A plea for an extension of the anatomical nomenclature: The locomotor system

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ABSTRACT

Anatomical nomenclature is the main tool of communication in morphology, anatomy and other medical disciplines as well as in medical education, and thus needs to be exact, flawless, elaborate and correct. The Terminologia Anatomica (TA) is a thorough and extensive list of anatomical terms and their definitions, and the current standard for human anatomical terminology. Although several revisions to the TA have been made in the last 20 years, some important anatomical structures are still not included. This article is aimed at correcting and extending the anatomical nomenclature described in the TA. We gathered and presented a list of anatomical terms, with their definitions and explanations, to provoke a discussion about correcting and extending the TA. Our list comprises of 96 terms related to the locomotor system of the human body, i.e., the bones, joints, muscles and related structures.

KEY WORDS: Anatomical terminology; anatomical nomenclature; Terminologia Anatomica; human locomotor system
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INTRODUCTION

This article is aimed at correcting and extending the anatomical nomenclature described in the Terminologia Anatomica (TA). It follows on from our previous contribution to the anatomical nomenclature of the nervous system and senses [1] and applies the same approach. Introductory remarks about the history and clinical relevance of anatomical nomenclature, the importance of anatomical nomenclature in accomplishing clear and unambiguous communication between different medical fields, and proposals of a large number of new terms have been stated in our previous articles [1-8].

The revised edition of the anatomical nomenclature was issued by the Federative Committee on Anatomical terminology (FCAT) 19 years ago. In 2009, the Federative International Programme on Anatomical Terminology (FIPAT) replaced the FCAT and, since then, has been working on the nomenclatures of all branches of anatomy; moreover, it has been preparing a new revised edition of the TA, which should be published in the near future. The second edition of the TA was published in 2011 (FIPAT, 2011) [9], however, with minor changes compared to the first edition.

In February 2017, the FIPAT published online the terminology on the peripheral nervous system, central nervous system and sensory organs, termed the Terminologia Neuroanatomica [TNA] (http://fipat.library.dal.ca/tna/), and the second edition of the Terminologia Embryologica [TE2] (http://fipat.library.dal.ca/te2), replacing the first edition published in 2013 [10].

This article is aimed at correcting and extending the anatomical nomenclature described in the last version of the TA, with the final goal to incorporate the revised list of terms into the new version of the TA [11]. Our aim is also to encourage a discussion and criticism among both clinical and anatomical experts throughout the world, who may not be closely involved in the revision process but who are, nevertheless, interested in having a complete nomenclature that would be applicable in all fields of medicine. Consistently with this, the FIPAT is open to all suggestions and comments concerning any aspect of its terminologies and nomenclatures.

In this article, we compiled a list of terms that are missing from the TA and that we have encountered in the literature during the past 17 years. These terms have been indicated in old and modern anatomical textbooks and atlases, other medical textbooks, and scientific articles, as well as during our own

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scientific research. Some of the terms from the textbooks, listed in this article, are not supported by the references as they are considered to be well-known. In other cases, we proposed terms for anatomical structures that had no precise definition. Some of the proposed terms have already been published by other authors, and were included here to highlight their importance. All suggested terms should be discussed by the wider scientific community and the members of the FIPAT; if they are correct and considered useful, they should be added to the new version of the TA.

In the following parts of the article we will present the list of new terms (written in bold italics) proposed to be incorporated in the TA, and corrections for the terms already included in the TA (written in italics). The terms within quotation marks are obsolete and/or not recommended terms, and the terms in parentheses are eponyms, synonyms or explanations. In total, 96 terms are proposed to be incorporated in the TA: 1 in *Anatomia generalis*, 44 in *Ossa*, 13 in *Juncturae*, and 38 in *Musculi*.

Anatomia generalis

- The general terms *transversus* and *transversalis* are not synonyms and should not be used synonymously. *Transversus* means lying or passing across something, while *transversalis* means lying on or passing along the transverse plane. The latter term is applied exclusively to the transverse plane of the human body: *planum transversale* (*plana transversalia*).
- The term *nates* is listed as the preferred term for the buttocks in the chapter on general terms. However, the term *clunes* is more frequently used, e.g., in composite terms such as *nervi clunium*. The rank of these terms should be changed as follows: *clunes*; *nates*.
- ***Linea interischiadica*** is an imaginary transverse line extending between the *tuber ischiadicum dextrum* et *sinistrum* dividing the *regio perinealis* into the anterior *regio urogenitalis* and the posterior *regio analis.*

Ossa; *Systema skeletale*

- *Impressiones gyrorum* (A02.1.00.040) are depressions on the *lamina interna calvariae* corresponding to the convoluted gyri of the cerebral cortex. There are two inconsistencies concerning this structure. Firstly, the impressions can be found on the upper surface of *pars orbitalis ossis frontalis* but are not listed under *os frontale*. Secondly, they cannot be considered to be synonyms of *juga cerebralia* as stated in the TA. *Juga cerebralia* are elevated ridges located between the *impressiones gyrorum* corresponding to the sulci between gyri of the cerebral cortex. The term "jugum" means yoke and thus must refer to an elevation on a surface and not a depression. The solution is simple: separate these entities and state them as individual items: ***impressiones gyrorum*** (with its non-preferred synonym *impressiones digitatae*) and ***juga cerebralia***.
- ***Processus maxillaris ossis palatini*** is a bony process of the *lamina perpendicularis ossis palatini*, located right below the *crista conchalis* and projecting ventrally to contribute to the formation of the *hiatus semilunaris* [12].
- ***Processus retroauricularis*** is a part of the *pars squamosa ossis temporalis* located dorsal to the *fossa mandibularis*. It protects the *meatus acusticus externus* against the backward movements of the *caput mandibulae* and the *discus articularis* of *articulatio temporomandibularis*.
- ***Canalis nervi petrosi majoris*** is missing in the TA and should be added. The *sulcus nervi petrosi majoris* and *hiatus canalis nervi petrosi majoris* (both located on the *facies anterior partis petrosae ossis temporalis*), are listed in the TA, but the canal that branches off from the *canalis nervi facialis* is missing from the terminology. Similarly, the ***canalis nervi petrosi minoris*** is missing and should be included in the TA.
- ***Canalis orbitocranialis*** is a curved bony canal between the orbit and *fossa cranii anterior*. It starts in the *foramen ethmoidale anterius* and terminates in one of the *foramina cribrosa* of *lamina cribrosa ossis ethmoidalis*. It transmits the *nervus ethmoidalis anterior* and *vasa ethmoidalia anteriora* from the orbit to the cranial cavity.
- ***Canalis orbitoethmoidalis*** is a short bony canal between the orbit and *cellulae ethmoidales*. It transmits the *nervus ethmoidalis posterior* and *vasa ethmoidalia posteriora* from the orbit to the ethmoidal cells.
- ***Cellulae zygomaticae*** are accessory air cells inside *processus zygomaticus ossis temporalis* and in the *tuberculum articulare ossis temporalis* that do not extend ventrally further than the *sutura zygomaticotemporalis*. They are rare findings, present only in 2% of cases [13].
- ***Fonticulus nasalis anterior et posterior*** *(clinically also termed "nasal fontanelles") are the areas of* the lateral nasal wall that do not contain bone and are only composed of the periosteum. They are usually found immediately above the insertion of *concha nasalis inferior* forming a thin wall between the *sinus maxillaris* and *meatus nasi medius. Fonticulus nasalis anterior* is located ventrocaudally to the *processus uncinatus conchae nasalis mediae* and fuses with the medial wall of the *sinus maxillaris*. The ventral and dorsal boundaries of *fonticulus nasalis anterior* are the posterior end of *processus uncinatus* and *os palatinum*, respectively. Both *fonticuli* are common sites of the ***ostium maxillare accessorium*** *(*of Giraldès), which are present in 30-40% of cases.
- ***Canalis sinuosus*** is a tortuous bony canal extending from the middle part of the *canalis infraorbitalis* to the anterior

wall of the *sinus maxillaris.* It contains the *nervus alveolaris superior anterior et vasa alveolaria superiora anteriora.*

- ***Foramen septale*** is the external end (terminal foramen) of *canalis sinuosus* and contains *ramus nasalis* (of Luschka), the terminal branch of *nervus alveolaris superior anterior* [14].
- *Fossa incisiva* is a term applicable to three different bony structures. ***Fossa incisiva maxillae*** is a paired shallow depression on the *facies anterior maxillae* above *dentes incisivi superiores* and serves as the attachment site for *musculus depressor septi nasi* ("fossa prenasalis"). ***Fossa incisiva mandibulae*** *i*s a similar paired shallow depression on the *corpus mandibulae*, above the *foramen mentale* and below *dentes incisivi inferiores*. ***Fossa incisiva ossis incisivi*** (*fossa incisiva premaxillae*), the most well-known of the three structures, is an unpaired oval depression (A02.1.00.060) in the midline of *facies palatina maxillae* of the *os incisivum* behind *dentes incisivi superiores primi*, into which the paired *canalis incisivus* opens.
- *Canalis incisivus* has two openings, the superior innominate opening located in the floor of *cavitas nasi*, and the inferior opening termed *foramen incisivum* (of Stensen/Steno), which opens into the *fossa incisiva ossis incisivi* (*fossa incisiva premaxillae*) and *cavitas oris* (or in a bony skull onto *basis cranii externa*). As it is a bony canal of the skull base, both openings of the canal can be termed as ***apertura interna canalis incisivi*** (the superior opening) and ***apertura externa canalis incisivi*** (the inferior opening), replacing the term "foramen incisivum", following the example of *canalis caroticus* or *canaliculus cochleae* [15].
- *Canalis mandibulae* is a bony canal within the mandible containing the *nervus alveolaris inferior et vasa alveolaria inferiora.* It starts in the *foramen mandibulae* and terminates by bifurcating into the ***canalis mentalis mandibulae*** ("anterior loop of mandibular canal") turning laterocranially and coursing towards the *foramen mentale* (containing the homonymous nerve and vessels), and into the ***canalis incisivus mandibulae***, continuing in the direction of *canalis mandibulae* and conveying neurovascular bundles for the first four teeth (*dentes incisivi, dens caninus et dens premolaris primus*) as follows: ***ramus incisivus nervi alveolaris inferioris, ramus incisivus arteriae alveolaris inferioris*** and accompanying veins [16].
- ***Foramen linguale mandibulae*** (the obsolete terms are "genial foramen", "foramen interspinosum"; "foramen mentale medianum" or "foramen of Bertelli") is a small opening in the midline of *corpus mandibulae* on its dorsal surface just above *spinae mentales superiores*, leading into a canal traversing the bone to approximately 50% of the buccolingual dimension of the mandible. The foramen contains the anastomosis of *rami sublinguales arteriae lingualis dextrae et sinistrae* [17,18].
- ***Recessus supraorbitalis sinus frontalis*** is a variably present extension of the *sinus frontalis* (in extensive pneumatization of the bone), projecting above the orbit.
- ***Planum sphenoidale*** is the roof of *sinus sphenoidalis.*
- ***Tuberculum sphenoidale*** is a bony prominence located at the anterior end of the *crista infratemporalis*, a crest between the *facies temporalis et facies infratemporalis alae majoris ossis sphenoidalis.*
- ***Planum mastoideum*** is the dorsolateral aspect of the temporal bone just above the *processus mastoideus.* It is used in otorhinolaryngology for performing the Rinne test (placing a high-frequency vibrating tuning fork on the *planum mastoideum*) and for surgical access to the *antrum mastoideum* and further to the internal ear.
- *Os hyoideum* is composed of unpaired *corpus* and paired *cornu majus et minus*. But there are more structures deserving appropriate terms, such as ***margo medialis et margo lateralis cornus majoris, crista mediana*** (a short unpaired vertical crest in the midline of the anterior aspect of the *corpus*) and ***crista transversa*** (a paired horizontal crest on the anterior aspect of the *corpus*).
- *Processus spinosi* of the second to sixth cervical (C2-C6) vertebrae are bifid and their branches can be termed ***tuberculum dextrum et sinistrum.***
- The posterior surfaces of the *corpus vertebrae* display several foramina. The *venae basivertebrales* pass through these foramina to enter bony canals inside the *corpus vertebrae* and join the *plexus venosus vertebralis internus anterior* and *plexus venosus vertebralis externus anterior*. These foramina can be termed ***foramina basivertebralia***.
- The vertebral endplate is a thin layer of the dense subchondral bone of *corpus vertebrae*, adjacent to *discus intervertebralis*. It can be termed ***lamella terminalis vertebrae.*** As *lamella* is used for the plates of *discus intervertebralis*, the Latin language offers an alternative, "bractea", meaning an iron leaflet.
- ***Isthmus arcus vertebrae (pars interarticularis vertebrae)*** is a narrow part of *arcus vertebrae* between the *processus articularis superior et inferior*, susceptible to fractures.
- The innominate crest (crest of Ivanic) located on the posterior surface of *pediculus vertebrae lumbalis* is used for orientation during certain procedures in lumbar vertebral column surgery. It can be termed ***crista vertebrae*** (Figure 1) [19].
- ***Tuberculum spinosum*** is the cranial prominent beginning of the *crista sacralis mediana.*
- ***Apex ossis coccygis*** is the most caudal tip of *os coccygis.*
- The articular surface of *caput costae* (*facies articularis capitis costae*) in ribs (usually the second to tenth rib), is divided by the *crista capitis costae* into two separate articular facets. According to our previous proposals, the

FIGURE 1. *Crista vertebrae* (CV) located on the posterior surface of *pediculus vertebrae lumbalis* [19].

articular facet can be termed *faciecula*, and these two facets can be termed ***faciecula capitis costae superior et inferior*** [5,6].

- ***Tuberculum costoabdominale*** is the most caudal point of the *arcus costalis*, located on the curvature of the tenth costal cartilage.
- ***Isthmus femoris*** is the region of *corpus femoris* with the smallest cross-section diameter of its *cavitas medullaris*, determined on anteroposterior radiograph. It can be found distal to the junction of the proximal- and middle-third of the femur. In clinical practice, the diameter of the cavity at the level of *isthmus femoris* affects the size of the nail during treatment of fractures. Its location substantially differs from the corresponding *isthmus humeri*, located proximal to the junction of the middle- and distal-third of the humerus [20].

Juncturae; *Systema articulare*

- In some joints, *cavitas articularis* is divided by the *discus articularis* into two separate cavities. These cavities should be termed ***cavitas superior et inferior*** in the *articulatio temporomandibularis* and ***cavitas medialis et lateralis*** in the *articulatio sternoclavicularis* and, when a disc is present which is in 50% of cases, in the *articulatio acromioclavicularis*.
- ***Ligamentum atlantoaxiale anterius*** is a strong membrane extending between the inferior border of *arcus anterior atlantis* and the anterior surface of *corpus axis*. It is thickened in the midline by a round cord, stretching between the *tuberculum anterius atlantis* and *corpus axis* and is the cranial continuation of *ligamentum longitudinale anterius*.
- ***Ligamentum glenotransversum*** connects the *processus transversus atlantis* and *massa lateralis atlantis*, often becomes ossified, and forms a bony arch bridging the gap between this arch and the costal element of *processus transversus*, through which *ramus anterior nervi cervicalis primi* directs from the *canalis vertebralis* [21].
- *Articulationes interchondrales* are joints between the sixth, seventh and eighth, and sometimes the ninth and tenth *cartilagines costales.* They are strengthened laterally and medially by ligamentous fibers termed ***ligamenta interchondralia***, passing from one cartilage to the other.
- ***Ligamentum lumbocostale*** ("ligamentum vertebrocostale" of Henle) is a thickened superior part of the *lamina media fasciae thoracolumbalis* as it attaches to the *processus costalis* of the first lumbar vertebra [L1] (25%) or L1 and L2 (75%), located dorsally to the *musculus quadratus lumborum* and ventrally to the *musculi intertransversarii* [22].
- *Ligamentum iliolumbale* (attached to the tip of *processus costalis* L5) is composed of two parts: the upper part inserts at the *labium internum cristae iliacae* and the lower (termed ***ligamentum lumbosacrale***) at the *ala ossis sacri*, merging with the *ligamentum sacroiliacum anterius*.
- The lumbosacral transition comprises several units. There is an unpaired symphysis between the inferior aspect of *vertebra lumbalis quinta* and the superior aspect of *basis ossis sacri*, which resembles the other intervertebral joints (*symphyses intervertebrales*). Dorsally, there is a paired synovial joint between the *processus articulares vertebrae lumbalis quintae* and *processus articulares superiores ossis sacri,* which resembles the other zygapophysial joints. There are syndesmoses represented by the long and short ligaments of the vertebral column. It is a misnomer to use the term *articulatio lumbosacralis* for the ventrally located symphysis. The terminology should be corrected as follows: ***symphysis lumbosacralis*** for the intervertebral symphysis and ***articulatio lumbosacralis*** for the zygapophysial synovial joint.
- ***Ligamentum intercornuale*** is a short, paired ligament (syndesmosis) between the *cornu sacrale* and *cornu coccygeum*.

Musculi; *Systema musculare*

- *Musculus pterygoideus medialis* consists of two heads. ***Caput profundum*** is the larger head originating from just above the medial surface of *lamina lateralis processus pterygoidei ossis sphenoidalis*. ***Caput superficiale*** is the smaller head originating from the *tuber maxillae* and *processus pyramidalis ossis palatini* [23,24].
- The mandibular sling is a common tendinous sling suspending the mandible, formed by the medial pterygoid and masseter muscles, and helping the elevation of the jaw. No Latin term exists and the newly proposed term ***pedica pterygomasseterica*** seems to be the most appropriate.
- ***Trigonum linguale anterius*** (of Pirogov) is a small flat space bounded ventrally by the posterior margin of *musculus*

mylohyoideus, caudally by the *venter posterior musculi digastrici* and cranially by *nervus hypoglossus.* Its floor is formed by the *musculus hyoglossus* and it contains *vasa lingualia.*

- ***Trigonum linguale posterius*** (of Béclard), also termed "angulus Béclardi", is a small flat space bounded dorsally by the *musculus mylohyoideus*, cranially by the *venter posterior musculi digastrici* and *musculus stylohyoideus* and caudally by the *cornu majus ossis hyoidei.* The triangle contains *vasa lingualia.*
- The origin of *musculus sternocleidomastoideus* is composed of two heads, ***caput sternale et caput claviculare***, which form the *fossa supraclavicularis minor.*
- ***Tendo intermedius musculi digastrici*** is a tendon between the *venter anterior et posterior musculi digastrici*. ***Tendo intermedius musculi omohyoidei*** is a tendon between the *venter superior et inferior musculi omohyoidei*.
- *Musculus longus colli* is a deep cervical muscle consisting of three parts, each with a different direction of muscle fibers. ***Pars obliqua superior*** extends between the *tuberculum anterius processus transversi vertebrarum cervicalium III-V* and *tuberculum anterius atlantis*. ***Pars obliqua inferior*** stretches between the anterior surface of *vertebrae thoracicae I-II* and *tuberculum anterius processus transversi vertebrarum cervicalium V-VI*. ***Pars recta*** extends between the anterior surface of *vertebrae cervicales V-VII et vertebrae thoracicae I-III* and the anterior surface of *vertebrae cervicales II-IV* [25,26].
- *Trigonum musculare (trigonum omotracheale)* is bound laterally by the *venter superior musculi omohyoidei* and *musculus sternocleidomastoideus* and medially by the midline of the neck. The medial border is an imaginary line. From the didactic point of view, a real border would be better. A possible solution is to describe both *trigona muscularia* as one unpaired space. This space may be called ***tetragonum musculare***, an unpaired space bordered laterally on each side by the *venter superior musculi omohyoidei* and *musculus sternocleidomastoideus.*
- ***Spatium paratonsillare*** is a space containing loose connective tissue. It is bound medially by the capsule of *tonsilla palatina* and laterally by the *fascia pharyngobasilaris*, *musculus constrictor pharyngis superior* and *musculus tensor veli palatini* surrounded by the fascia. Ventrally it is bound by the *arcus palatoglossus* and dorsally by the *arcus palatopharyngeus*, with their corresponding muscles.
- ***Spatium pterygomandibulare*** is a narrow space between the *ramus mandibulae* (laterally), *musculus pterygoideus medialis* (medially) and *musculus pterygoideus lateralis* (cranially). It contains the *nervus lingualis*, *nervus alveolaris inferior* and *vasa alveolaria inferiora*.
- ***Speculum rhomboideum*** is a term for the aponeurotic origin of *musculus trapezius* at the *processus spinosi* of the cervical and thoracic (T) vertebrae. Its borders are variable; cranially it may originate from the *processus spinosus* of C3-C6 and caudally from the *processus spinosus* of C6-T3. It has a rhomboid shape with the center located at the level of the *vertebra prominens* [27]. Due to its structure, an additional, more systemic term is proposed: ***aponeurosis rhomboidea musculi trapezii***.
- ***Fascia dorsi*** is the fascia covering the superficial (first) layer of back muscles (*musculus trapezius et latissimus dorsi*) and is cranially continuous with the *fascia nuchae.*
- ***Trigonum suboccipitale*** is a deep space located dorsally at the transition between the head and neck. Medially, it is bound by the *musculus rectus capitis posterior major*, laterally by the *musculus obliquus capitis superior*, and caudally by the *musculus obliquus capitis inferior.* It contains the *pars atlantica arteriae vertebralis* and *nervus suboccipitalis.* The *nervus occipitalis major* passes over this space superficially [28].
- A part of *fascia endothoracica* covers the superior surface of the diaphragm, while a part of *fascia endoabdominalis* covers its inferior surface. The parts of these fasciae covering the diaphragm should be denominated specifically as ***fascia phrenica superior*** (instead of *fascia phrenicopleuralis*) and ***fascia phrenica inferior*** (instead of *fascia endoabdominalis*).
- *Processus transversus vertebrae lumbalis* is very rudimentary and reduced into the small *processus accessorius et mammillaris.* A process of the lumbar vertebra directing laterally in the horizontal plane is a rudimentary rib and thus termed correctly *processus costalis*, which should be preferred to *processus costiformis*, as already discussed by Kachlik et al. [5]. Unfortunately, many clinical books use the incorrect term "processus transversus" and, moreover, the ligaments and muscles stretching between these processes are termed *ligamenta intertransversaria* and *musculi intertransversarii*, respectively. From the grammatical and anatomical point of view, these structures should be termed *ligamenta intercostalia* and *musculi intercostales*, and to distinguish the latter from *musculi intercostales externi, interni et intimi* of the thorax they could be termed ***musculi intercostales lumborum*** (and similarly for the ligaments – ***ligamenta intercostalia lumborum***).
- ***Ligamentum ilioinguinale*** is an alternative and clinically preferred term for *arcus iliopectineus* (A04.5.02.010). From the morphological point of view, it seems reasonable to use this term as the structure diverges from the *ligamentum inguinale* and attaches to the *eminentia iliopubica.*
- *Lamina posterior fasciae thoracolumbalis* consists of two laminae (a superficial and deep lamina). The superficial lamina is formed by the flat tendon (aponeurosis) of *musculus latissimus dorsi.* The deep lamina is composed of

bands of fibers passing laterocaudally from the midline and constituting a series of accessory posterior ligaments that anchor the *processus spinosi* L2-L5 to the *os ilium* and resist flexion of the lumbar vertebral column. These two layers can be termed ***lamella superficialis et profunda*** to follow the example of dividing *laminae* into *lamellae* [29].

- ***Fascia vesicoumbilicalis*** (of Delbet) is the triangular part of *fascia extraperitonealis* stretching from the umbilicus and paired *chorda arteriae umbilicalis* caudally to the urinary bladder where it blends with the *fascia pelvis visceralis* of the urinary bladder [30].
- ***Fossa lumbosacralis*** (of Cunéo and Marcille; sometimes also called "fossa iliolumbalis") is bounded medially by the *corpus vertebrae lumbalis quintae* (the body of L5) and *promontorium*, laterally by the medial border of *musculus psoas major*, and caudally by the cranial border of *ala ossis sacri*. Cranially, it contains adipose tissue and lymph nodes and caudally, it contains the *nervus obturatorius* and *truncus lumbosacralis*. It is usually crossed by *vasa iliaca communia* [31].
- ***Fossa obturatoria*** is located at the lateral border of the lesser pelvis, containing the *nervus obturatorius, vasa obturatoria* and *nodi lymphoidei*. These lymph nodes are removed during pelvic lymphadenectomy.
- ***Fascia abdominis superficialis*** is both the clinical and classical term for the fascia of *musculus obliquus externus abdominis*. The TA has introduced the term *fascia investiens* and for the fascia of the lateral abdominal muscles the term *fascia investiens profunda, intermedia et superficialis* are used. These terms do not reveal the structures they cover and thus they should be discussed and potentially reconsidered (see below).
- *Diaphragma pelvis* contains two openings: the ventral *hiatus urogenitalis* and a dorsal, innominate, opening for *canalis analis recti*. The dorsal opening can be named ***hiatus analis***.
- *Fascia pelvis visceralis* is a common term for a group of heterogenic structures within the lesser pelvis surrounding and interconnecting the organs in the cavity. It can be divided into three frontal layers (plates or pillars): ***lamina vesicalis*** is the ventral plate, embracing the urinary bladder (and the prostate in males), ***lamina genitalis*** is the middle plate, encompassing the *cervix uteri* (and the vagina in females), and ***lamina rectalis*** is the dorsal plate, covering the rectum. All three plates contain blood and lymph vessels within their lateral parts, lymph nodes and nervous plexuses as well as condensed fibrous bands (sometimes with smooth muscle fibers), directed from the dorsolateral aspect of the lesser pelvis wall to the pelvic organs.
- There are inconsistences in the order and form of adjectives in terms of the synovial bursae. All Latin terms for subcutaneous and subtendinous bursae use the concordant adjective before the specifying systemic adjective, e.g., *bursa subcutanea infrapatellaris*, *bursa subtendinea prepatellaris*, *bursa subcutanea calcanea*; except for the *bursa infrapatellaris profunda* and *bursa tendinis calcanei* ("retrocalcaneal bursa"). These terms should be corrected as ***bursa subtendinea/profunda infrapatellaris*** and ***bursa subtendinea calcanea***, respectively, to have a concise terminology and to clarify the exact position of the latter [32-34].

DISCUSSION

As discussed in our previous articles, anatomists have been trying to achieve a complete and unambiguous anatomical terminology since 1895. Even though this goal has been accomplished to a large extent, the terminology will continuously be corrected and extended in the future, as further developments in diagnostic and therapeutic methods are made.

The TA has been updated in neuroanatomy, following extensive research in the field. Numerous microscopic structures of the brain were incorporated in the current version of TNA. However, many important gross anatomical structures, visible to the naked eye, were neglected in the TNA and, thus, should be incorporated in the next version of TA. Our articles are aimed to encourage discussion among anatomists and clinicians about including the missing anatomical structures in the TA.

At the present time, the role of an anatomist is not only to broaden the knowledge of the human body and extend the anatomical nomenclature, but also to work closely with clinicians to unify the terminology in theory and practice. Anatomists should understand why specific terms are used in clinical medicine, to ensure their correct use and to resolve any discrepancies between the official terminologies (e.g., the TA) and those specifically used in clinical medicine.

The discrepancy in the use of anatomical terminology also exists between anatomists from different countries. An example is the terminology of fascia. Fascia is defined differently in mainland Europe compared to the United Kingdom, the United States of America, and Canada. In Europe, the term *tela subcutanea* (listed in the TE as *tela subcutanea* [E5.17.2.0.0.0.1], in the Terminologia Histologica as *tela subcutanea; subcutis; hypodermis* [H3.12.00.2.00001], but missing in the TA) is used to describe a layer of tissue located deep to the reticular layer of the dermis, while the term *fascia* is used for the tissue covering a muscle or a group of muscles within one compartment (fasciae of muscles; *fasciae musculorum* [A04.0.00.038]), an organ (visceral fascia; *fascia visceralis* [A04.0.00.036]) or to describe a denser layer of connective tissue within sparser connective tissue anlage. The term *fascia investiens*, which is sometimes used to

describe a layer of connective tissue around a muscle (or a group of muscles), may even deepen the terminological confusion. A thorough and detailed discussion on this topic would extend far beyond the scope of this article. Nevertheless, it is necessary to define these basic terms and two reviews on this subject [35,36] provide valuable information. *Fascia superficialis* is a membranous layer separating the subcutaneous tissue into two adipose sublayers ***(lamina superficialis et profunda telae subcutaneae)***. The layer can be observed throughout the human body, although its arrangement and thickness vary according to the region of the body, as well as gender. For instance, the layer is thicker in the lower limbs than the upper limbs, on the posterior compared to the anterior aspect of the body, and in females compared to males [37]. Muscular fibers can be found within *fascia superficialis*, most prominently in the neck (*platysma*), face (superficial musculoaponeurotic system), anal region (*musculus sphincter ani externus*), scrotum and labia majora (*tunica dartos et tunica labiorum*), and areola. *Fascia superficialis* may be viewed as the human homologue of the cutaneous muscle layer (*panniculus carnosus*) found in the fascia of other mammals [38]. *Fascia superficialis* is recognized as the *stratum membranosum telae subcutaneae abdominis* ("fascia abdominis subcutanea of Scarpa") in the TA, and the *stratum membranosum telae subcutaneae perinei* ("fascia perinei suerficialis of Colles") and *fascia saphena* in the published consensus documents [39-43].

Fascia profunda is a fibrous membrane forming an intricate network that envelopes and separates muscles, forms sheaths for vessels and nerves, strengthens ligaments around joints and binds all these structures together into a firm, compact mass. The deep fascia surrounds all the muscles in the body, but has different features according to the region. In the limbs, the fascia is easily separable from the underlying muscles, being connected to them only by some myofascial expansions, and is more evident around the joints. Muscles are free to move in their epimysium surrounded by *fascia profunda*. In the trunk, the same structural features are recognized in *fascia thoracolumbalis*, *vagina musculi recti abdominis* and *fascia cervicalis*; on the contrary *fascia glutea, deltoidea, pectoralis et trapezia (nuchae)* are firmly adherent to their underlying muscles due to many intramuscular septa. These muscles are not separable from the fascia and epimysium is not recognizable. The term "fascia investiens" should be abandoned as it causes more confusion to this topic.

Similarly, a large number of terms that are also not included in the anatomical nomenclature, concern the ossification centers and growth plates (*physes*) of the bones. We have proposed some of those terms in our previous articles, but again, it is a very large and complex topic and deserves its own space for discussion.

There are also discrepancies in the description of the fasciae of the neck and the spaces located between them. A vertical space situated laterally and dorsally to the pharynx is given different names in anatomical atlases and the TA, i.e., *spatium peripharyngeum*, *spatium parapharyngeum*, *spatium lateropharyngeum*, and *spatium pharyngeum laterale*. On the contrary, the term *spatium retropharyngeum* is unique but it is applied to two different spaces located behind the pharynx and in front of the vertebral column, separated by a fibrous sheet that has no specific name (*fascia intercarotica*; "fascia alaris"). Unfortunately, at the moment, there is not enough published studies based on high-quality dissections to conclude this topic.

A similar problem concerns two narrow vertical spaces in the neck. The first triangular space is bound ventrally by the *musculus scalenus anterior*, dorsally by the *musculus scalenus medius*, and caudally by the first rib. It contains the *plexus brachialis, plexus cervicalis* and *arteria subclavia*. In addition, more names are applied to this space, as follows: "fissura interscalenica, fissura scalenorum, hiatus scalenicus, hiatus scalenorum posterius, interscalenic triangle, scalene hiatus". The other triangular slit, situated ventrally to the first one, is bound ventrally by the *musculus sternocleidomastoideus*, dorsally by the *musculus scalenus anterior* and caudally by the first rib. It contains the *vena subclavia, truncus subclavius*, and *tendo intermedius musculi omohyoidei*. It could be termed "fissura prescalenica" or "hiatus scalenorum anterius" but no consensus exists concerning the precise anatomical description of these two structures. Thus, extensive anatomical and imaging studies should be conducted to determine the correct terminology.

Individual proposals to revise the nomenclature can be found in the current literature. One of those proposals concerns the term *musculus omohyoideus*, where Ottone et al. [44] suggested to change the name to "musculus scapulohyoideus" based on its insertion on the scapula and due to the fact that the Greek term for the shoulder blade "omoplate" is not generally used [44]. Kachlik et al. [7] proposed to use the term *omus* for the shoulder and the authors of this article do not consider necessary to change the term, because they do not find it incorrect and misleading, both from the anatomical and from the linguistic point of view [7].

There is an ongoing discussion on which terms should be included in the TA among anatomists all over the world. However, the effort should be extended to clinicians, and their proposals should be taken into account as the most important role of anatomy is in clinical medicine. This article is aimed to encourage these steps and to serve as the basis for such activity.

CONCLUSION

The TA is the main tool of communication in anatomy and clinical medicine. Our goal is to improve and extend the TA so it can become an ingrained and integral part of all medical disciplines. We can only achieve this goal through open discussion about all elements of the TA.

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DECLARATION OF INTERESTS

The authors declare no conflict of interests.

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