-old Fetus 41– right side - Laboratory Anatomy – UNINCOR - BH

In Sprengel's deformity characterized by congenital elevation of the scapula, caused by interruption of its caudal migration in the embryonic period, and accompanied by hypoplasia of the scapula with formation of the omovertebral bone (congenital calcification of the levator scapulae muscle), knowledge of the triangle and its relations are extremely important for surgical treatment, without sequelae by nerve injuries, by any open surgical technique employed.[150]

Boon *et al.*[151]report a case treated surgically in which, prior to the procedure, dissection was performed in 16 cadavers to better understand the local anatomy. Reginaldo et al.,[150] Boon et al.,[151] and Siu et al.[152] observed that the dorsal scapular nerve, located on the upper medial edge of the scapula, is the one with the highest risk of injury; accessory and suprascapular nerves are rarely at risk. These authors[150-152] thus confirm, by reporting the complications or sequelae of surgical treatment, that knowledge of the Romboesplenioescapular Triangle would indeed be fundamental for the safe surgical treatment of this deformity (Figures 7A and 7B).

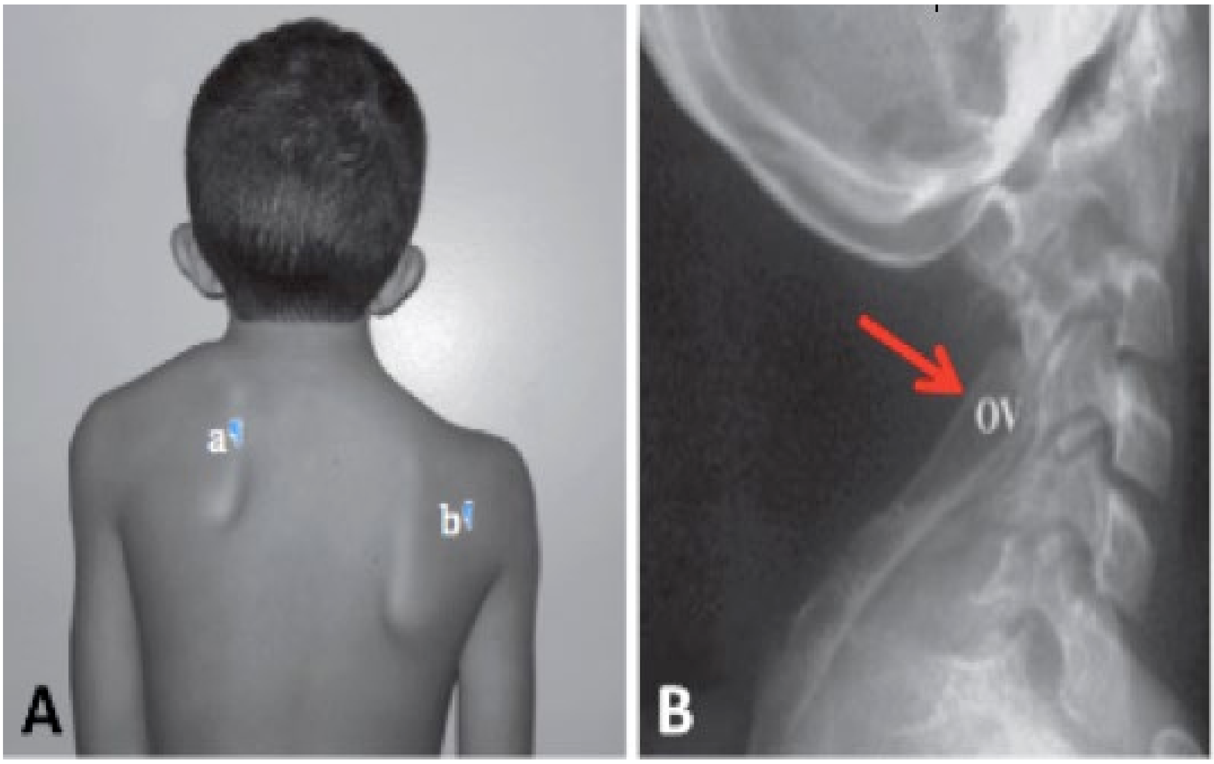

Figure 7 – A) Sprengel deformity - a- Elevated scapula (disease side); b- Normal scapula; B) Red arrow - OV - Omovertebral bone (calcification of the levator scapulae muscle)

Source: Modified from Reginaldo *et al*. Deformidade de Sprengel: Tratamento Cirúrgico pela Técnica de Green Modificada. Rev Bras Ortop. 2009;44(3):208-13[150]

In the treatment of giant cystic hygroma with nuchal extension or cystic lymphangioma in the newborn, knowledge of the Romboesplenioescapular Triangle and its relationships and content is important to prevent possible complications such as those reported by Bull and Cavinatto[153] in the surgical treatment of cystic hygroma in newborns and children[153] (Figure8).

Figure 8 – Giant cystic hygroma in a newborn

Source: Linfangioma cervical no recém-nato. Available from: <http://dermis.net/bilder/CD099/550px/img0027.jpg>[154]

So, also, one finds reference to the importance of the structures that make up the triangle studied here in the Corball PhD Thesis,[155](*Colgajo del Trapecio Inferior aportes sobre su Anatomia Vascular*). This author details the importance of the structures described here in the Romboesplenioescapular Triangle and their content, for the removal and use of trapezius myocutaneous flaps used for cervical, facial and thoracic reconstruction. However, the author does not define or describe this triangle.[155]

In the anatomical review study (Revicion Anatomica De Los Colgajos Miocutaneos), by Lanza, Cavaliere and Albornoz[156], the authors emphasize the wide need for knowledge of the muscular, vascular and nervous structures that make up the triangle as described, for myocutaneous flaps with use of the trapezius. However, the authors do not describe or delimit the Romboesplenioescapular or Dorsal Scapularis Triangle (Figures 9 e 10).

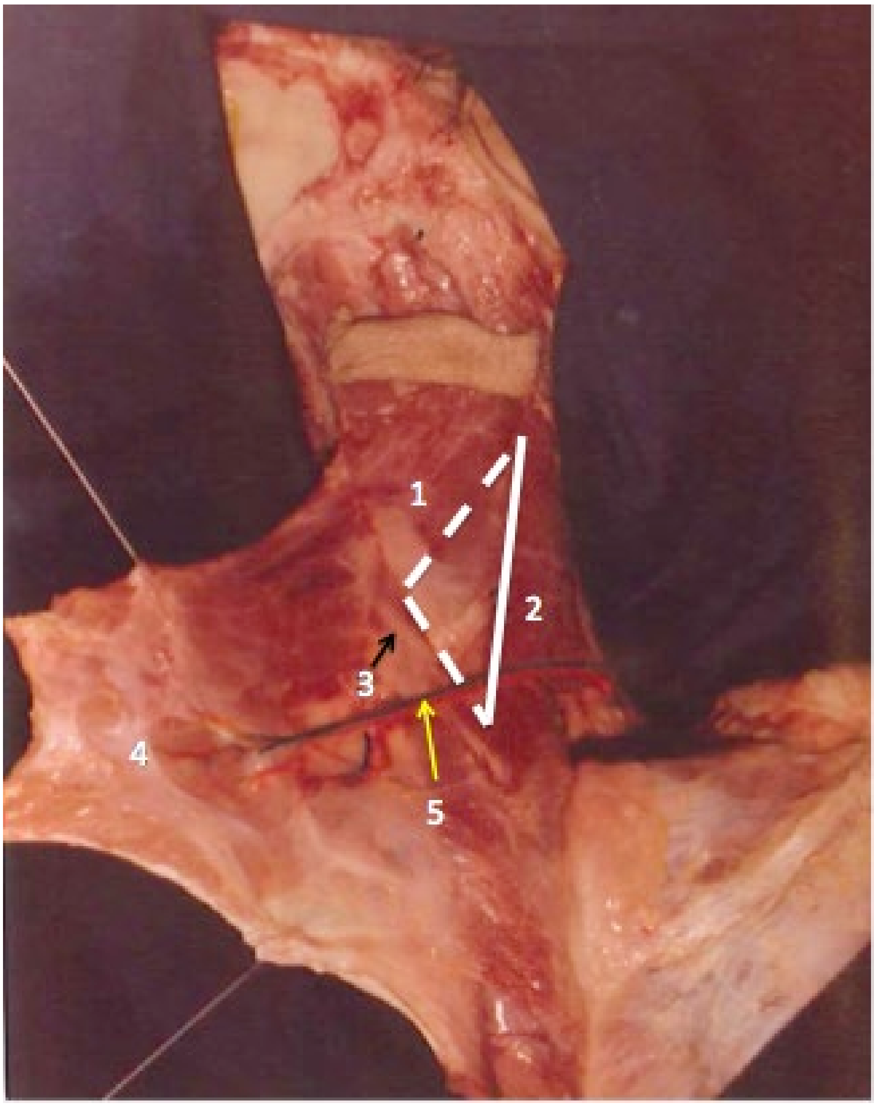

Figure 9 – Romboesplenioescapular Triangle delimited by discontinuous white lines at the medial and base edge, and continuous at the lateral edge: 1- Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle, 4 - Trapezius muscle, 5 - Trapezius muscle vessels branches of the dorsal scapular vessels

Source: Modified from Lanza HL, Cavaliere E, Albornoz JV. *Revicion Anatomica De Los Colgajos Miocutâneos*[156]

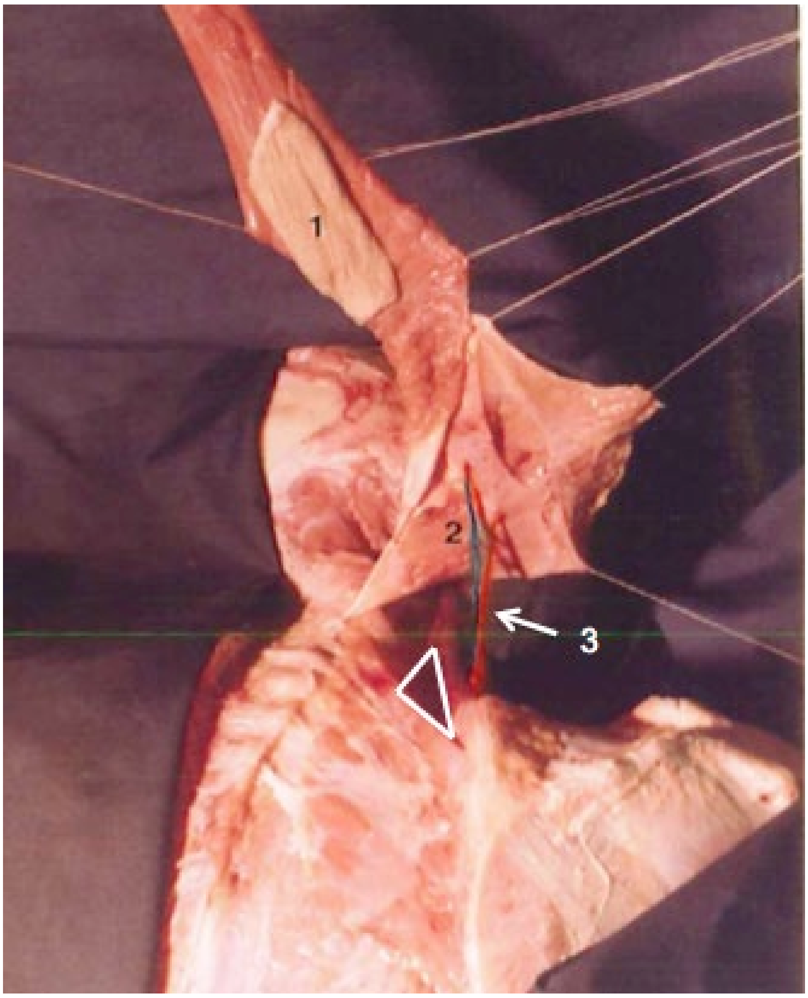

Figure 10 – Romboesplenioescapular Triangle triangular area in continuous white lines: 1- Skin flap, 2 - Trapezius muscle, 3 - Trapezius muscle vessels, branches of the scapular dorsal vessels

Source: Modified from Lanza HL, Cavaliere E, Albornoz JV. *Revicion Anatomica De Los Colgajos Miocutâneos*[156]

In premature infants Monteiro and Canale[157] reported their experience in ligating the ductus arteriosus using a minimally invasive dorsal access technique, through access to the thoracic cavity through the 3rd or 4th intercostal space using the triangle of auscultation, with ample high subscapular detachment. Prior knowledge of the Romboesplenioescapular or Dorsal Scapularis Triangle could allow its use as an alternative surgical route to the chest, by videothoracoscopy, without extensive scapular and subscapular detachment for the surgical procedure, since the opening of the chest would be done in intercostal space corresponding to the surgical skin incision.

In the medical and surgical literature researched there are references and reports of differentiated risk of injury to the structures that were studied in this research on the Romboesplenioescapular or Dorsal Scapularis Triangle, in diseases that affect this anatomical region of the dorsum, or even those that, for their treatment, require trapezius myocutaneous grafts.[150-156]

Thus, without prior anatomical knowledge of this triangle, its precise location and relationships, in surgical procedures in this region of the back, irreparable damage to nervous, vascular and muscular structures may occur, leaving sequelae or partially or completely preventing the medical surgical procedure.

2. OBJECTIVE

Objective

To describe the Romboesplenioescapular Triangle, a geometric anatomical space, and its relationship with the dorsal scapular artery, accessory and dorsal scapular nerves, considering its anatomical importance for medical-surgical applications.

3. METHOD

Method

This research was carried out from anatomical dissections, from formalized cadavers and already dissected by the teachers and students, in the courses of medicine and odontology, and carried out at the Universities UNIVALE - Governador Valadares - MG - Faculty of Dentistry (FOG), UNIVAÇO - Ipatinga - MG, UNEC - Caratinga - MG, UNINCOR - BH - MG, totaling 40 human cadavers, and 3 human fetuses, one being 4 months old, one 6 months old anencephalic, and one 7 months old.

The Group of Human Cadavers is composed of 37 male and 3 female cadavers already dissected in the courses of the institutions: UNIVALE - FOG, UNIVAÇO, UNEC and UNINCOR - BH. The 3 fetuses were previously dissected and available to the Anatomy Laboratory at UNINCOR - BH. The 40 cadavers were dissected during periods of the author's work in the institutions cited as professor of Human Anatomy. There were 5 cadavers at UNIVALE - FOG, 20 cadavers at UNIVAÇO, 5 cadavers at UNEC and 10 cadavers at UNINCOR - BH. In the latter, the 3 human fetuses were dissected. The solutions of cadaveric and fetal fixation used in the institutions were: 10% formaldehyde, 10% glycerol and 10% absolute alcohol. The nerves and vessels were painted with Acrilex® fluorescent paint. Lemon yellow paint (Acrilex® 102) was used for nerves, red paint (Acrilex® 103) for arteries, and blue paint (Acrilex® 109) for veins. The research project was authorized by the Boards of the Faculties of the Universities: UNIVALE - FOG, UNIVAÇO, UNEC and UNINCOR - BH; and approved by the Ethics and Research Committee of the Cardiovascular Foundation São Francisco de Assis (Tables 1, 2).

Table 1 - Origin of the Human Adult Cadaveric Material

Institutions	**Cadavers**
UNIVALE - FOG–Governador Valadares	**5**
UNIVAÇO – Ipatinga	**20**
UNINCOR- BH – Belo Horizonte	**10**
UNEC – Caratinga	**5**
Total	**40**

Table 2 - Gender and Age of Human Material

Institutions	Gender and age	Amount
Cadavers from the 4 institutions	Adult male cadavers	37
Cadavers from UNINCOR-BH – MG	Adult female cadavers	2
Cadaver from UNIVAÇO – Ipatinga– MG	Adult female cadaver	1
Fetuses from UNINCOR-BH –MG	Male human fetuses	3
Total		**43**

The set of fetuses surveyed is thus composed of: 1 fetus of 4 months, 1 fetus of 6 months anencephalic, and 1 fetus of 7 months, all from UNINCOR-BH (Table 3).

Table 3 - Fetuses Used in the Research

Institutions	Fetuses
Anatomy Laboratory UNINCOR–BH	1 four-month-old fetus
Anatomy Laboratory UNINCOR–BH	1 six-month-old anencephalic fetus
Anatomy Laboratory UNINCOR–BH	1seven-month-old fetus
Total fetuses	**3 Fetuses**

Two trapezius muscle folding techniques were used to expose the Romboesplenioescapular Triangle on both sides of the back, thus dividing the cadavers and fetuses into 2 Groups, with a Group consisting of 20 cadavers and 3 fetuses, and another of only 20 cadavers. In Group 1, of 20 cadavers and 3 fetuses, the technique was to bend the trapezius origin for its insertion - that is, from medial to lateral. In Group 2, of 20 cadavers, the trapezius was folded from its insertion to its origin, that is, from lateral to medial. The total number of dissected and studied sides was 80 sides of adult cadavers and 6 sides of fetuses (Table 4).

Table4 – Division into Groups according to the technique of access to the Romboesplenioescapular Triangle, number of cadavers and sides studied

Triangle Access Technique	Human Material	Sides studied
Group 1 - Lateral folding	20 cadavers and 3 fetuses	46
Group 2 - Medial folding	20 cadavers	40
Total	**43**	**86**

The techniques for folding the trapezius muscle used in this research, for the right and left sides of the dorsum, were: in Group 1 (20 cadavers and 3 fetuses), the lateral folding technique of the trapezius muscle of its spinal or vertebral and cranial fixation was performed for its scapular fixation. In Group 2 (20 cadavers), the trapezius and clavicular fixation medial technique of the Trapezius muscle was performed for its spinal or vertebral and cranial fixation. Thus, it was possible to observe the structures that make up the triangle on both sides dissected, their measurements, their relations and their content (Chart 1).

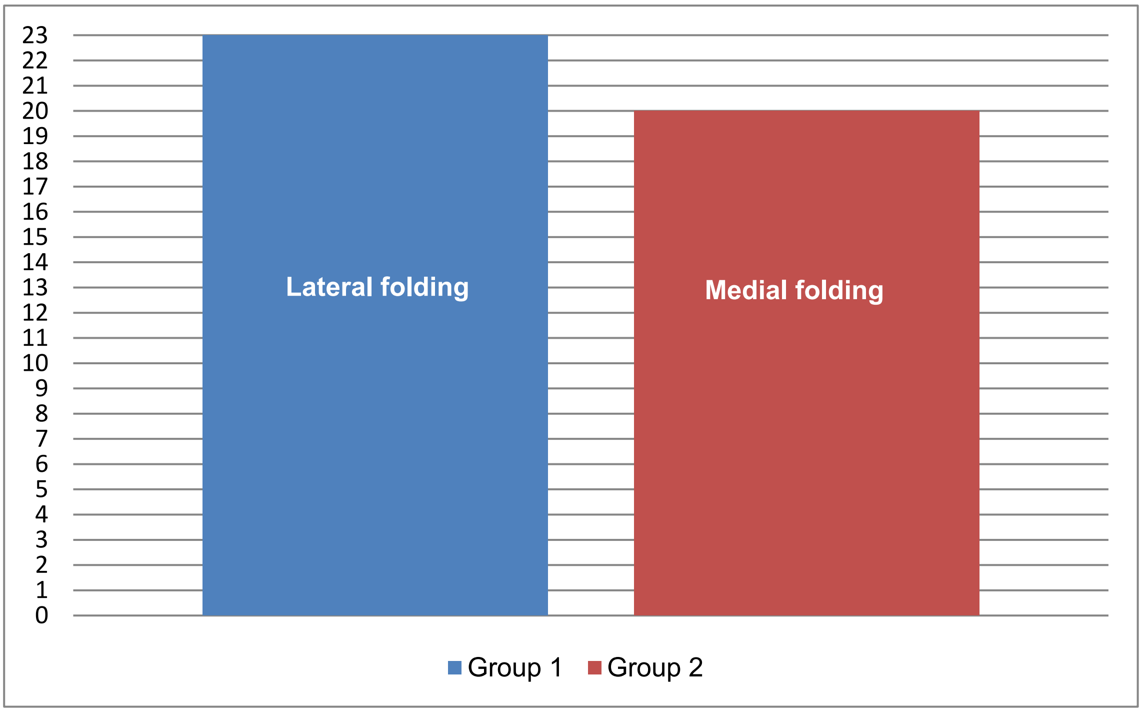

Chart 1 – Group of cadavers and fetuses using the TREE access technique. Group 1 - The technique used was lateral folding; Group 2 - The technique used was medial folding

The cadavers were listed and numbered as follows: the 20 cadavers of UNIVAÇO - Ipatinga, were numbered from 1 to 20; the 10 UNINCOR-BH cadavers were numbered from 21 to 30; the 5 cadavers of UNIVALE - FOG - Governador Valadares from 31 to 35; the 5 cadavers of UNEC - Caratinga from 36 to 40 and the 3 fetuses from 41 to 43. Measurements of the Romboesplenioescapular Triangle were performed in its delimitations next to its lateral edge, medial edge and base of the triangle on both sides of the dorsum only of adult human cadavers. The measurement of the lateral edge was taken from the medial edge of the levator scapulae muscle from its contact at the lateral angle, at the base of the triangle, with the rhomboideus minor muscle until its contact with the splenius capitis muscle at the upper angle of the triangle. The measurement of the medial edge was taken from the lateral edge of the splenius capitis muscle from its contact at the medial angle, at the base of the triangle, with the rhomboideus minor muscle up to its contact with the levator scapulae muscle at the upper angle of the triangle. The base measurement was taken from the upper border of the rhomboideus minor from its contact at the lateral angle of the triangle with the levator scapulae muscle to its contact at the medial angle of the triangle with the splenius capitis muscle. Regarding the content of the triangle, the following were studied: the position, situation, relationship and variations of the dorsal scapular artery with the dorsal scapular nerve and the accessory nerve, in the Romboesplenioescapular Triangle on both dissected sides of the dorsum, only in adult cadavers.

4. RESULTS

Results

The Romboesplenioescapular (TREE) or Dorsal Scapularis Triangle is important for locating three structures: the accessory nerve, the dorsal scapular nerve and the dorsal scapular artery. This triangle can be observed in all 40 dissected human cadavers, 80 dissected sides, and in the 3 human fetuses, 6 dissected sides.

The measures found in this research in relation to the Romboesplenioescapular Triangle (TREE), taken on both sides of adult human cadavers were: the base formed by the rhomboideus minor muscle presented measures from 3.4 to 4.0 cm (3.70 ± 0.30), the lateral edge of its boundary formed by the levator scapulae muscle was 8.3 to 9.0 cm (8.65 ± 0.35), and the medial edge of its boundary formed by the splenius capitis muscle was 4, 2 to 5.0 cm (4.60 ± 0.40). These data are shown in Table 5, Figure 11, Charts 2, 3 and 4.

Table 5 – Measurements, Means and Standard Deviation of TREE in human cadavers

TREE measurements	Measurements	Means	Standard Deviatior
Base	3,4 - 4 cm	3,70 cm	0,30
Lateral edge	8,3 - 9 cm	8,65 cm	0,35
Medial edge	4,2 - 5 cm	4,60 cm	0,40

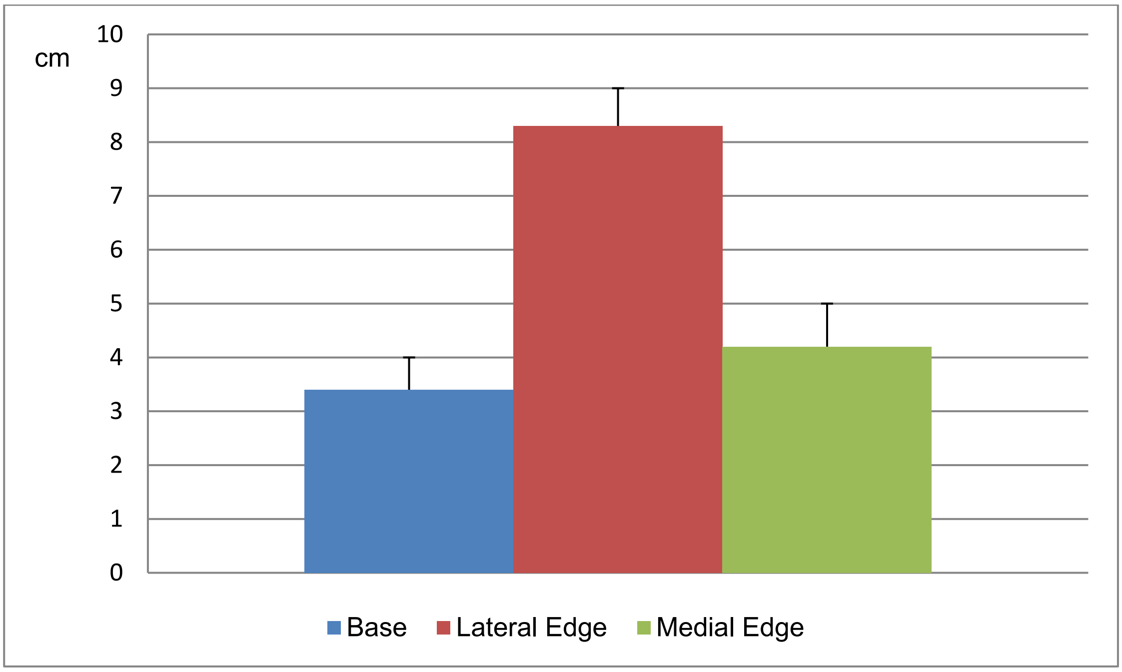

Chart 2 - Measurements of TREE limits

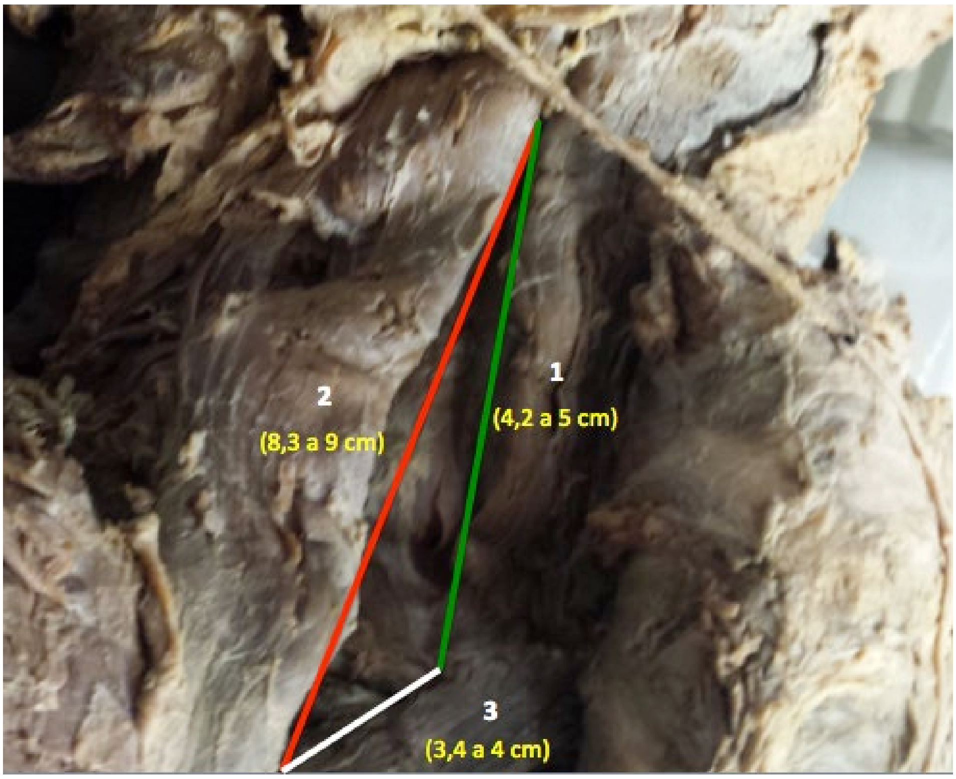

Figure 11 – Romboesplenioescapular Triangle, right side, delimited and with measurements in centimeters, represented in colored lines: Lateral edge, red; medial edge, green; and base, white. 1- Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle

Source: Photography of Cadaver 2 - left side - UNIVAÇO - Ipatinga - MG

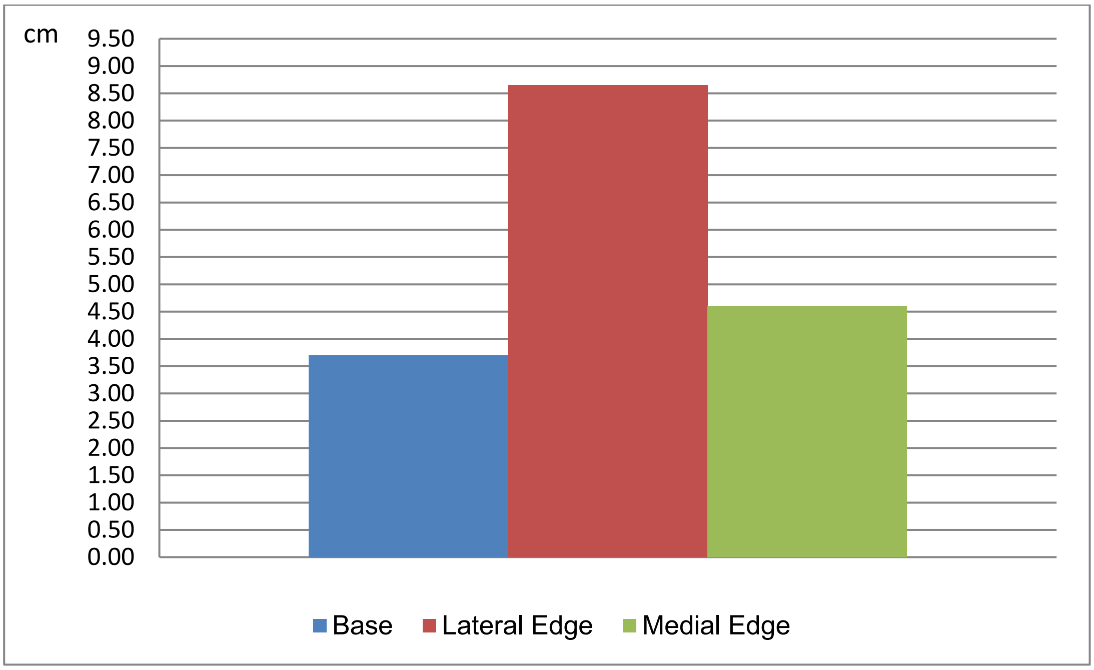

Chart 3 - Averages of TREE measurements

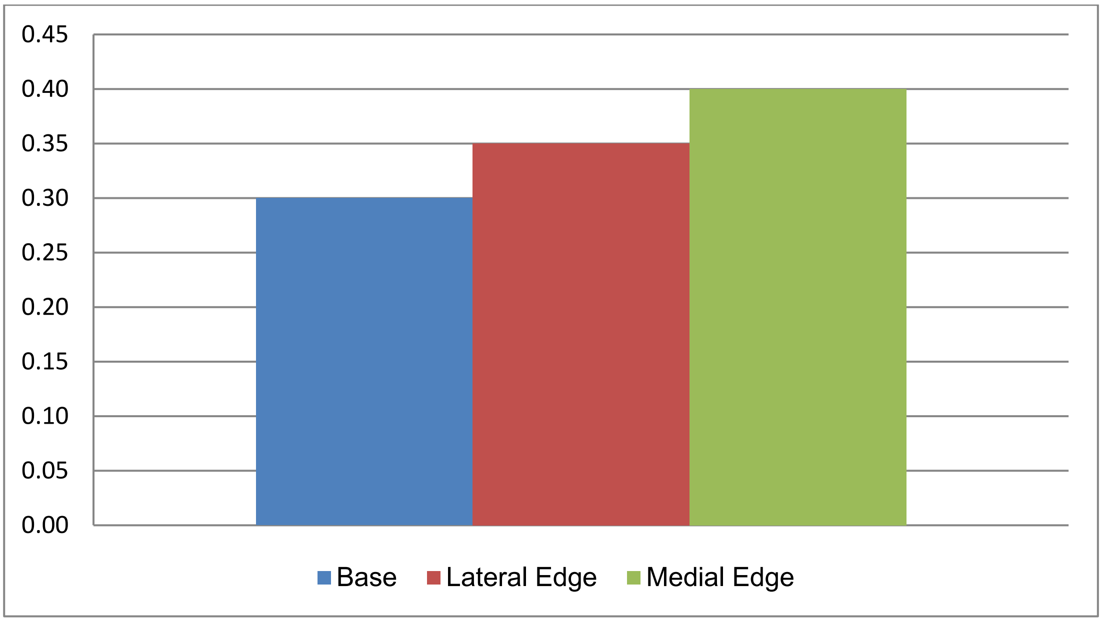

Chart 4 - Standard deviation of TREE measurements

In all dissected cadavers and also in the fetuses, the Romboesplenioescapular Triangle was found on both sides of the dorsum, but the measurements were only performed on adult human cadavers (80 sides). On all dissected cadaveric sides, relations were found between the accessory nerve, the dorsal scapular nerve, and the dorsal scapular artery with the muscular structures that delimit the Romboesplenioescapular Triangle. The accessory nerve is located superficially and dorsally to the levator scapulae muscle, and composing the content of the triangle are the dorsal nerve of the scapula and the dorsal artery of the scapula. These relationships were not researched in fetuses, as the number available for this research was small. The presence of the Romboesplenioescapular Triangle and its content (dorsal scapular artery and nerve) was investigated on them, but no measures were taken and the relationship between the structures of the Triangle and its variations was not studied (Figure 12).

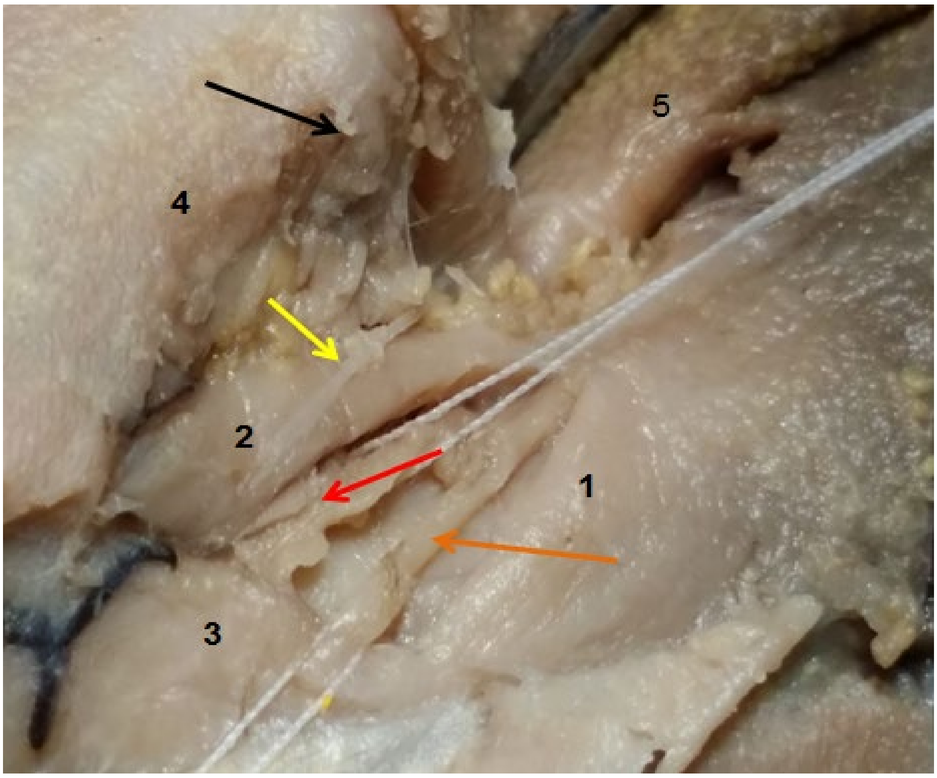

Figure 12 – Photography of 7-month-old Fetus 43. Romboesplenioescapular Triangle: 1 - Splenius capitis muscle; 2 - Levator scapulae muscle; 3 - Rhomboideus minor muscle; 4 - Trapezius muscle folded laterally and cranially; 5 - Sternocleidomastoid muscle; yellow arrow - sectioned accessory nerve; black arrow - section point of the accessory nerve; orange arrow - dorsal scapular nerve repaired by white silk thread; red arrow - scapular dorsal vessels repaired by white silk thread

Source: Photography of 7-month-old Fetus 43 - left side – Anatomy Laboratory – UNINCOR - BH

Variations were found in the origin of the dorsal scapular artery, not studied in fetuses, as described in the researched anatomical literature.[9,11,16,34] In this study, the variations found in the 80 dissected sides were divided into Groups A, B, and C. In

Group A it originated from the transverse cervical artery, branch of the thyrocervical trunk, (Group A - 42 cadaveric sides - 52.5 %), in Group B directly from the subclavian artery (Group B - 32 cadaveric sides - 40%) and in Group C of the suprascapular artery (Group C - 6 cadaveric sides - 7.5%) (Table 6, Chart 5).

Table 6 - Division into Groups of variations in the origin of the dorsal scapular artery

Groups	Sides	Percentage
Group A - Cervical transverse	42	52,5%
Group B - Subclavian	32	40,0%
Group C – Suprascapular	6	7,5%
Total	**80**	**100,0%**

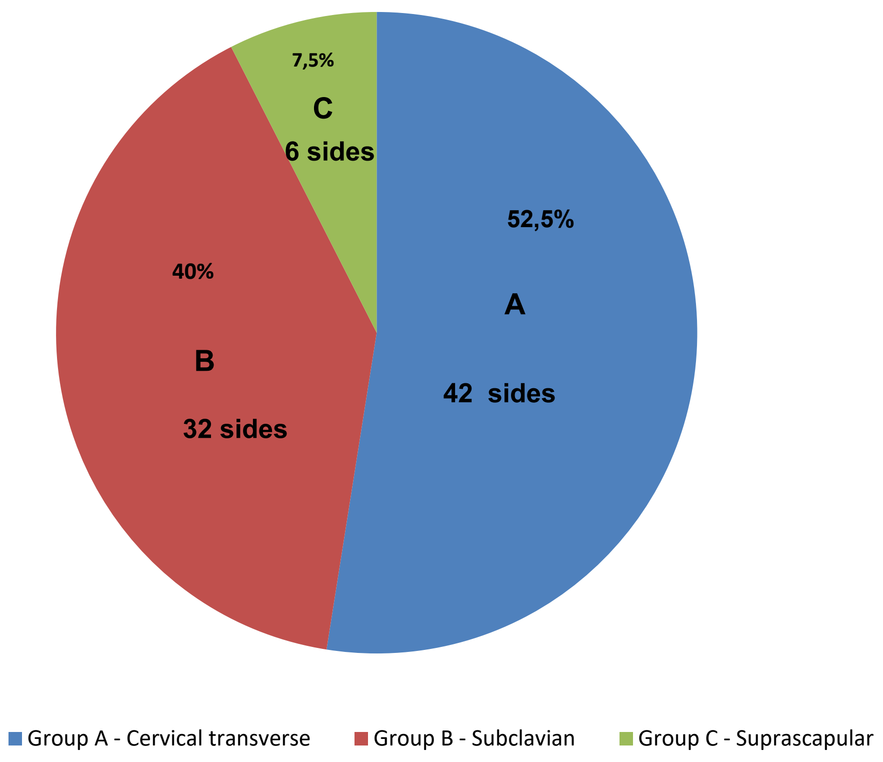

Chart 5 - Division into Groups of the cadaveric sides studied of the variations of the dorsal scapular artery according to their origin

Group A was subdivided into two Subgroups A1 and A2. Subgroup A1 was composed of 22 cadaveric sides (27.5%) in which the dorsal scapular artery was in an ante-scalenic path, and in Subgroup A2 in which the dorsal scapular artery was in a retro-scalenic path on 20 cadaveric sides (25%).

Group B was also subdivided into two Subgroups B1 and B2. In Subgroup B1 the dorsal scapular artery running in a post-scalenic position was found on 18 cadaveric sides (22.5%), and in Subgroup B2 the dorsal scapular artery running in position and retro-scalenic path was found on 14 cadaveric sides (17,5%).

In Group C composed of 6 cadaveric sides (7.5%), the dorsal scapular artery was found originating from the suprascapular artery. (Table 7, Chart 6, Figures 13, 14 e 15).

Table 7 - Division into Subgroups of variations in the origin of the dorsal scapular artery

Subgroups	Sides	Percentage
A1 – Transverse cervical ante-scalenic	22	27,5%
A2 – Transverse cervical retro-scalenic	20	25,0%
B1– Subclavian post-scalenic	18	22,5%
B2 – Subclavian retro-escalenic	14	17,5%
C – Suprascapular	6	7,5%
Total	**80**	**100,0%**

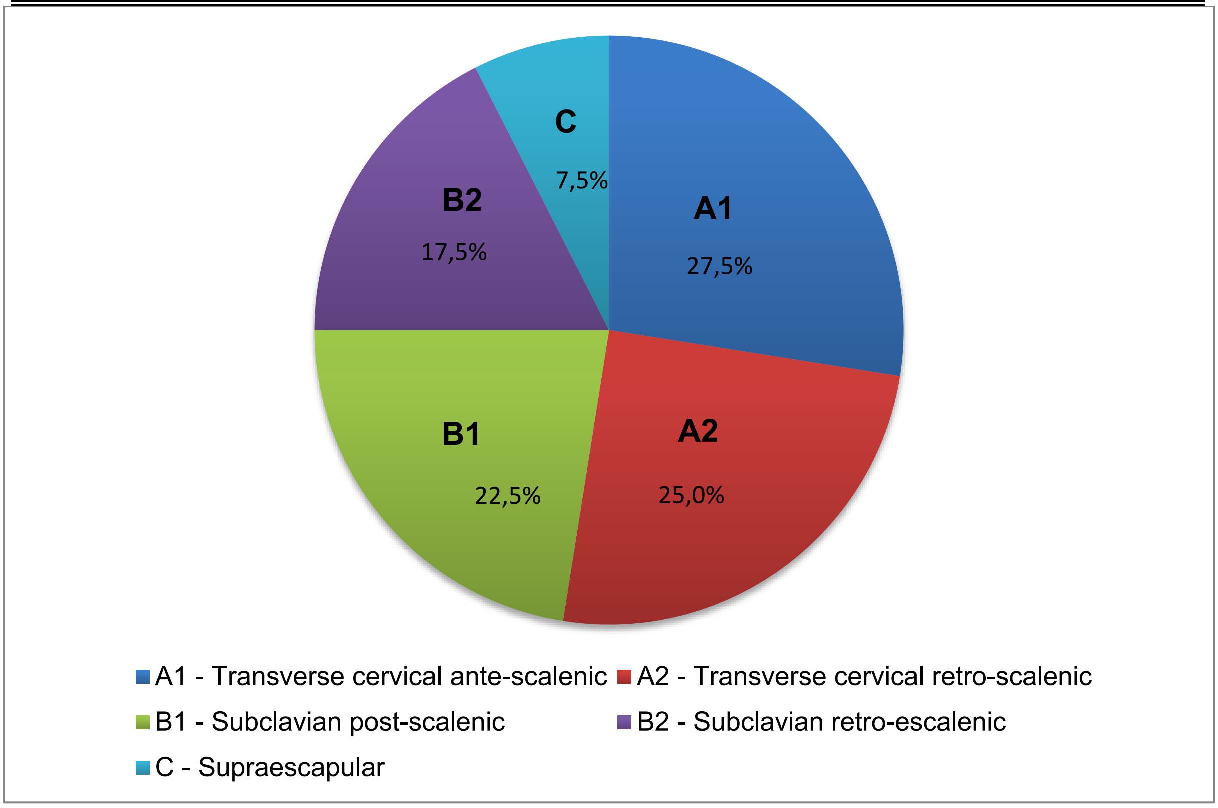

Chart 6 - Division into subgroups of variations of the dorsal scapular artery

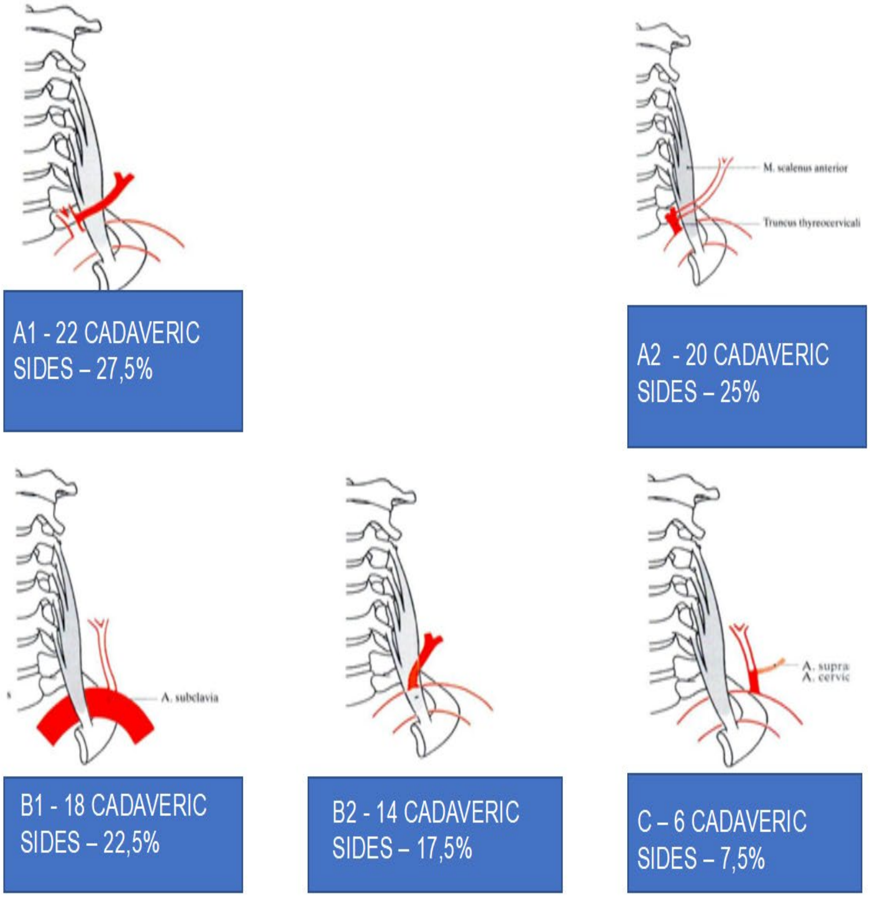

Figure 13 - Variations found in the dorsal scapular artery - Subgroups A1, A2, B1, B2, and C

Source: Modified from Rickenbacher J, Landolt AM, Theiler K. Praktische Anatomie Rücken. Berlin: Springer-Verlag; 1982[114]

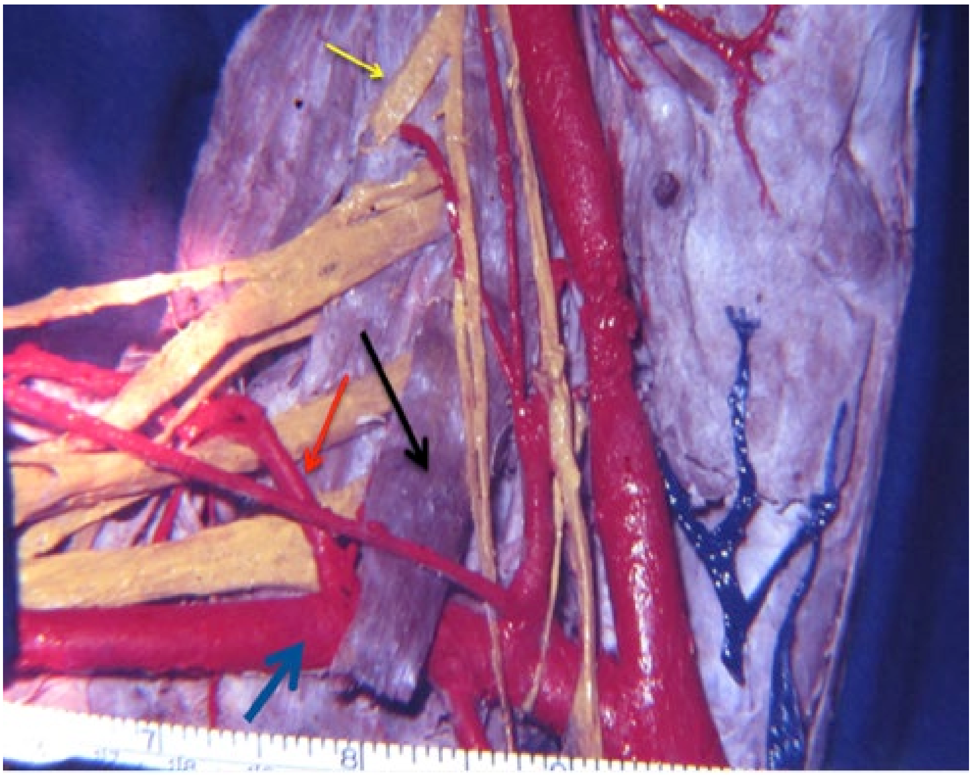

Figure 14 - Dorsal scapular artery (red arrow) originating from the subclavian artery (blue arrow), in a post-scalenic position, and crossing between the upper and middle trunk of the brachial plexus (scalenus anterior muscle - black arrow). Dorsal scapular nerve originating from C4 (yellow arrow)

Source: Photography of Cadaver 1 - right side – UNIVAÇO – Ipatinga – MG

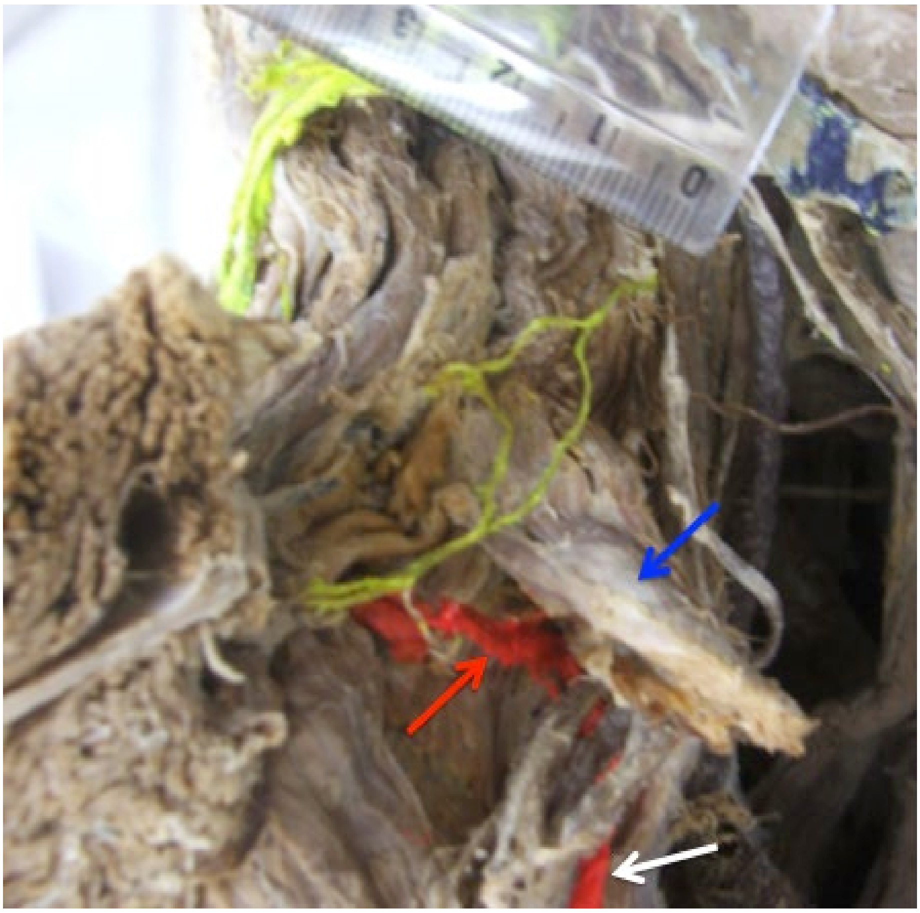

Figure 15 – Dorsal scapular artery (red arrow) originating from the transvers cervical artery (branch of the thyrocervical trunk) in a retro-scalenic path, scalenus anterior muscle folded (blue arrow)

Source: Photography of Cadaver 12 - right side – UNIVAÇO – Ipatinga – MG

Regarding the path of the dorsal scapular artery, from its origin to the dorsal region, when it reaches the Romboesplenioescapular Triangle, path variations in relation to the brachial plexus were found, which were not studied in the fetuses. On 44 cadaveric sides (55%), the dorsal scapular artery crossed between the superior and middle trunk. On 32 cadaveric sides (40%), the artery crossed between the anterior and posterior divisions of the superior trunk, and on 4 cadaveric sides (5%), the dorsal scapular artery crossed between the middle and inferior trunks (Table 8).

Table 8 - Variations in the path of the dorsal scapular artery in relation to the brachial plexus

Path of the dorsal scapular artery in relation to the brachial plexus	Sides	Percentage
Between the superior and middle trunks of the brachial plexus	44	55%
Between the anterior and posterior divisions of the superior trunk of the brachial plexus	32	40%
Between the middle and inferior trunks of the brachial plexus	4	5%
Total	**80**	**100,0%**

On all sides of the groups of adult cadaveric studied, the dorsal scapular artery was found within the Romboesplenioescapular Triangle occupying its lateral angle.

Regarding the caliber of the dorsal scapular artery - not studied in fetuses - it was shown, by simple comparative visualization, to be similar to that of the radial artery on the same side of the studied cadaver, as mentioned in the researched anatomical literature.[2,11]

In this study, the variations of the accessory nerve were investigated only in relation to its position next to the levator scapulae muscle on the back, but not studied in the fetuses, and its variations in the lateral cervical triangle[10] (posterior) were also not studied. This nerve was presented on 72 cadaveric sides (90%), as a single nerve trunk running dorsally and caudally across the Romboesplenioescapular Triangle, and in contact with the dorsal surface of the levator scapulae muscle that laterally limits the triangle described here. However, on 8 cadaveric sides (10%) the division of this nervous trunk into two branches was observed with the lateral branch moving to a position close to the lateral edge of the levator scapulae muscle - in this case, failing to traverse it dorsally as a single trunk. In these 8 cadaveric sides mentioned above (10%) it was observed that the dorsal scapular nerve was also laterally displaced towards the inferio-lateral angle of the Romboesplenioescapular Triangle, formed by the cranial border of the scapular portion of the rhomboideus minor and the medial and caudal border of the levator scapulae muscle (Chart 7, Figures 16 e 17).

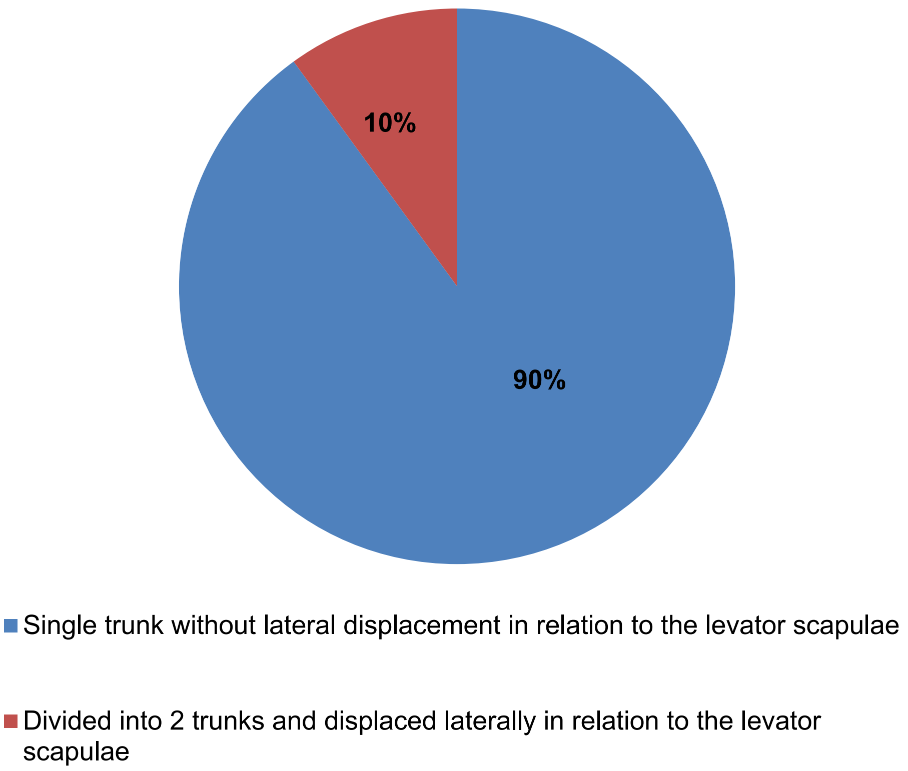

Chart 7 - Variations in the position of the accessory nerve in relation to the levator scapulae muscle in the TREE

Figure 16 - Accessory nerve (yellow arrow) and its relationship with the levator scapulae muscle. 1 - Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle delimiting the Romboesplenioescapular Triangle

Source: Photography of Cadaver 26 - left side – UNINCOR - BH – MG

Figure 17 - Lateral displacement of the accessory nerve - lateral branch of the accessory (black arrow) and dorsal scapular nerve (yellow arrow) displaced laterally next to the dorsal scapular artery (red arrow). 1 - Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle

Source: Photography of Cadaver 32 - left side – UNIVALE - FOG – MG

Regarding the position of the dorsal scapular nerve within the Romboesplenioescapular Triangle - not studied in the fetuses - it was observed in this study that in 72 cadaveric sides (90%) this nerve is presented in a mid-lateral position inside the Romboesplenioescapular Triangle, and on 8 cadaveric sides (10%) it was displaced laterally close to the infero-lateral angle of the triangle next to the dorsal scapular artery. In these 8 cadaveric sides, the accessory nerve was divided into 2 branches (lateral and medial) with a branch with a laterally deviated path (lateral branch) (Chart 8 and Figures 18 and 19).

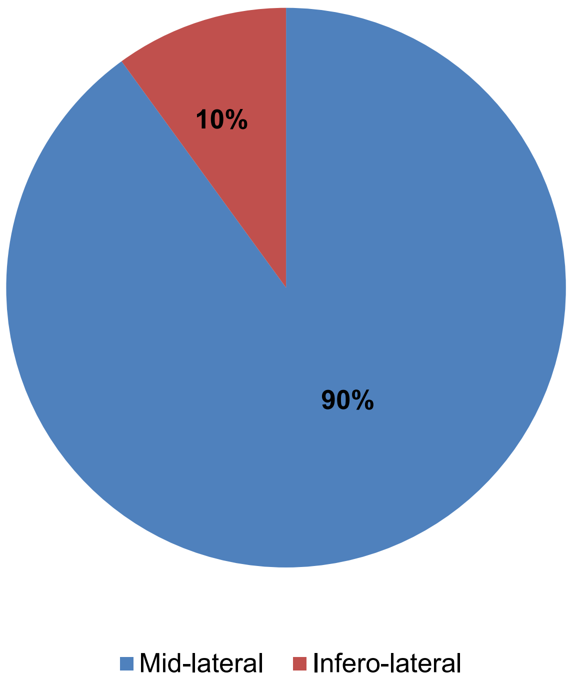

Chart 8 - Variations in the position of the dorsal scapular nerve in the TREE

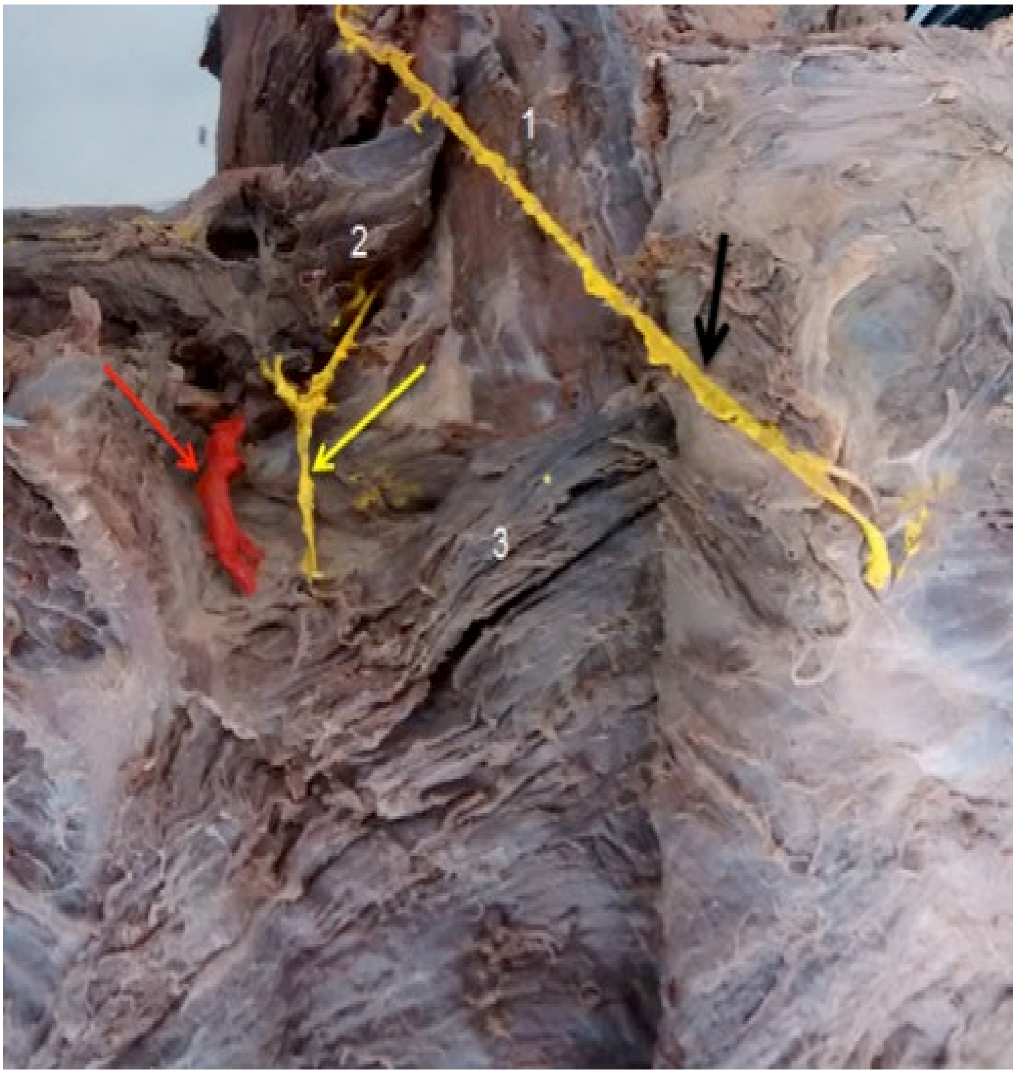

Figure 18 - Variations in the position of the dorsal nerve of the scapula (yellow arrow) in the Romboesplenioescapular Triangle, here, occupying the mid-lateral position (90%). Dorsal scapular artery (red arrow) at the lateral angle of the triangle described here. Accessory nerve, without division, (black arrow) running dorsally along the levator scapulae muscle. 1 - Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle

Source: Photography of Cadaver 4 - left side – UNIVAÇO – Ipatinga – MG

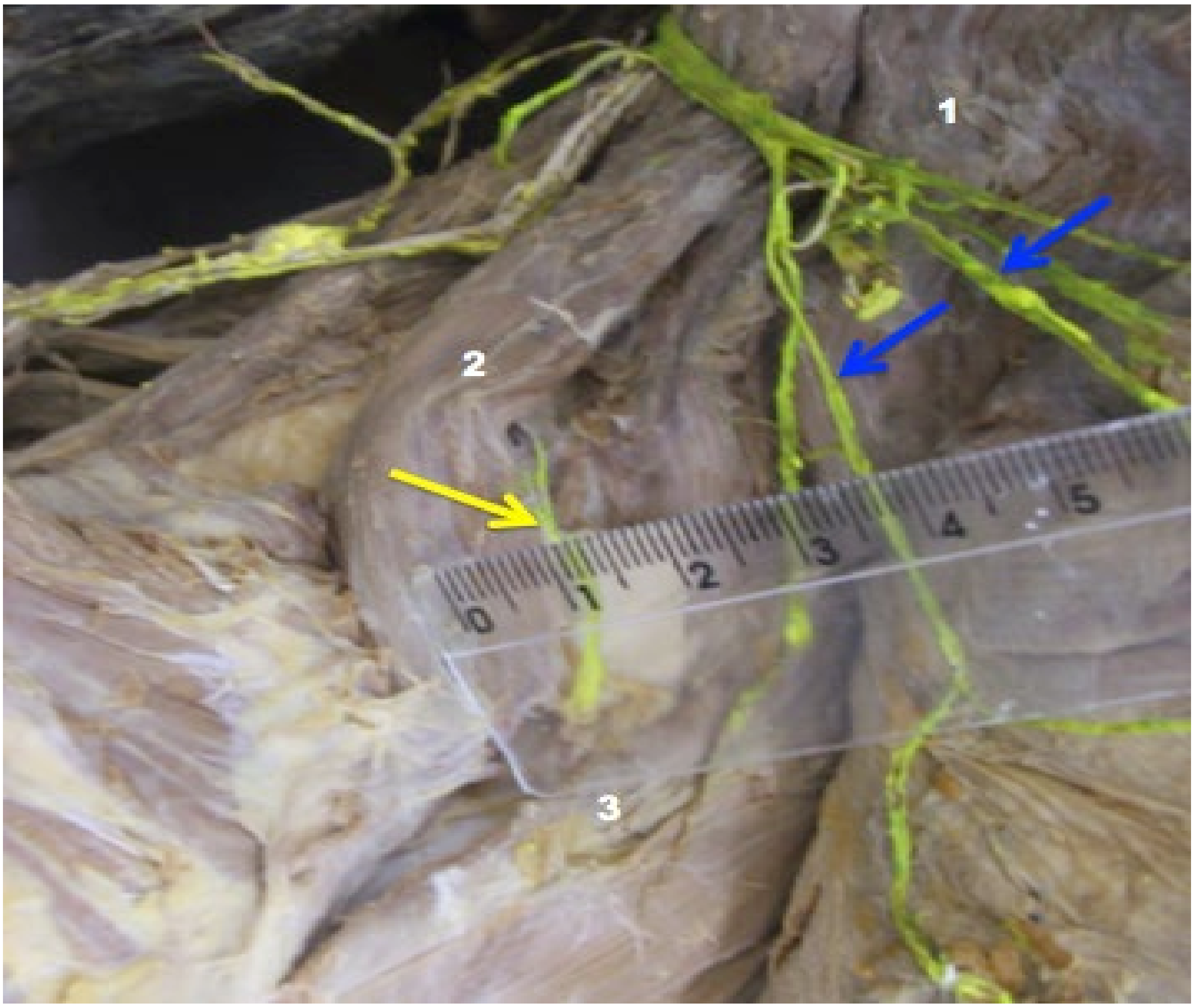

Figure 19 – Dorsal scapular nerve displaced laterally (yellow arrow), accessory nerve divided into 2 branches (blue arrows). 1- Splenius capitis muscle. 2 – Levator scapulae muscle, 3- Rhomboideus minor muscle

Source: Photography of Cadaver 39 - left side – UNEC

Regarding the origin of the dorsal scapular nerve in the brachial plexus - not studied in the fetuses - it was found in this research that in 76 cadaveric sides, (95%) the dorsal scapular nerve emerged from C4 and C5, after perforating the scalenus medius and going dorsally deep to the trapezius and the levator scapulae. On 4 cadaveric sides (5%) the nerve originated from the root of C5, receiving contribution from C4, but emerging cranially and anterior to the scalenus medius, without perforating it, however (Chart9).

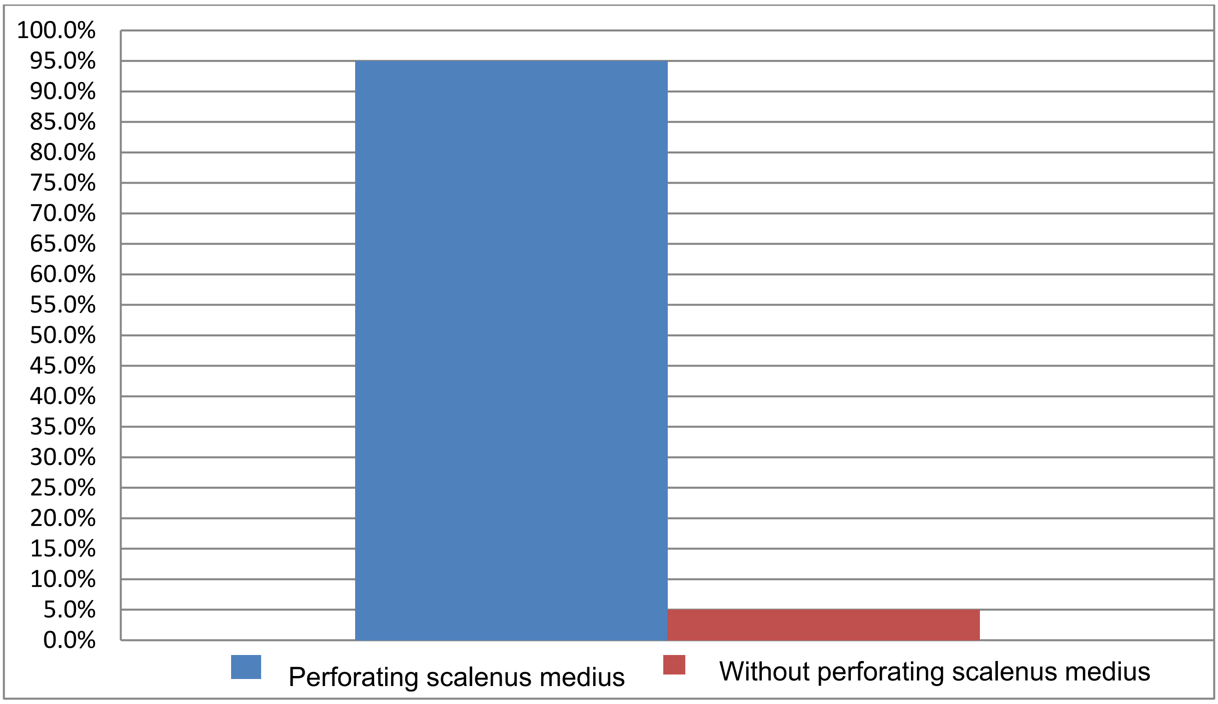

Chart 9 - Path variations at the origin of the dorsal scapular nerve in the brachial plexus

In this research, regarding variations in relation, path and position maintained between the dorsal scapular nerve and the levator scapulae muscle - not studied in fetuses - the following variations were observed: in 72 cadaveric sides (90%), the dorsal scapular nerve did not cross the levator scapulae, giving it muscular branches when it crossed the muscle deeply and laterally; on 8 cadaverous sides (10%), the dorsal scapular nerve crossed through the levator scapulae muscle and emerged dorsally and superficially inside the Romboesplenioescapular Triangle (Chart 10 and Figure 20).

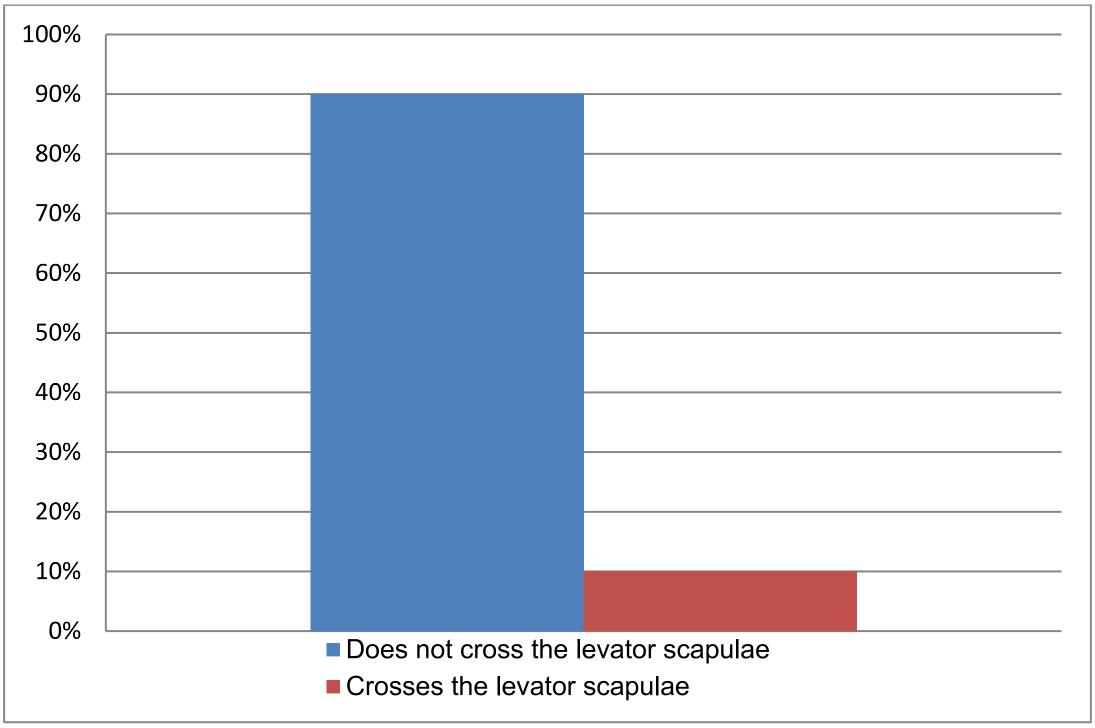

Chart 10 - Variations in the path and position of the dorsal scapular nerve in relation to the levator scapulae muscle in the TREE (Romboesplenioescapular Triangle)

Figure 20 - Variation of path and position of the dorsal scapular nerve (yellow arrows) in relation to the levator scapulae muscle. Nerve does not perforate the levator scapulae muscle (2), here folded and pulled medially by forceps (blue arrow) and occupies a mid-lateral position on the Romboesplenioescapular Triangle. Dorsal scapular artery occupying the angle of the same triangle (red arrow). Splenius capitis muscle (1) covered by displacement of the levator scapulae muscle (2). rhomboideus minor muscle (3) covered by medial displacement of the levator scapulae muscle.

Source: Photography of Cadaver 29 - right side – UNINCOR - BH – MG

5. DISCUSSION

Discussion

It is noteworthy that an anatomical description is of particular importance for the Health Sciences, since it refers to the position, situation and relationships of one or more structures in a given region of the human body and its importance for medical-surgical practice. Anatomy is considered to be a dynamic discipline, the knowledge of which has been added over the centuries, as the other Sciences advance. Therefore, the claim that Anatomy is a science that has no new scientific contributions to offer for the advancement of all human science becomes unacceptable.

In the book *De Humani Corporis Fabrica*,[11] the Romboesplenioescapular or Dorsal Scapularis Triangle is depicted in drawing, by Andreas Vesalius,[11] but without any description. In the French, Italian, American and German atlases and anatomy books of the 19th, 20th and 21st centuries, it is also depicted with even its content in a figure or drawing, but there is no description of its delimitation and content, or even importance.[11-128]

The observation of this body region in anatomical practice and the perception that important structures had a superficial path and within of the Romboesplenioescapular Triangle or Dorsal Scapularis Triangle motivated the present research.

The books systematically only describe the superficial and deep dorsal muscles, without any reference to the Romboesplenioescapular geometrical space of this important cranial region of the dorsum. In them, we find the descriptions of the lower back Triangles as the upper lumbar (Grynfelt Triangle)[158] and lower (Jean-Louis Petit Triangle),[159] and also the triangle of auscultation.[14] In the deep cranial region of the nape, the suboccipital Triangle (Tillaux Triangle)[160] is described, but the Romboesplenioescapular or Dorsal Scapularis Triangle located inferiorly and superficially to the suboccipital Triangle is not described and recognized in the anatomical literature of the aforementioned centuries.[11-60]

We also find the quotation from Testut and Jacob[9] who in their book, Topographic Anatomy, described a triangular space between the serratus posterior superior, the levator scapulae and the splenius. The authors did not specify which splenius they were referring to, whether the capitis or cervicis, and with the muscles in different plane situations, as is the case of the serratus posterior superior that is in a deep position in relation to the others, leaving thus the Triangle without continuity of planes. The authors cite, as content, small branches (branches, according to Testut and Jacob)[9] of the posterior scapular artery (dorsal scapula - IAT)[10] and muscle bundles of the sacrolumbar muscle (semispinalis - IAT),[10] but do not position and locate these structures, and do not describe the dorsal scapular artery and dorsal scapular nerve as the content of this space. In this same region, Testut[26-27] describes a triangle formed by the cranial part of the splenius capitis, between the left and right splenius capitis muscle and the occipital bone, which it calls the splenius triangle. The content, quoted by Testut,[26-27] are the semispinalis capitis muscles, which he called larger complexes.

The present study showed the importance of the relationship in the triangular Romboesplenioescapular space of the accessory nerve with the dorsal nerve of the scapula, and of the dorsal nerve of the scapula with the dorsal scapular artery inside this triangular space. Therefore, the muscles that form the Romboesplenioescapular or Dorsal Scapularis Triangle are: the splenius capitis, the levator scapulae and the rhomboideus minor. The Triangle floor is formed superiorly by two muscles: laterally, by the scalenus posterior muscle and medially, by the splenius cervicis muscle. Inferiorly, the floor is formed by the serratus posterior superior muscle.

The classic authors of human anatomy only mention the muscles that delimit the triangle in isolation and likewise its content, without describing the Romboesplenioescapular Triangle and the structures and the content of that triangle[12-128].

Gray[61] in his book “Gray Anatomy,” and also in “Gray’s Anatomy,” [62] describes the formation and the central and peripheral paths of the accessory nerve. This author cites the plexiform disposition of the union of the accessory nerve with the branches of C2, C3 and C4 in the posterior triangle (lateral - IAT)[10] of the neck. It describes the path from the deep side of the trapezius muscle to almost its caudal margin. It also mentions the variations of the accessory nerve when it comes to the spinal origin - which can vary from C3 to C7 - and its relation to the sternocleidomastoid, where according to the author[61,62], this nerve can end without perforating this muscle with C3 and C4 fibers, so in this case the trapezius muscle is innervated only by the third and fourth cervical nerve. Gray[90] describes the dorsal scapular nerve as formed by C5 roots, which may receive contributions from C3 and C4, and is named by Gray,[90] the scapular dorsal nerve. Its roots emerge from the corresponding intervertebral foramen to soon penetrate and pierce the scalenus medius muscle. It then appears on the surface of the scalenus medius and follows, in this way, deeply to the levator scapulae towards the back, where it penetrates the rhomboids, following deeply into these muscles where it branches and distributes. As for the dorsal scapular artery, Gray[108] does not establish a correct name for it, and first he mentions it as a deep branch of the transverse cervical artery (IAT),[10] and then he calls it the descending scapular. Gray[108] does not refer to its relationship with the Romboesplenioescapular Triangle, despite mentioning that it (descending scapula)[108] is accompanied by the dorsal scapular nerve (dorsal scapular nerve - IAT).[10] This author does not cite these structures as the content of any triangular space on the back.

Testut and Jacob[9], in their book “Topographic Anatomy”, mention a triangular space between the splenius (they do not detail which one), the serratus posterior superior muscle and the levator scapulae. Testut,[65] in his “Treatise on Human Anatomy,” describes the accessory nerve, naming it spinal, from its origin in the bulb and spinal cord - that is, its central path. It also describes the cervical peripheral path of the spinal nerve (accessory - IAT), [10] detailing its relations, situation and position in the anterior and posterior (lateral - IAT) triangle [10] of the neck. In the peripheral and dorsal path, Testut[65] makes no mention of the relations of this nerve with any triangle of the upper dorsal region, just mentioning its penetration at the anterior edge of the trapezius and, as well, its branching and distribution in this muscle. The dorsal scapular nerve is not recognized as an individual and independent nerve by this author.[89] Testut[89] recognizes two distinct nerves: the nerve of the levator scapulae (which he calls the angular nerve), and the rhomboid nerve.[89] Regarding the dorsal scapular artery named by Testut[110] - the posterior scapular artery, which according to this author has a caliber similar to that of the radial artery - after its origin from the subclavian, in the retro-scalenic space (which he called interscalene) or in the post-scalenic space, crosses between the trunks of the brachial plexus towards the back. The path of this artery in relation to the brachial plexus is described by him as generally crossing between the superior and middle trunk of this plexus (C6 and C7), rarely crossing between the middle and inferior trunk (C7 and C8), and exceptionally between the roots of the inferior trunk (C8 and D1 as mentioned by him).[110] Testut[110] also considers that the posterior scapular artery (scapular dorsal - IAT) [10] is divided into two main branches: a branch for the trapezius (called trapezoidal) or external and a scapular or internal branch. It describes that the trapezoidal branch is accompanied in its descending portion by the spinal nerve (accessory - IAT).[10] The scapular branch after reaching the spinal border of the scapula is accompanied by the dorsal scapular nerve, which he calls the angular and rhomboid nerve.[89] Testut[110] does not quote or describe this artery occupying or crossing any trigonometric region on the back.

Poirier,[34,35] in his book "Traité D'Anatomie Humaine", describes the splenius capitis, levator scapulae (angular according to this author) and rhomboideus minor muscles, their muscle insertions, their action, innervation, anatomical variations and anomalies without making reference to any triangle formed by them. Regarding the accessory nerve, which Poirier[70] calls the spinal nerve, he describes the formation, the central and peripheral path of the spinal nerve. Poirier[70] describes its peripheral path, in the anterior cervical triangle to the sternocleidomastoid and then in the posterior cervical triangle (lateral - IAT) [10] to the anterior edge of the trapezius. He also mentions the accessory anastomoses with the third, fourth and fifth cervical spinal nerves located in the posterior cervical region, and classifies them into 5 types according to their shape, and the number of cervical roots that participate in these anastomoses. Poirier[70] does not mention the relationship between the accessory nerve and the levator scapulae muscle on the back. In his description of the dorsal scapular nerve, which Poirier[94] calls the rhomboid nerve, he also mentions the nerve of the levator scapulae, which he calls the angular nerve, as different and independent nerve structures, not detailing the variations in formation, path and position of these two nerves. Poirier[70,94] does not describe the relationship of these two nerves with any geometric space on the back. The dorsal scapular artery is called the posterior scapular artery.[117] This author describes the variations of origin, without citing statistical data, stating that this artery may originate from the subclavian, the thyrocervical trunk or the costocervical trunk. Regarding the path and relationships of this artery, Poirier,[117] divides it into two portions: the cervical or horizontal portion crosses the roots of the C6 and C7 brachial plexus and occasionally C7 and C8. In this region it crosses the omohyoid muscle and goes to the edge of the trapezius, then reaches the levator scapulae, which he called the shoulder blade angle.[117] The scapular or vertical portion follows the spinal border of the scapula and runs between the serratus posterior superior and the rhomboids that cover it. Poirier[117] details the branches of the posterior scapular and its irrigation territory. He makes reference to a branch of this artery for the trapezius, which he calls the trapezius artery, and which participates in the vascularization of the trapezius, the levator scapulae, the splenius, and the semispinalis. This author cites the anastomoses of the cervical portion, of the posterior scapular artery (dorsal scapula – IAT),[10] with the vertebral, deep cervical and superficial transverse cervical arteries.[117] He also highlights the division of the branches of the scapular or vertical portion into anterior ones, which irrigate the serratus posterior superior, posterior ones that in turn irrigate the rhomboids and trapezius, internal ones that anastomose with dorsal branches of the intercostal, and external branches that anastomose with the suprascapular and subscapular arteries. This author[117] does not describe the relationship of this artery with any geometric space on the back.

Tandler,[66] in his book Treatise on Systematic Anatomy, he describes the accessory nerve, which he calls the spinal nerve, and reports its central origin and its internal and external branch. In his quote about the external branch, he refers to the cervical path, its joints with cervical branches, its passage through the lateral cervical triangle, and its penetration at the external edge (anterior - IAT) [10] of the trapezius muscle, and reports that this nerve innervates the levator scapulae. There is no mention of its relationship with any triangle in the dorsal region or the path of the accessory nerve on the back. When dealing with the dorsal scapular nerve, Tandler[95] describes its relationship with the scalenus medius muscle and the levator scapulae. He mentions that in its path on the back, this nerve is accompanied by the descending branch of the transverse cervical artery (dorsal scapular artery - TAI).[10] He states that the dorsal scapular nerve innervates the scalenus medius, the levator scapulae, which he also mentions as innervated by the accessory nerve, the serratus posterior superior, and the serratus anterior. There is no description of the relationship of these structures with any triangular space on the back. In his Treaty of Anatomy, Tandler[109] refers to the dorsal scapular artery as a transverse cervical or posterior scapular artery; mentioning its relationship with the roots of the brachial plexus (C5 and C6, C6 and C7), it also describes its division into three branches: supraspinatus, ascending and descending. The descending branch is mentioned by him as the most important, describing its path along the vertebral border of the scapula and its relationship with the rhomboids. Tandler[109] does not refer to the path within any trigonometric space on the back for this artery or for the dorsal scapular nerve.

Sappey[33] in his book, "Traité D'Anatomie Descriptive", describes the rhomboideus minor, splenius capitis and levator scapulae muscles, citing their origin, insertion, action and innervation. However, he does not refer to any triangular space between these muscles. He only mentions the triangle between the two splenius capitis and the base of the occipital bone - which contains the semispinalis of de head (semispinalis capitis – IAT), which he called large complexes. In regard to the accessory nerve, called the spinal nerve by Sappey,[68] the author describes its origin in the central nervous system and its central and peripheral path. He also mentions the importance of its internal branch that follows along with the vagus nerve for phonation. He describes spinal anastomoses (accessory - IAT)[10] with the cervical roots of the second, third and fourth cervical nerves in the posterior (lateral - IAT)[10] of the neck. The external branch, which is called the cervical or descending branch by Sappey,[68] is described in its cranial part as crossing the internal carotid, the internal jugular, the stylohyoideus and digastricus muscles. He mentions its relationship with the sternocleidomastoid muscle - in its posterior or deep side - and the path to the supraclavicular fossa where it then enters the trapezius muscle where it is distributed and branches. Regarding the dorsal scapular nerve, Sappey[93] does not identify it as a proper and isolated nerve. He describes two nerves: the nerve of the levator scapulae, which he calls the angular muscle nerve (origin C4 and C5), and the rhomboid nerve (origin C4 and C5). Regarding the angular and rhomboid nerves (scapular dorsal - IAT),[10] Sappey[93] does not describe any relation of these with the dorsal scapular artery and also does not mention any triangular space related to these nerves or even with the artery. The dorsal scapular artery is called the posterior scapular by Sappey.[116] He cites three variations of origin: first, as a common trunk with the inferior thyroid artery, second, as the origin of the suprascapular artery, and third, as the origin of the subclavian artery. He also describes its path between the trunks of the brachial plexus, but does not mention which trunk. He reports its path to the trapezius and its course between the rhomboid muscles and the serratus posterior superior. He highlights its collateral branches without naming them, describing only that it gives branches to the sternocleidomastoid, scalenes, levator scapulae (called angular), trapezius, splenius, and semispinalis capitis (called great complex). Despite presenting a figure of this artery occupying a triangular space between the splenius capitis, the levator scapulae and the rhomboideus minor, he does not describe, or even quote, such a space.

Waldeyer[84] in his book, “Waldeyer Anatomie des Menschen,” describes the central and peripheral path of the spinal nerve (or accessory according to Waldeyer),[84] together with the superficial branch of the dorsal scapular artery which he calls the transverse neck. However, he does not mention the relationships of these structures with the triangle described in this research. The author describes the path of the dorsal scapular nerve[97] that follows the deep branch of the transverse neck[118] (dorsal scapular artery in IAT), [10] but does not refer to these structures with any geometric space on the back.

The literature data found regarding variations in the origin of the dorsal scapular artery are referred to in Lanz's[114] book and also in Corball's thesis[155]. The two authors cite studies referring to variations in the origin of the dorsal scapular artery. However, Corball[155] refers to the different variations of origin of this artery, but does not specifically mention its variations in relation to the brachial plexus, as detailed by Lanz,[114] in his book. Corball[155] describes the variations found in his study of the trapezoidal arterial branch of the posterior scapular artery (scapular dorsal - IAT), [10] which according to him is important in the vascularization of the trapezius, which can be applied to the myocutaneous flaps of this muscle, the object of his thesis. He also refers to variations in origin and path of the dorsal scapular artery, and in his cadaveric study (45 cadavers - 90 sides), he found hypoplasia and absence of superficial cervical and posterior scapular arteries on one side. He reported three sides with absence of the superficial cervical artery and on five sides, hypoplasia. Regarding the posterior scapular artery (scapular dorsal - IAT),[10] he found one side with hypoplasia. This author[155] classified the variations found in 4 classes. In class I (36 sides - 41.4%), the posterior scapular artery originated from the first portion of the subclavian as a transverse cervical artery that gives rise to the superficial and dorsal cervical branches of the scapula; in class II (47 sides - 54%), the posterior scapular artery came from the subclavian of its first or second portion as an independent artery. In class III (3 sides - 3.41%), it came from the subclavian, from its second or third portion, as a common trunk that originated by division the superficial cervical and posterior scapular artery (scapular dorsal - IAT).[10] In class IV (1 side - 1.14%), which Corball[155] called the class of variations, the dorsal scapular artery originated from the axillary artery. He did not detail in a table the relations between the posterior scapular artery and the brachial plexus; he only mentions that in classes II and III he found relationships between this artery and the brachial plexus. This thesis makes reference to the works of Huelke,[161,162] in which this author proposes the modification of the name of the posterior scapular artery and also the deep branch of the transverse cervical artery to the dorsal scapular artery, by demonstrating that it is a constant vessel and accompanies the nerve called the dorsal scapular.

In his work, Huelke[161,162] mentions the relationships between the dorsal scapular artery (scapular dorsal - IAT),[10] with the brachial plexus in all the cadavers surveyed, but these data were not detailed in a table by Corball[155]. Huelke[161,162] cites the work of Adachi[163] and his study of the variations in origin, position and path of the dorsal scapular artery called Adachi[163] as the transverse cervical artery. In his book, Lanz[114] classifies the various variations of origin studied and found in the literature, without mentioning the absence or hypoplasia of this artery. Nor does he mention any case of total absence of relations between the dorsal scapular artery (he called the cervical transverse deep branch, transverse colli, or dorsal scapular) and the brachial plexus. The variations found related to the origin of the dorsal scapular artery are classified using as criteria the vascular origins and the relationship with the scalenus anterior muscle, and also report two studies (one study of variations of origin, and another of location of the variations, based on Adachi[164] research, with 93 cadavers, 186 sides). Thus, in this study of variations in the origin of the dorsal scapular artery, 55.3% of variations originate from the transverse cervical artery, a branch of the thyrocervical trunk. 36.2% originate directly from the subclavian and in 8.5% from the suprascapular. Lanz[114] refers to the different variations of locations of this artery in relation to the scalenus anterior muscle. He found the dorsal scapular artery in an ante-scalenic location originating from the transverse cervical (thyrocervical trunk) in 56.6%, while in a retro-scalenic location originating directly from the subclavian in 10.4%, and post-scalenic also directly from the subclavian in 33%. He classifies the relationships between the transverse cervical artery and the brachial plexus, also based on the work of Adachi[164] (186 cadaveric sides - 93 cadavers), but he does not mention or name this artery as a dorsal scapula. Lanz[114] uses the dorsal scapular designation only for the deep branch of the transverse cervical on the back, after the branching of the transverse cervical into superficial and deep branches next to the deep face of the levator scapulae, thus already on the back and without relations with the brachial plexus. This author states that the superficial cervical artery can also be called the dorsal scapular regardless of its origin being the thyrocervical or subclavian trunk, which contradicts the previous study and description. The relations between the transverse cervical artery and the brachial plexus described by Lanz[114] (study

Adachi[164 -] 186 sides - 93 cadavers) were: crossing between the superior and middle trunk 23.3%, between the middle and inferior trunk 15.8%, under the inferior trunk 6.0%, between the roots of the inferior trunk (C8 and D1) 1.6%, and crossing cranially to the superior trunk 54.3%. Lanz[114] does not mention or describe this artery occupying any geometric space on the back.

Huelke[161,162] in his review work on the dorsal scapular artery makes a comparative study of his findings with those of the literature. He observes the confusion established by the anatomical terminology used in the various works by several authors, which makes comparative studies and understanding of the results difficult. This author proposes the designation of the dorsal scapular artery (scapular dorsal - IAT) [10] for this vessel. His findings, studied in 89 cadavers (178 sides), are classified into groups A, B, C and D. In group A - 30.9% originate directly from the transverse cervical artery, branch of the thyrocervical trunk; in Group B - 30.3% originate directly from the second portion of the subclavian, 1.1% originate together with the costocervical trunk, 2.2% originate together with the suprascapular; in Group C - 30.9% originate directly from the third portion of the subclavian, 0.6% originate together with the costocervical trunk, 1.7% originate together with the suprascapular; in Group D - (From other sources) - 3%. 0.6% originate from the thyrocervical trunk; 0.6% originate from the first portion of the subclavian; the first portion of the axillary 1.2%; and the second portion of the axillary 0.6%, totaling 3%. Huelke[161,162] compares his study with that of Daseler and Anson[165] who studied 765 sides and the statistical differences found are in Group A - 31.6% originated directly from the transverse cervical, in Group B, in which Daseler and Anson[165], found only in 18.2% originated directly from the second portion of the subclavian; in Group C - 42.3% originated directly from the third portion of the subclavian; in Group D - (from other sources) totaling 7.6%, with 3.1% originating directly from the first portion of the subclavian, 1.6% together with the suprascapular of the first portion of the subclavian, at 0.8 % together with the costocervical trunk of the first subclavian portion, 1.2% directly from the first axillary portion, 0.8% directly from the internal thoracic, 0.1% directly from the ima thyroid artery, and in no case from the second axillary artery portion.

Reiner e Kasser[166] studied the frequency of variation in the origin of the dorsal scapular artery (scapular dorsal - IAT)[10] in humans. These authors performed an anatomical study with 81 cadavers (44 male and 37 female, all Caucasian) in which they were able to study 157 sides due to the loss of 5 sides. Reiner and Kasser[166] found in their study in male cadavers (85 sides) the following frequency of variation of the dorsal scapular artery (dorsal scapular, according to these authors): 25.9% originated from the transverse cervical artery, 31.8% from the second portion (retro-scalenic as named in this thesis) of the subclavian artery, 40.0% from the third portion (post-scalenic portion as named in this thesis) of the subclavian artery, 2.3% from other arteries. In female cadavers, the frequency of variation was: 19.4% originated from the transverse cervical artery, 40.3% from the second portion (retro-scalenic portion as called in this thesis) of the subclavian artery, 37.5% from the third portion (post-scalenic portion as studied in this thesis) of the subclavian artery, 2.7% from other arteries. These authors diverge from classic studies, and cite the studies by Adachi[164] and DeGraris[167], who describe racial differences between Asians, Caucasians and blacks in the frequency of variation of origin of the dorsal scapular artery, but emphasize that their studies were based on Caucasian cadavers, from ancestors from northern Europe, and born in the state of Tennessee (USA). Reiner and Kasser[166] conclude that the subclavian artery is the main origin of the dorsal scapular artery, but claim that there is no explanation for the discrepancies found in the literature regarding the frequency of variation in the origin of the dorsal scapular artery. These authors conclude based on their findings and on studies by Huelke[161,162] that there is no reason for maintaining different anatomical terms for the same structure regardless of its origin, and claim that this artery should be called the dorsal scapular artery (dorsalis scapulae - IAT).[10]

Comparing the research carried out in this thesis with data from the literature, we find similarity with the findings in the study by Huelke,[161,162] Adachi[163,164] Daseler and Anson,[165] and with the studies by Reiner,[166] with statistical differences, however. In the research reported here and performed on 80 cadaveric sides, the origin of the dorsal scapular artery was classified into 3 Groups (A, B and C). The origin was directly from the transverse cervical artery (branch of the thyrocervical trunk) and was found on 42 cadaveric sides - 52.5% - Group A. In Group B, the origin of the dorsal scapular artery was found directly on the subclavian on 32 cadaveric sides - 40%; and in Group C, it originated directly from the suprascapular and was found on 6 cadaveric sides - 7.5%. No dorsal scapular artery origin was found in the axillary, ima thyroid, or even internal thoracic arteries. Subgroups were subdivided and the muscle that divides the subclavian into portions - that is, the scalenus anterior muscle - was used as the reference nomenclature. Group A was divided into ante and retro-scalenic and Group B into pre and post-scalenic, to facilitate understanding of the location and situation of the artery, and thus facilitate future comparative studies. In all the cadaveric sides studied, in this thesis, a direct relationship between the dorsal scapular artery and the brachial plexus was found, as in the study by Huelke.[161,162] None of the works found in the researched literature makes reference to the location of the dorsal scapular artery with the angle of the Romboesplenioescapular Triangle, and its content together with the homonymous nerve.

With regard to the accessory nerve, Lanz[64] mentions in his book that the variations presented by this nerve are due to its formation in the neck - that is, the branches that the accessory nerve receives from the cervical plexus in the posterior cervical triangle (lateral - IAT).[10] He details in figures the variations in formation between the roots of the cervical spinal nerves and the accessory nerve in the posterior cervical triangle. In his figures, he demonstrates the variations in the path of the cervical roots (C3, C4 and C5) that contribute to the formation of a plexus, which he calls the cervical accessory plexus (a name that does not appear in the IAT)[10] within the posterior cervical triangle. It details that this plexus can be formed in three regions: 1) Next to the sternocleidomastoid; 2) On the way to the trapezius and inside the posterior cervical triangle; 3) Close to the front edge of the trapezius or deeply to it. Lanz[64] does not describe these roots of the cervical accessory plexus on the back. In his description he does not mention the division of the accessory nerve trunk, into 2 or more trunks, on the back after penetrating the trapezius, but reports only that it emits muscular branches in its descending path to the trapezius. The author does not correlate the division of the accessory nerve with the change in position and situation of the dorsal scapular nerve.

In the literature on head and neck cancer surgery, this plexus is also studied as in the three works by Kiener et al.[168,169,170] The authors investigated variations in the formation of the cervical accessory plexus in the neck through intraoperative electromyographic studies, anatomical studies by dissection, and studies of the trapezius muscle isolated by maceration, descaling and staining using the Sihler technique. The results found by Kiener et al.[168] in intraoperative electromyographic studies performed on 14 patients (17 radical neck dissections) demonstrated, according to the authors, that functionally the descending (caudal) part of the trapezius muscle is innervated by a thin branch that accompanies the accessory nerve in the posterior cervical triangle, and that the transverse and ascending (cervical) part is innervated by the main trunk of the accessory nerve. Thus, they conclude that the use of electrostimulation and the care with these branches can avoid the shoulder-arm syndrome as a consequence of injury to the accessory nerve. In their anatomical study of dissection in 46 cadavers (92 dissected sides), Kiener et al.[169] reported the relationships between the accessory nerve in the anterior cervical triangle and the internal jugular vein; in the posterior cervical triangle (lateral - IAT) [10] with the nerves of the cervical plexus, with the border of the sternocleidomastoid muscle and with the clavicle. The authors also highlight the many variations in the relationship between the accessory nerve and cutaneous branches of the cervical plexus, which they consider not to be the correct reference for the accessory nerve, and also mention the variations found between the relationships between the great auricular nerve and the accessory nerve described in literature. In this same study, the authors found and described the relationship between the accessory nerve and the sternocleidomastoid muscle, citing that in 37% of the cases the accessory nerve ran dorsally to the muscle, and in 63% of the cases it crossed the muscle. Regarding relations with the internal jugular vein, they report that in 56% of the cases the nerve ran ventrally to this vein and in 44% of the cases dorsally to it. In their study of variations in relation to the contributions of the cervical plexus roots to the accessory nerve, Kiener et al.[169] report that they found only 9% receiving only one branch of the cervical plexus contributing to the accessory nerve, 61% with two branches, and 30% with 3 branches. They point out that none of these branches joined the trunk of the accessory nerve near the anterior edge of the trapezius. Kiener et al.[169] refer that in most cases additional thin and small branches originating from the accessory nerve were found about 2 cm medial to the trapezius. The authors conclude that, surprisingly, the available data on topographic anatomy, as well as surgical anatomy, of the accessory nerve and the branches for the trapezius of the cervical plexus are confusing and often wrong. And they report that the descriptions given in their study can help to minimize the risk of accessory injury during neck surgery and preserve the additional innervation of the trapezius muscle offered by the branches of the cervical plexus. Regarding the study with the Shiler technique carried out by Kiener et al.,[170] 22 isolated muscles were used to determine how the accessory nerve and the branches of the cervical plexus to the trapezius contribute to the innervation of each of the three parts (ascending , transverse and descending) of the trapezius muscle. The authors found in all 22 muscles the innervation of each of the three parts of the trapezius muscle studied. In all the investigated muscles, the nerve supply to the descending (caudal) part of the muscle consisted of a single thin branch of the accessory nerve, whereas the transverse and ascending (cervical) part of the trapezius was innervated as well by the accessory nerve and the branches of the cervical plexus to that muscle. The authors conclude that handling this thin branch with extra care, which innervates the descending part of the trapezius muscle, can minimize adverse results in neck surgeries.

Pu YM, Tang EY and Yang XD[171] studied the formation and contribution of the cervical plexus with motor fibers to the accessory nerve in the posterior cervical triangle (lateral - IAT) [10] through electrostimulation and histochemical study of nerve fibers. These authors studied these variations in 34 patients during the procedure of oncological radical neck dissection, and identified and stimulated the accessory nerve and branches C2, C3 and C4 that went to the trapezius. Potentials were recorded in three conditions: with the accessory nerve intact, with the upper section of communication between the accessory nerve and the cervical branches, and with the complete section of the accessory nerve. The nerves that were electrostimulated that did not produce reactions were analyzed for their acetylcholinesterase activity. Before the section of the accessory nerve, its stimulation led to an evident contraction in all parts of the trapezius muscle in all patients. Contributions from C2 were observed in 15 patients, from C3 in 21 patients, and from C4 in 20 patients. After sectioning the upper half of the accessory nerve, the results were similar. After the nerve was completely sectioned, contributions from C2 were seen in only 2 patients, from C3 seen in 20 patients and from C4 in 19 patients. Histochemical staining revealed that the unresponsive branches contained both motor and sensory axons. The authors conclude that the accessory nerve offers the main motor input for the trapezius muscle, but the preservation of branches originating from C2, C3, and C4 for the trapezius muscle, during modified neck dissection, should improve the postoperative results.

Kim JH *et al.*[172] reported an intraoperative study of electrostimulation during the dissection of the posterior cervical region, and demonstrated the contribution of the cervical roots to the innervation of the trapezius which join the accessory nerve in the posterior cervical triangle (lateral - IAT).[10] In this study of 24 patients, evoked responses were demonstrated with stimulation of the spinal accessory nerve in all 24 patients in the ascending, transverse and descending part of the trapezius muscle. C2 contributions were found and observed in 2 of the 24 patients; however, none of these patients had evoked responses in all three parts of the trapezius muscle. C3 contributions were found and observed in 11 of the 24 patients, providing evoked responses for all three parts of the muscle in only 8 patients; and C4 contributions were found and observed in 20 of the 24 patients, providing evoked responses to all three parts of the muscle in 16 of them. These authors[172] conclude that the spinal accessory nerve provides the main and most consistent motor input to the trapezius muscle. They also observed that the branches of nerves C2, C3 and C4 provided motor aid for the trapezius muscle; however, they were either inconsistently present, or when present, irregularly innervated the three parts of the trapezius muscle.

In national research Vargas AF et al.[173] published a study of applied anatomy of the accessory nerve entitled "Surgical anatomy of the spinal accessory nerve: how to prevent injuries in surgical procedures on the posterior cervical triangle." In a study carried out on 8 cadavers (16 dissected sides), these authors found ramification of the accessory nerve in the posterior cervical triangle (lateral - IAT),[10] with a 25% branchless trunk, a 37.5% one branch and two branches in 37.5% of the cases. Considerable variation was observed in the regional anatomy of the accessory nerve in the posterior cervical triangle, according to them. They also reported that measures taken in their study revealed that the accessory nerve maintains a relatively constant relationship with the great auricular nerve in the posterior cervical triangle, and concluded that the great auricular nerve is a useful anatomical reference for the identification of the accessory nerve in the posterior cervical triangle. According to the authors, this approach suggests a possibility of decreasing iatrogenic injury to the accessory nerve, often related to the cervical manipulation of adjacent anatomical structures, without direct exposure of the accessory nerve.

None of the studies cited makes reference to the division of the main trunk of the accessory nerve on the back, but rather to the entry of branches of the cervical plexus with the accessory nerve in the trapezius, which some authors call the cervical accessory plexus (a name not found in the IAT).[10] Also, they did not highlight the relationship between the splitting of the trunk of the accessory nerve on the back and the lateral displacement of the dorsal scapular nerve, as with that found in this research. The research of this thesis did not study the accessory nerve in the posterior cervical triangle, and intraoperative electrostimulation studies were not performed *in vivo*, nor histochemical studies or studies with muscle isolated and stained by any solution, but in cadavers and fetuses on the back and in relation to the Romboesplenioescapular Triangle.

Lanz[90] describes variations in the formation of the dorsal scapular nerve originating from C4 and C5 and or C3 and classifies them into four types: 1 - variations in the origin of its roots (dorsal scapular nerve) with the scalenus medius muscle; 2 - the composition of its roots of origin in the cervical nerves; 3 - its relationship with the cranial part of the long thoracic nerve; 4 - and also with the caudal part of the long thoracic nerve. It does not describe any relationship between this nerve and any triangular space on the back, just detailing its path to the rhomboids muscles, and citing that this nerve is accompanied by the deep descending branch of the transverse cervical artery. Although in his book on the anatomy of the back Lanz[114] shows in figure the triangular space between the muscles splenius capitis, the levator scapulae and the rhomboideus minor, he does not describe such a space, nor does he even mention the relations of the dorsal scapular artery, accessory nerve and dorsal scapular nerve with this triangular space.

Tubbs *et al.*[174] studied the surgical anatomy of the dorsal scapular nerve, which they called the scapular dorsal nerve. In their study, of 10 cadavers and 20 dissected sides, these authors describe references of measures of origin and path in the scalenus medius muscle, as well as their distance from the vertebral border of the scapula. Regarding the spinal origin, the origin was found in 19 sides only in C5, in 1 side the origin of C5 and C6. They refer to the studies by Chen et al.[175] who described the surgical treatment of 22 patients with compression of the dorsal scapular nerve by the scalenus medius muscle, and hope that the reference measures presented by them will help surgeons who surgically treat diseases of this nerve. Tubbs et al.[174] also cite the study by Frank et al.[176] who carried out a cadaveric study of the motor innervation of the levator scapulae muscle in 35 cadavers. Frank et al.[176] found the levator scapulae muscle innervated by the dorsal scapula nerve in only 11 of the 35 cadavers studied. The authors cite that they found no significant differences between the dissected sides. In the study by Tubbs et al.,[174] all cadavers presented the levator scapulae innervated by the dorsal scapular nerve, as well as the rhomboids. These authors did not find any cadaver that presented the dorsal scapular nerve innervating the serratus posterior superior muscle.

Kida and Tani[177] describe a case in which they found the dorsal scapular nerve innervating the cranial portion of the serratus posterior superior muscle. The authors propose that nerves that innervate muscles of somites and myotomes of different segments are called posterior extramural nerves.

In researching this thesis, with regard to the dorsal scapular nerve, its measurements and variations in the posterior cervical triangle have not been studied. Variations of origin in the brachial plexus of the dorsal scapular nerve were studied, which in 95% (76 sides) presented as originating from C4 and C5 and perforating the scalenus medius muscle; and in 5% (4 sides) it had the same origin, but without perforating the scalenus medius. Also, the relationship between the dorsal scapular nerve and the levator scapulae muscle was studied. In 90% (72 sides) the nerve did not cross the muscle, giving it only branches, and in 10% (8 sides) the nerve crossed the levator scapulae muscle. No study references were found in the literature describing variations in the position of the dorsal scapular nerve, as reported in this study in relation to the Romboesplenioescapular Triangle. In 90% (72 sides) the nerve occupied a mid-lateral position, and in 10% (8 sides) an inferolateral position. Thus, on all sides studied, the nerve was accompanied by the dorsal scapular artery, which occupied the angle of the Romboesplenioescapular Triangle.

Gupta *et al.*[178] published a topographic study of the path of the accessory nerve and its roots in the posterior cervical triangle (lateral - IAT)[10] in 16 human fetuses and studied several reference parameters of this nerve in the posterior cervical region, with the aim of helping to prevent injuries to this nerve in that anatomical region. The authors did not study the accessory nerve on the back and did not describe any geometric space related to that nerve in the dorsal region. In this research, the accessory nerve in the posterior cervical region of the fetuses was not studied. The presence of the Romboesplenioescapular Triangle and its content was studied on the back of the 3 fetuses and on the 6 dissected sides. Variations in nerve structures and scapular dorsal arteries have not been studied in fetuses. (Figure 21).

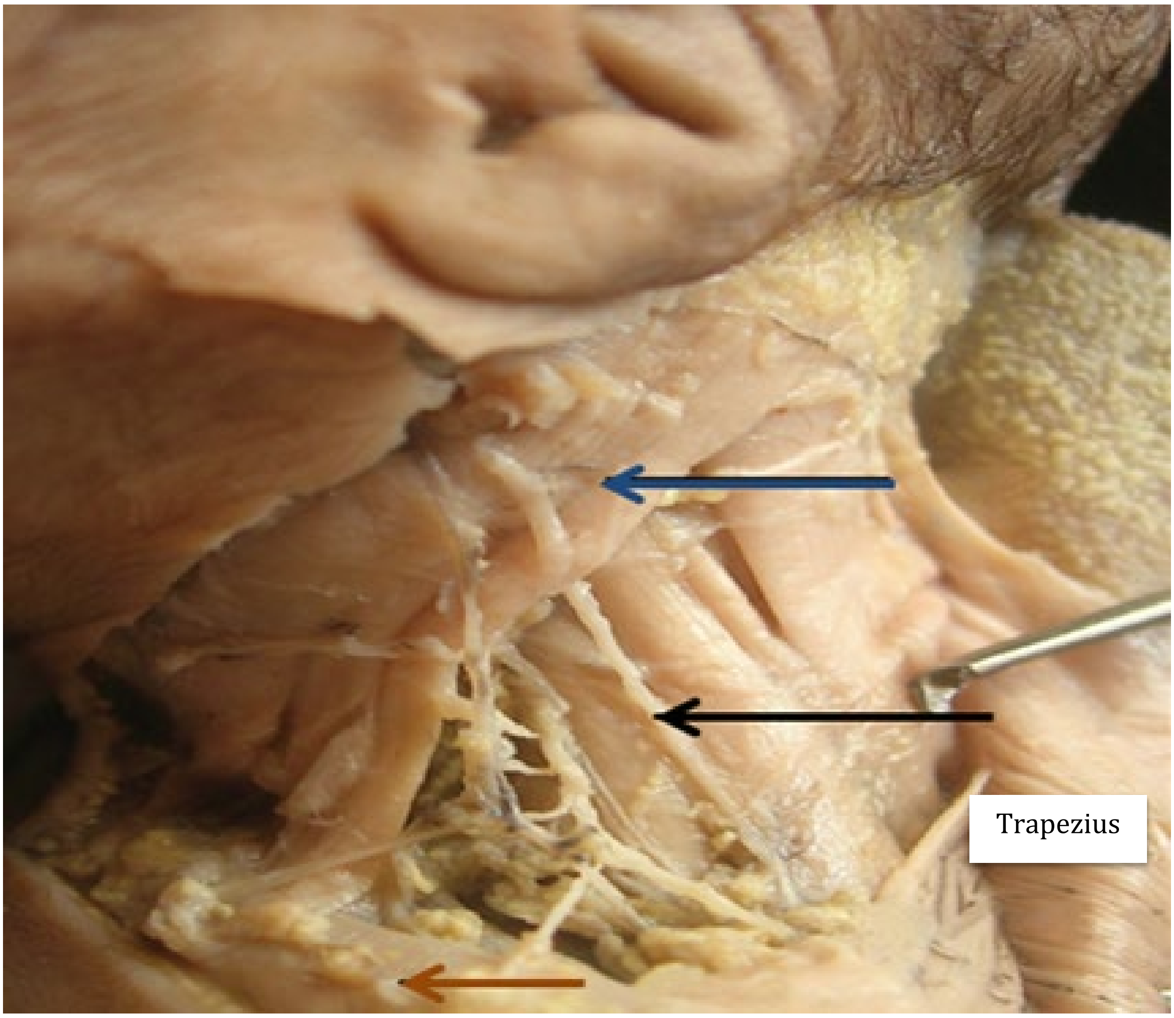

Figure 21 - Demonstration of the accessory nerve path in the posterior cervical triangle (lateral - IAT)[10]. Blue arrow - sternocleidomastoid muscle, black arrow - accessory nerve, brown arrow - clavicle

Source: Modified from Gupta C, Ray B, D'Souza AS, Murlimanju BV. Accessory nerve: topographic study of its spinal root in human fetuses. J. Morphol. Sci. 2012; 29(2):82-6[178]

The researched medical and surgical literature supports the concept expressed in the present study that this triangle should be described so that surgical procedures in the treatment of congenital diseases of the back can be performed with greater safety, as in the case of Sprengel's deformity.[150]

Reginaldo *et al.*[150] in his work to treat Sprengel's deformity, refers to the importance of nervous structures, but without describing or defining the Romboesplenioescapular Triangle (Figures 22, 23 e 24).

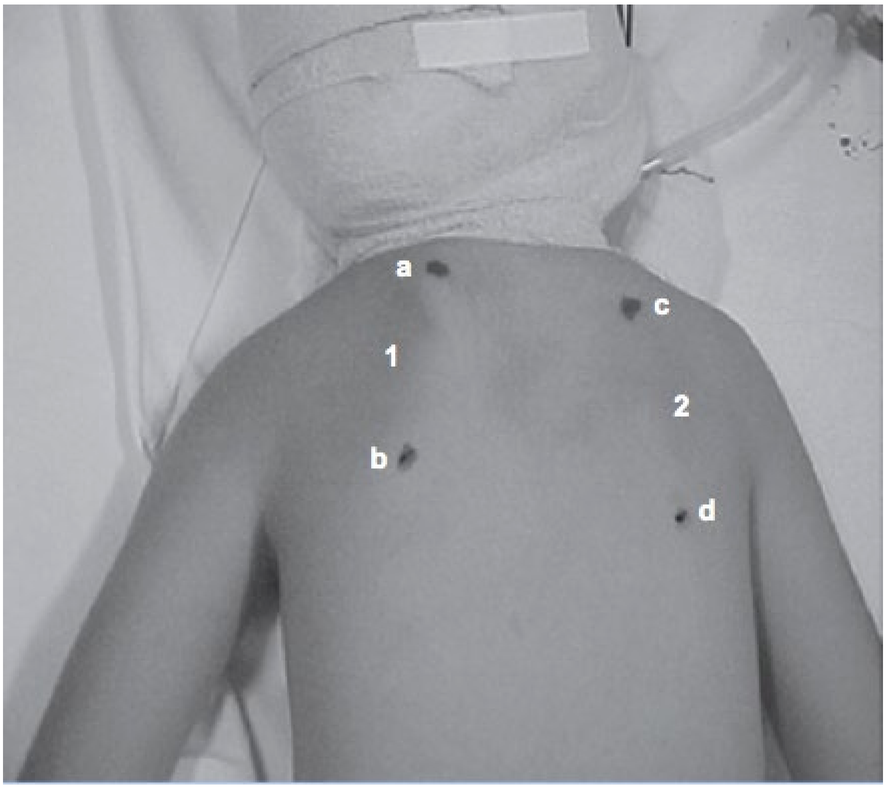

Figure 22 - Sprengel deformity - surgical marking: 1- Elevated scapula (disease side); 2- Normal scapula; a- Upper angle of the left scapula; b- Lower angle of the left scapula; c- Upper angle of the right scapula; d- Lower angle of the right scapula

Source: Modified from Reginaldo S S *et al.* Sprengel deformity: surgical treatment using the modified Green technique. Rev Bras Ortop. 2009;44(3):208-13[150]

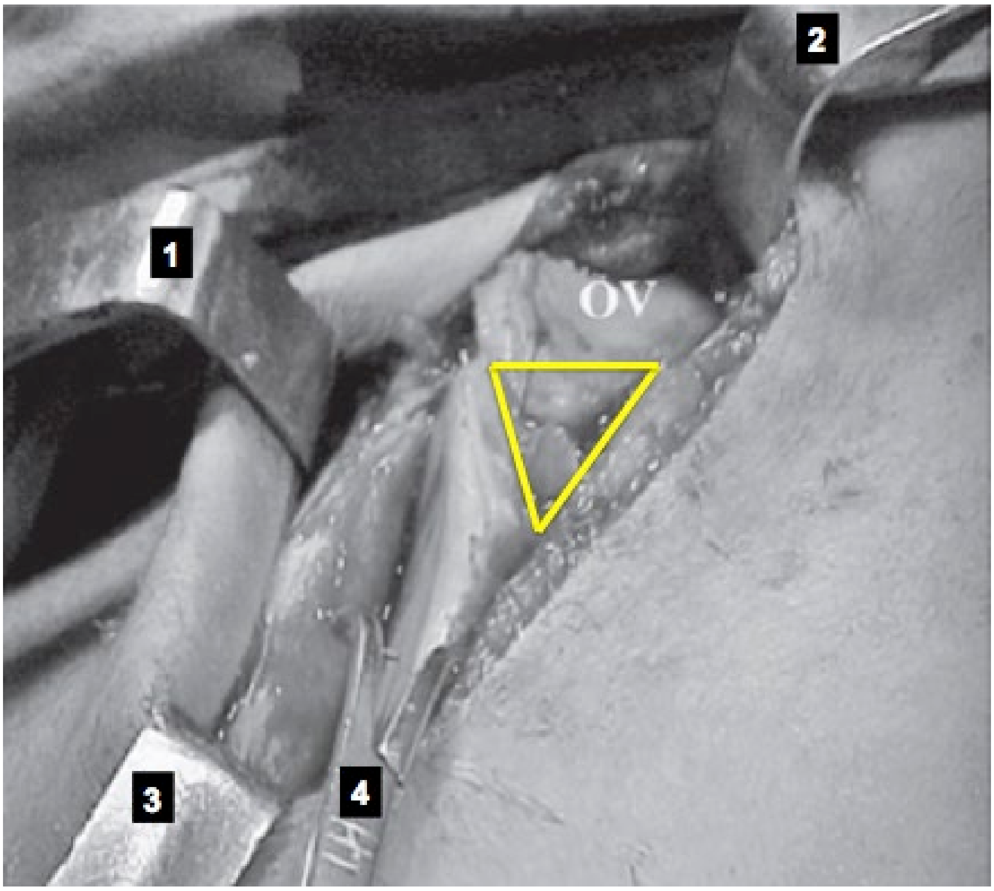

Figure 23 - Sprengel deformity - Dissected and exposed omovertebral bone (OV). Romboesplenioescapular Triangle delimited by yellow lines; 1, 2, 3 - Farabeuf retractors, 4 - Backhaus forceps displacing the scapula

Source: Modified from Reginaldo S S *et al.* Sprengel deformity: surgical treatment using the modified Green technique. Rev Bras Ortop. 2009;44(3):208-13[150]

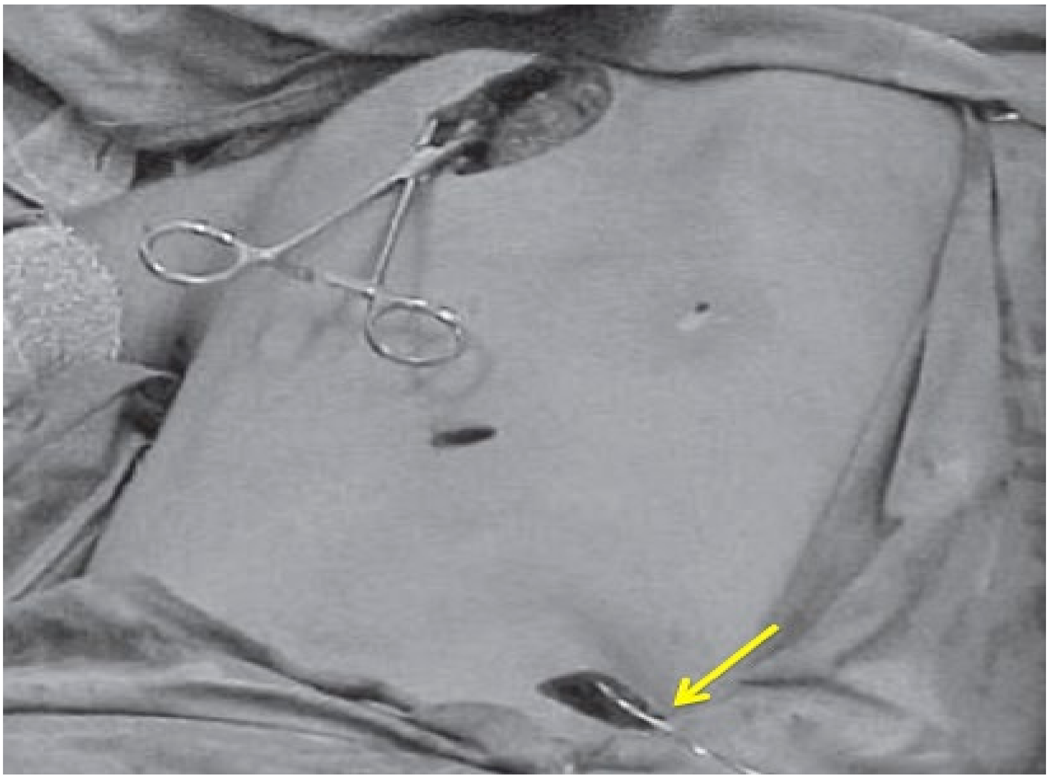

Figure 24 - Sprengel deformity - surgical procedure for traction of the scapula with Backhaus forceps to fix the scapula by steel wire. Yellow arrow steel wire

Source: Modified from Reginaldo S S *et al.* Sprengel deformity: surgical treatment using the modified Green technique. Rev Bras Ortop. 2009;44(3):208-13[150]

The authors Boon et al.[151] sought to review the anatomy of the dorsal region and made anatomical dissections in 16 cadavers to review the relationships of nerves and vessels in this dorsal region. The authors reported the need to carefully observe the dorsal scapular nerve (dorsalis scapulae - IAT)[10] during the surgical treatment of Sprengel's deformity. However, they did not describe the Romboesplenioescapular Triangle; they only reported the structures at risk of injury during the procedure, but without describing the relationships and variations of this Triangle.

In their work to treat Sprengel's syndrome, Siu *et al.*[152] highlighted the importance of nerve structures in this dorsal region without, however, making any description of the Romboesplenioescapular Triangle and its medical-surgical importance.

Bul and Cavinato[153] described diseases of the neck and head in children and reported the importance of the relationship of nervous structures in the treatment of hygromas or lymphangiomas. However, they did not describe the Romboesplenioescapular Triangle.

In his doctoral thesis, Corbal[155] reports on the anatomy of this dorsal region and mentions the classic anatomy books, exposing in the dissections the geometric region of the Romboesplenioescapular Triangle without, however, defining or describing it. He presents the major superficial and deep structures without describing the relationships of the same content as Romboesplenioescapular Triangle.

Lanza, Cavaliere and Albomoz[156] published an anatomical review on myocutaneous flaps of the trapezius and the structures that relate to the Romboesplenioescapular Triangle, but did not describe or define it. This important study highlights the superficial structures and their relationships, but it does not detail the deep structures as the content of the Triangle now researched and also does not emphasize the medical and surgical importance of the Romboesplenioescapular triangular region.

It must be considered that in the treatment of scapular tumors, in order to avoid neurological sequelae, tumor and bone resection requires knowledge of the Romboesplenioescapular Triangle and its relationships - a fact that is evidenced in the studies by Carpintero et al.[179] and Breglia et al.,[180] who refer to the neurological sequelae of surgical treatment.

There is also no mention of the Romboesplenioescapular Triangle in the study by Esparza et al.[181] on pathologies of the scapula in pediatrics and reports on Sprengel syndrome, congenital scapular duplication and primary scapular tumors (osteochondroma, aneurysmal bone cyst, congenital fibrosarcoma, Langerhans cell histiocytosis and Ewing's sarcoma). The authors refer to several diseases that, for their treatment, require a surgical approach to the triangular region that was the object of this research. Thus, it is considered that without knowledge of this Triangle, such approaches may constitute a risk for patients. However, in his work there is no mention of the triangular Romboesplenioescapular space.

Nowinski and Duchene[182] reported cases of septic subscapular abscesses that progressed to septicemia due to late diagnosis. In this disease, the subscapular puncture through the base of the Romboesplenioescapular Triangle can be safe and easy to perform, thus allowing the early diagnosis of the abscess and its treatment by drainage or aspiration.

Trigonometric descriptions, such as the one adopted in the present study to describe the Romboesplenioescapular Triangle, have been used since ancient times to the present day and are a safe way of understanding and recognizing structures and their relationships. Such procedure was evidenced in the work of Cardoso et al.[183], where they used a trigonometric reference for safe access by dissecting the basilic vein in the forearm.

Daroda, Leitão and Daroda[184] described treatment of giant cervical cystic hygroma in adults. They mention the additional methods of treatment with aspiration, injection of sclerosing agents, application of laser and radiotherapy and use of OK-432 (derived from low virulence human strains of group A Streptococcus pyogenes, type 3, incubated with benzylpenicillin). However, they did not report anything about the Romboesplenioescapular Triangle or about the attention required regarding the nervous and vascular structures of the posterior cervical region and neck, but only to the phrenic, recurrent laryngeal nerve, brachial plexus and carotid artery.

Ameh, Laberge and Laberge[185] describe in their book the different types of lymphangiomas that affect children in Africa. The authors study its incidence, demographic distribution, its embryology, its pathology, its nosological classification, and also describe the treatment of lymphangiomas, with the new sclerotherapy techniques using the new sclerosing substances (OK-432). They cited the results and complications of using these new sclerosing substances. However, these authors do not fail to mention that in many cases complete surgical resection of cervical lymphangiomas needs to be performed, which has among its possible complications sequelae, due to lesions of the cranial nerves VII, X, XI, XII, recurrent, phrenic laryngeal, and cervical sympathetic chain (Figure 25).

Figure 25 - Left cervical ulcerated cystic lymphangioma in a child

Source: Ameh EA, Laberge LC, Laberge J-M. Paediatric Surgery: A comprehensive text for Africa. Available from <http://www.global-help.org/publications/books/help_pedsurgeryafrica110.pdf>.Access 27/06/2015[185]

Bhandari and Maurya[186] described recent advances in the treatment of brachial plexus injuries. One of the techniques described by the authors used the accessory nerve graft and its anastomosis with the suprascapular nerve for the reinnervation of the rotator cuff muscles of the shoulder. For safe access to the accessory nerve in the dorsal region, as described in the reported technique, knowledge of the Romboesplenioescapular Triangle is important. However, the authors do not refer to the geometric space researched in this thesis (Figure 26).

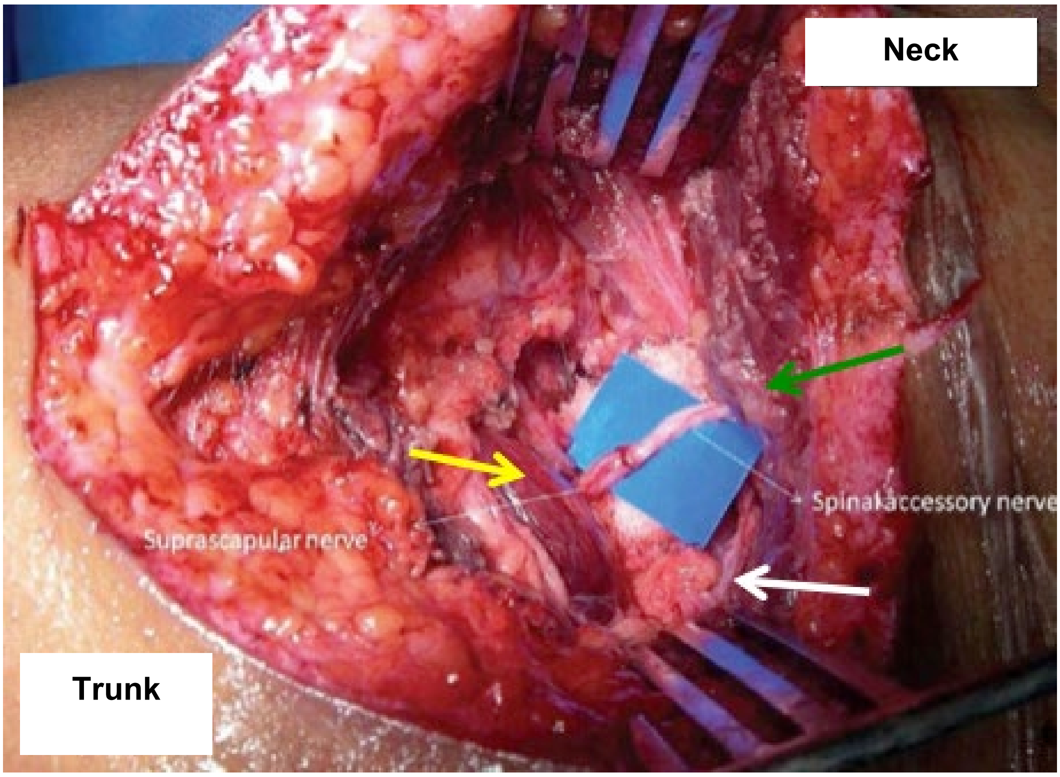

Figure 26 - Blue rectangle: accessory nerve anastomosis with suprascapular nerve. Green arrow: sectioned trapezius muscle. Yellow arrow: upper angle of the scapula. White arrow: supraspinatus muscle

Source: Modified from Bhandari PS, Maurya S. Recent advances in the management of brachial plexus injuries. Indian Journal of Plastic Surgery[186]

In his treatise on surgical technique, Kleinschmidt[187] presented various amputation techniques and surgical approaches to the Romboesplenioescapular region, but without describing or defining it.

In the second edition of his treatise on vascular anatomy, Uflacker[188,189] demonstrated the variations of origin of the dorsal scapular artery, but did not mention its relationship with the Romboesplenioescapular Trigonometric space.

This Triangle is represented in anatomical models of the head and neck and also of the back, with no indication and quote that this space is described or referenced in Human Anatomy (Figure 27).

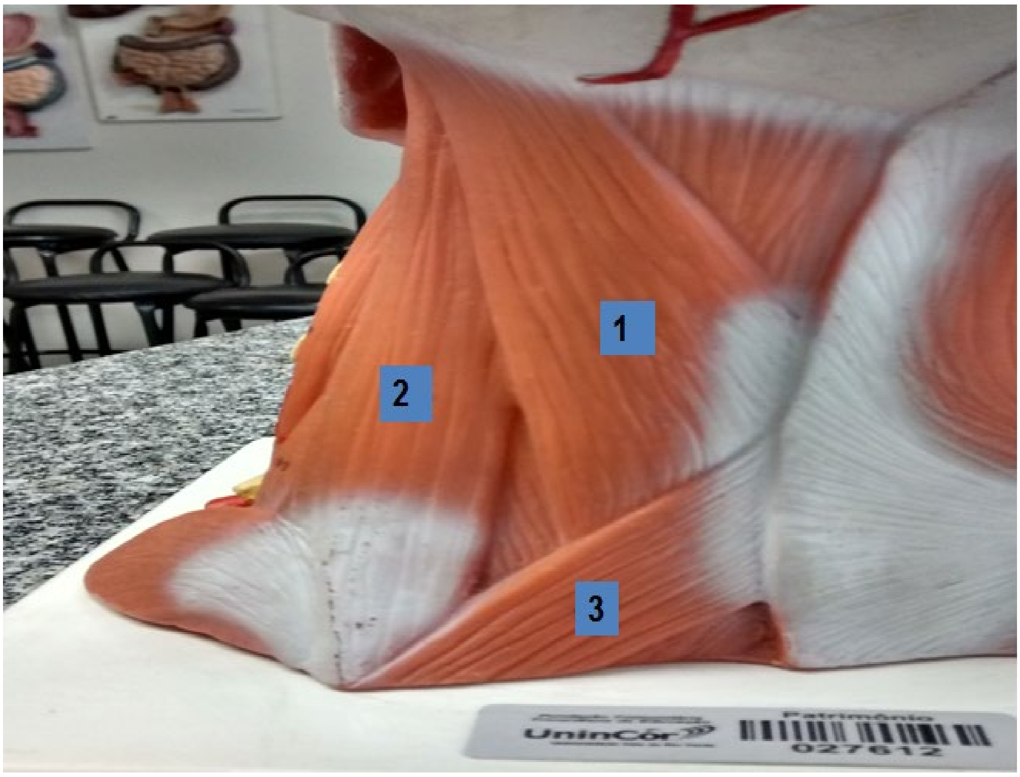

Figure 27 - TREE in anatomical model of the musculature of the head and neck:
1 - Splenius capitis muscle, 2 - Levator scapulae muscle,
3 - Rhomboideus minor muscle

Source: Modified Model 3B Scientific® C05 [(1000214)] – Anatomy Laboratory UNINCOR - BH – Property 027612

The Romboesplenioescapular Triangle, formed by the muscles splenius capitis, levator scapulae and rhomboideus minor, had not yet been described or defined in the anatomical literature, as well as its relationship with the three structures that have been described in this research.

The present research made it evident that the Romboesplenioescapular Triangle and its content were present in all the cadavers and fetuses studied. The relationships, situations and positions, as well as the variations of the accessory nerve, the dorsal scapular nerve and the dorsal scapular artery related to the studied triangle were not found in the literature. The position of the dorsal scapular artery at the lateral angle of the triangle is not described in the anatomical literature, as it does not describe it and does not relate it to the object of this research. Thus, this anatomical description is important for surgical medical practice in any access to the upper dorsal and scapular region that implies exploration of the medial scapular region. It also becomes relevant in the treatment of congenital or acquired diseases, as well as in amputations of the upper limb and in the drainage of abscesses in the subscapular region. The strict knowledge of this triangle allows locating and avoiding injuries to noble structures and avoiding sequelae to patients (Figure 28).

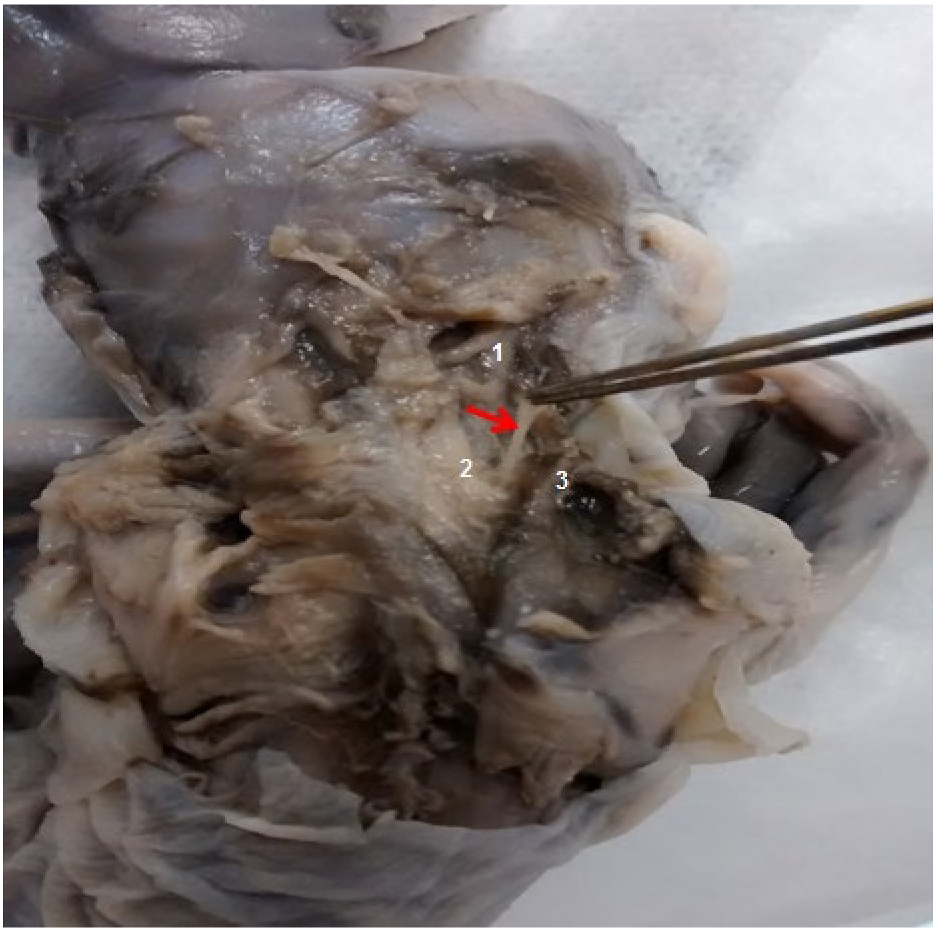

Figure 28 - Photography of a 4-month-old Fetus 42. Romboesplenioescapular Triangle: 1- Splenius capitis muscle, 2 - Levator scapulae muscle, 3 - Rhomboideus minor muscle, red arrow - dorsal scapular artery at the angle of the TREE

Source: Photography of 4-month-old Fetus 42 - right side - Anatomy Laboratory – UNINCOR- BH

When considering the consistency of the findings of this research regarding the Romboesplenioescapular or Dorsal Scapularis Triangle, we believe that its description will contribute to the construction and improvement of human anatomical and surgical medical knowledge.

6. CONCLUSION

Conclusion

The anatomical description of the Romboesplenioescapular or Dorsal Scapularis Triangle identifies it as an anatomical space or defined structure present in all studied human bodies, regardless of gender or age. Its content with the presence of the dorsal scapular artery, the dorsal scapular nerve and its relationship with the accessory nerve ensure its importance in medical-surgical practice.

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8. APPENDIXES

APPENDIX 1

Authorizations from the FCSFA Ethics Committee and University Institutions for research – UNIVALE, UNINCOR-BH, UNEC, UNIVAÇO.

Appendix 1.1

NPG FCSFA
"Verdade é Jesus, Palavra de Deus."
S. João 14.6

FUNDAÇÃO CARDIOVASCULAR SÃO FRANCISCO DE ASSIS
Pós-Graduação em Cardiologia e Cirurgia Cardiovascular (Parecer CFE-MEC 576/91)
"Verdade é Jesus Palavra de Deus"
(S. João 14.6)

FUNDAÇÃO CARDIOVASCULAR SÃO FRANCISCO DE ASSIS
COMITÊ DE ÉTICA EM PESQUISA
CARTA DE APROVAÇÃO

Protocolo NPG-FCSFA 01/15

O Comitê de Ética em Pesquisa (CEP) da Fundação Cardiovascular São Francisco de Assis reuniu-se em 16 de Fevereiro de 2015 e aprovou o Projeto/Trabalho: Trígono Romboesplênioescapular: Relação da Artéria Dorsal da Escápula com o Nervo Dorsal da Escápula e Nervo Acessório, assim como os Termos de Autorização para uso do Material Humano (Cadáveres) e dos Laboratórios das seguintes Instituições: UNINCOR-BH, UNIVALE-GV, UNIVAÇO-IPATINGA, UNEC-CARATINGA, sob a responsabilidade do Investigador Principal **Prof. Dr. Ronaldo Araújo Abreu sob orientação do Prof. Dr. Otoni Moreira Gomes sendo registrado neste CEP *sob o nº01/15.***

Belo Horizonte, 02 de Março de 2015.

Dra. Elaine Maria Gomes Freitas (OAB)
Diretora Executiva FCSFA.ServCor

Appendix 1.2

univale®
Universidade Vale do Rio Doce
Governador Valadares - MG

Reconhecida pelo parecer 16/92 - Portaria 1037/92 MEC
Fundação Percival Farquhar (Mantenedora)
CNPJ: 20.611.810/0001-91

Governador Valadares, 09 de dezembro 2014

Termo de autorização para uso do laboratório de Anatomia.

Da Coordenação do setor: Prof. Nilson S. Ferreira

Da Coordenação de Curso: Profa. Érika A. Miranda

Para: Dr. Ronaldo A. Abreu.

Atendendo a solicitação do professor Ronaldo Araújo Abreu para uso da infraestrutura do laboratório de anatomia da Universidade Vale do Rio Doce – Univale para estudos por parte do professor que está cursando o doutorado. Defiro o pedido autorizando o uso do laboratório nos termos e condições abaixo:

1- A presença do professor será acompanhada do nosso coordenador do setor.
2- Não será permitida a retirada de peças anatômicas do laboratório.
3- Toda atividade prática que exigir manuseio de peças fora das cubas, deverá ser solicitadada com antecedência.

Registra-se que esta autorização não configura nenhum tipo de trabalho em favor da Univale.

Ciente

Dr. Ronaldo Araújo Abreu

Profa. Érika A. Miranda
Coordenação do Curso de Odontologia

Appendix 1.3

UninCor
Universidade Vale do Rio Verde

Belo Horizonte, 23 de Março de 2015

Termo de autorização para uso do laboratório de Anatomia.

Da Direção da Unidade: Prof. Luciano Resende Martins de Souza

C/C: Gerência Administrativa: Cássia Milena Garôfalo

Para: Dr. Ronaldo Abreu.

Atendendo a solicitação do professor **Ronaldo Araújo Abreu** para uso da infraestrutura do laboratório de anatomia da Universidade Vale do Rio Verde - Unincor - para estudos por parte do professor que se encontra em licença não remunerada, e está cursando o doutorado. Defiro o pedido, autorizando o uso do laboratório nos dias 06, 07 e 08 de Maio (no turno da tarde), nos termos e condições observados pelos nossos alunos e professores.

1º - Somente será permitida a presença do professor, acompanhado do nosso técnico de laboratório.

2º - Não será permitida retirada de peças anatômicas ou qualquer outro material do laboratório.

3º - Toda atividade prática que exigir manuseio de peças fora das cubas, deve ser solicitada com antecedência para o devido preparo por parte do nosso técnico.

Registra-se que esta autorização não configura nenhum tipo de trabalho em favor da UninCor.

Prof. Luciano Resende M. de Souza
Diretor de Unidade
UninCor / Campus BH

Cássia Milena Garôfalo
Gestora Administrativo
Campus BH / UninCor FCTE

Prof. Luciano Resende Martins de Souza
Cássia Garôfalo

Ronaldo Araújo Abreu

Appendix 1.4

Caratinga, 27 de outubro de 2004.

Termo de autorização para uso do laboratório de Anatomia

Da Coordenação do Setor: Prof. Ronaldo A. Abreu

Da Diretoria da FAMEC: Prof. Dr. Eli Nogueira

Para: Prof. Ronaldo A. Abreu

Atendendo a solicitação do professor Ronaldo Araújo Abreu para uso da infraestrutura do laboratório de Anatomia da FAMEC-UNEC para estudos por parte do professor para estudos da região do dorso em material humano, e que já esta em uso nas aulas de Anatomia Humana desta instituição. Defiro o pedido autorizando o uso do laboratório de Anatomia nos termos e condições observados pelos nossos alunos e professores.

1- Somente será permitida a presença do professor acompanhado de nossos técnicos de laboratório;

2- Não será permitida a retirada de peças anatômicas ou qualquer material do laboratório;

3- Toda atividade prática que exigir manuseio de cadáveres fora das cubas deve ser solicitada com antecedência para o devido preparo por para dos técnicos do laboratório de Anatomia.

Registre-se que esta autorização não configura nenhum tipo de trabalho a favor da UNEC.

Ciente

PROF. RONALDO A. ABREU

DR. ELI NOGUEIRA
DIRETOR DA FACULDADE DE
MEDICINA DE CARATINGA

Appendix 1.5

UNIVAÇO
UNIÃO EDUCACIONAL DO VALE DO AÇO

Ipatinga, 8 de março de 2001

Termo de autorização para uso do laboratório de Anatomia

Da Coordenação do Setor: Prof. Ronaldo A. Abreu

Da Presidente UNIVAÇO: Prof. Ubiratan de Castro

Para: Prof. Ronaldo A. Abreu

Atendendo a solicitação do professor Ronaldo Araújo Abreu para uso da infraestrutura do laboratório de Anatomia da FAMEVAÇO-UNIVAÇO para estudos por parte do professor para estudos da região do dorso em material humano, e que já esta em uso nas aulas de Anatomia Humana desta instituição. Defiro o pedido autorizando o uso do laboratório de Anatomia nos termos e condições observados pelos nossos alunos e professores.

1- Somente será permitida a presença do professor acompanhado de nossos técnicos de laboratório;

2- Não será permitida a retirada de peças anatômicas, e de qualquer material do laboratório;

3- Toda atividade prática que exigir manuseio de cadáveres fora das cubas deverá ser solicitada com antecedência para o devido preparo por para dos técnicos do laboratório de Anatomia.

Registre-se que esta autorização não configura nenhum tipo de trabalho a favor da FAMEVAÇO-UNIVAÇO.

Ciente

Prof. Ronaldo Araújo Abreu

Ubiratam de Castro
Presidente

APPENDIX 2

Appendix 2

LIST OF HUMAN MATERIAL

This list describes information about the data of the 40 dissected human cadavers and 3 fetuses and the institutions to which they belong.

1- Unknown cadaver n ° 1: Black male cadaver, estimated to be 56 years old, height 165 cm, with autopsy report of death from acute pulmonary edema. Institution UNIVALE.

2- Unknown cadaver n ° 2: Male cadaver, brown, with an estimated age of 62 years, height of 155 cm, with autopsy report of death due to heart failure. Institution UNIVALE.

3- Unknown Cadaver No. 3: Male cadaver, brown, estimated to be 70 years old, 170 cm tall, with autopsy report of death from cirrhosis and liver failure. Institution UNIVALE.

4- Unknown cadaver n ° 4: White male cadaver, estimated to be 53 years old, 162 cm tall, with autopsy report of death from brain hemorrhage and cirrhosis. Institution UNIVALE.

5- Unknown cadaver n ° 5: Female, black cadaver, estimated to be 50 years old, height 160 cm, with autopsy report of death from tuberculosis and pleural emphysema. Institution UNIVALE.

6- Unknown Cadaver No. 6: Black male cadaver, estimated to be 50 years old, 152 cm tall, with autopsy report of death from cirrhosis, liver failure and ascites. Institution UNIVAÇO.

7- Unknown Cadaver No. 7: Black male cadaver, estimated to be 54 years old, 156 cm tall, with autopsy report of death from renal failure, and anasarca. Institution UNIVAÇO.

8- Unknown Cadaver No. 8: Male cadaver, brown, with an estimated age of 62 years, height of 166 cm, with autopsy report of death by cerebral hemorrhage. Institution UNIVAÇO.

9- Unknown Cadaver No. 9: Male cadaver, brown, estimated to be 65 years old, height 161 cm, with autopsy report of death from tuberculous peritonitis. Institution UNIVAÇO.

10- Unknown cadaver n ° 10: Black male cadaver, estimated to be 67 years old, height of 163 cm, with autopsy report of death from chagasic cardiomegaly ??.Institution UNIVAÇO.

11- Unknown cadaver n ° 11: Black male cadaver, estimated to be 55 years old, height 164 cm, with autopsy report on death of pericarditis ??.Institution UNIVAÇO.

12- Unknown Cadaver No. 12: White male cadaver, estimated to be 59 years old, 168 cm tall, with autopsy report of death from renal failure, anasarca. Institution UNIVAÇO.

13- Unknown Cadaver No. 13: Male cadaver, brown, estimated to be 60 years old, height 165 cm, with autopsy report of death from tuberculosis, and malnutrition. Institution UNIVAÇO.

14- Unknown cadaver n ° 14: Male, brown, estimated age of 48 years, height of 160 cm, with necropsy report of death of undetermined cause. Institution UNIVAÇO.

15- Unknown Cadaver No. 15: Black male cadaver, estimated to be 70 years old, 158 cm tall, with death necropsy report of cerebral ischemia. Institution UNIVAÇO.

16- Unknown cadaver n ° 16: White male cadaver, estimated to be 56 years old, 159 cm tall, with death necropsy report of cerebral ischemia. Institution UNIVAÇO.

17- Unknown cadaver n ° 17: Black male cadaver, estimated to be 52 years old, 154 cm tall, with death necropsy report from pulmonary emphysema and bronchopneumonia. Institution UNIVAÇO.

18- Unknown cadaver n ° 18: Black male cadaver, estimated to be 57 years old, height 160 cm, with autopsy report of death from bronchopneumonia and pleural emphysema. Institution UNIVAÇO.

19- Unknown cadaver n ° 19: Black male cadaver, estimated to be 62 years old, height 164 cm, with death necropsy report of cerebral ischemia. Institution UNIVAÇO

20- Unknown cadaver n ° 20: Black male cadaver, estimated to be 65 years old, height 167 cm, with death necropsy report caused by cerebral hemorrhage. Institution UNIVAÇO.

21- Unknown cadaver n ° 21: Female, black cadaver, estimated to be 56 years old, 164 cm tall, with no determined cause of death. Institution UNINCOR-BH.

22- Unknown cadaver n ° 22: White female cadaver, estimated to be 58 years old with a height of 159 cm, with no determined cause of death. Institution UNINCOR-BH.

23- Unknown cadaver n ° 23: Black male cadaver, estimated to be 66 years old with a height of 166 cm, with no determined cause of death. Institution UNINCOR-BH.

24- Unknown cadaver n ° 24: Black male cadaver, estimated to be 67 years old with a height of 168 cm, with no determined cause of death. Institution UNINCOR-BH.

25- Unknown cadaver n ° 25: White male cadaver, estimated to be 56 years old, 162 cm tall, with no determined cause of death. Institution UNINCOR-BH.

26- Unknown cadaver n ° 26: White male cadaver, estimated to be 59 years old, 172 cm tall, with no determined cause of death. Institution UNINCOR-BH.

27- Unknown cadaver n ° 27: Black male cadaver, estimated to be 60 years old with 170 cm height, with no determined cause of death. Institution UNINCOR-BH.

28- Unknown cadaver n ° 28: Black male cadaver, estimated to be 61 years old with a height of 167 cm, with no determined cause of death. Institution UNINCOR-BH.

29- Unknown cadaver n ° 29: Black male cadaver, estimated to be 69 years old with 164 cm height, with no determined cause of death. Institution UNINCOR-BH.

30- Unknown cadaver n ° 30: Black male cadaver, estimated to be 55 years old with a height of 168 cm, with no determined cause of death. Institution UNINCOR-BH.

31- Unknown cadaver n ° 31: White male cadaver, estimated to be 62 years old with a height of 167 cm, with no determined cause of death. Institution UNIVALE – FOG – GV.

32- Unknown cadaver n ° 32: Black male cadaver, estimated to be 60 years old with 170 cm height, with no determined cause of death. Institution UNIVALE – FOG – GV

33- Unknown cadaver n ° 33: Black male cadaver, estimated to be 70 years old and 173 cm tall, with no determined cause of death. Institution UNIVALE – FOG – GV

34- Unknown cadaver n ° 34: Male, black cadaver, with an estimated age of 64 years with a height of 157 cm, with no determined cause of death. Institution UNIVALE – FOG – GV

35- Unknown cadaver n ° 35: Black male cadaver, estimated to be 67 years old with a height of 174 cm, with no determined cause of death. Institution UNIVALE – FOG – GV

36- Unknown cadaver n ° 36: Black male cadaver, estimated to be 60 years old with a height of 172 cm, with no determined cause of death. Institution UNEC – CARATINGA.

37- Unknown cadaver n ° 37: Black male cadaver, estimated to be 63 years old with 162 cm height, with no determined cause of death. Institution UNEC – CARATINGA

38- Unknown cadaver n ° 38: Black male cadaver, estimated to be 68 years old with 173 cm height, with no determined cause of death. Institution UNEC – CARATINGA.

39- Unknown cadaver n ° 39: White male cadaver, estimated to be 61 years old with a height of 159 cm, with no determined cause of death. Institution UNEC – CARATINGA.

40- Unknown cadaver n ° 40: Black male cadaver, with an estimated age of 74 years with a height of 164 cm, with no determined cause of death. Institution UNEC – CARATINGA.

41- Unknown anencephalic fetus with an estimated age of 6 months n ° 41: death from anencephaly. Institution UNINCOR – BH.

42- Unknown fetus with an estimated age of 4 months n ° 42: without determined cause of death. Institution UNINCOR – BH.

43- Unknown fetus with an estimated age of 7 months n ° 43: without determined cause of death. Institution UNINCOR – BH.