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New Terminologia Anatomica highlights the importance of clinical anatomy

Running title: New Terminologia Anatomica

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ABSTRACT

Although not all authors agree that Terminologia Anatomica merits special attention, any type of scientific terminology should be clear, exact, logical, coherent and worldwide accepted. A precise definition of every anatomical term is also crucial. New changes have recently been approved by Federative International Programme on Anatomical Terminology (FIPAT) as the previous version of terminology required minor revisions. This situation offers an opportunity to take a closer look at these new and interesting modifications. It turns out that selected traditional names, such as *cavitas glenoidalis*, *incisura scapulae*, *linea intermedia*, *femur*, *talus* (for pertinent bones), *foramen mandibulae*, *platysma*, *diaphragma*, *cusps anterior*, *posterior et septalis*, *extremitas superior et inferior (ren)*, *musculus puborectalis*, *ramus colli (n. facialis)*, *arteria dorsalis nasi*, *sulcus (et ramus) interventricularis posterior*, *vena interventricularis posterior*, and several modern names (Terminologia Anatomica 1998), such as *hilum splenicum*, *hilum renale*, *musculus sphincter pyloricus*, *membrana tympanica*, *nucleus interpositus anterior et posterior* and so forth, have been excluded from the list of official anatomical names. Moreover, Roman numerals are not used for other structures than cranial nerves. Therefore, bones and muscles are numbered with Arabic numerals, which breaks with the long tradition. Nevertheless, the new version of anatomical terminology has both strengths and limitations, which warrants further refinement.

Key words: anatomical nomenclature, anatomical terminology, clinical anatomy, Nomina Anatomica, Terminologia Anatomica

INTRODUCTION

When Basle Nomina Anatomica (BNA) was issued in 1895, a number of fundamental rules of terminology were established. One of those tenets was ‘use only one name for one structure’. Although this rule was originally introduced to discard multiple synonyms at that time, it also conveys the message that any official term should be chosen with utmost care as only one name will be valid. Unfortunately, many authors and instructors use obsolete and invalid terms. For example, the pubic symphysis (*symphysis pubica* in Latin) is sometimes referred to as the symphysis pubis in today’s anatomical textbooks. The suprarenal gland is very often called the adrenal gland. Another example of antiquated terminology is the use of the word *lien* and its derivatives (e.g. *hilum lienale* or *lienis*, *lig. lienorenale*, etc.) instead of the valid term *splen* (spleen in English), or the use of the obsolete term *ventriculus* for the stomach (*gaster*). Although not all anatomists agree that Terminologia Anatomica deserves due consideration, as many clinicians, researchers and teachers use their own versions of terminology, and medical students must adhere to the version that is used by their instructors [6], this argument is not compelling for several reasons. First, a clear lesson from the history is that the use of synonyms and invalid terms not only hinders the process of teaching and learning but also casts a shadow on scientific practice. Second, such as status of terminology hampers communication both within the discipline and between anatomists and other researchers, leading to misunderstandings and mistakes in scientific writing. Further, many authors were inspired by the idea that a revised and extended version of terminology could be a powerful tool in communication between anatomists and other specialists [1, 4, 7-15]. Thus, this concept seems reasonable. In 2016, new corrections and extensions were tentatively approved by Federative International Programme on Anatomical Terminology (FIPAT) in Göttingen, Germany as the previous version of terminology required minor revisions [3]. The FIPAT stresses the importance of clinical anatomy. Even though the revised version of terminology shows a tendency towards greater precision and uses modern and traditional terms, a number of new problems arose. Briefly, not all changes are consistent with each other (e.g. *os femoris* should have *caput et collum ossis femoris*, *hilum splenis* should be translated as the hilum of the spleen or *hilum splenicum* should not have been changed at all; similarly, renal hilum means *hilum renale*, but if the Latin term is *hilum renis*, then it should be translated as the hilum of the kidney, etc.), and some of them are contentious (e.g. the replacement of old and traditional terms with longer and awkward names such as the use of *foramen inferioris alveolare* instead of *foramen mandibulae*, the use of *diaphragma*

respiratorium seu thoracoabdominale instead of *diaphragma*, the use of different patterns of declension, etc.). Moreover, there are too many synonyms, and not all errors have been corrected (e.g. *fascia iliopsoas* should be termed *fascia iliopsoatica*) [8]. At the same time, other useful terms [9-12] have not been endorsed. On balance, it can be argued that the recent version of Terminologia Anatomica has both strengths and limitations, which warrants further refinement.

GENERAL TERMS

The use of the terms *collum* and *cervix* is often inconsistent. To solve this problem, the term *collum* should be confined to pertinent parts of bones like *collum costae*, *collum anatomicum et chirurgicum (humerus)*, *collum mandibulae*, *collum scapulae*, *collum radii*, *collum femoris* etc. As a result, *ramus colli (n. facialis)* is now termed *ramus cervicalis*. The older version of Terminologia Anatomica [2] used the term *os* for both mouth and a general name of any bone, which was rather inconvenient. From now on, the Latin term for mouth will be *ostium orale*, which is a sensible decision. Other important modifications include the replacement of the terms *extensor* and *flexor* by the terms *extensorius* and *flexorius*. Also *peripheralis* was changed into *periphericus* (Table 1).

SKELETAL SYSTEM

A number of new names have been endorsed by FIPAT [3] because they are believed to be more adequate than the traditional terms (Table 1). For example, the old name *cavitas glenoidalis* (glenoid cavity in English) was replaced by the new term *fossa glenoidalis* (glenoid fossa in English). It should be acknowledged that the shallow depression that articulates with the head of the humerus is better described as a fossa rather than a cavity. On the other hand, this term matches with *fossa acetabuli* (acetabular fossa), and this situation is unfortunate as the latter is not an articular surface. Such congruity might be misleading for students and therefore it was avoided. The term *linea intermedia* was replaced by the term *zona intermedia* (intermediate zone) as there is no clear line but rather an area between the inner and outer lip on the iliac crest. It was argued that the name *linea intermedia* was a typographical error. The English equivalent of *eminentia iliopubica* (i.e. iliopubic ramus) [2] was changed into iliopubic eminence [3]. The lateral angle of the scapula is termed *processus glenoidalis* (glenoid process) because of the practical usage of this term. Thus, the scapula has three processes: the acromion, the coracoid process and the glenoid process. The term suprascapular notch was replaced by the more adequate term superior scapular notch (*incisura*

scapulae superior in Latin) as there is also the inferior scapular notch (spinoglenoid notch). At the same time, a number of traditional names for several bones have been modified in order to distinguish them from parts of the body. The term *femur* (thigh in English) and the term *talus* (ankle in English) are now restricted to those parts of the lower limb, while the names for pertinent bones have been changed into *os femoris* (femur in English) and *os tali* (talus in English), respectively. The reasons behind these modifications are clear. For some inexplicable reason the parts of these bones are termed according to the discarded system (e.g. *caput, collum, corpus femoris* instead of *caput, collum, corpus ossis femoris*), thereby producing inconsistency.

MUSCULAR SYSTEM

The ancient term *diaphragma* (diaphragm), which comes from the Greek word *διάφραγμα* (*septum transversum*, Vesalius) was replaced by the new term *diaphragma respiratorium seu diaphragma thoracoabdominale* (respiratory diaphragm), even though the shorter and more convenient term thoracic diaphragm is already used by some authors. This modification was necessary to distinguish this muscle from the pelvic diaphragm. It is noteworthy that the widely used term *diaphragma urogenitale* (urogenital diaphragm) was not reintroduced, thereby upholding the earlier decision [2]. Interestingly, the most superficial muscle of the neck is now termed *musculus platysma* (platysma muscle in English) instead of *platysma* (platysma myoides, Galen) [3]. The muscle that is occasionally present between the temporalis and the lateral pterygoid muscle is termed *musculus pterygoideus proprius* (pterygoideus proprius muscle in English), even though this is inconsistent with the English names of other pterygoid (not ‘pterygoideus’) muscles. It should be remembered that there are two different styles of naming muscles in English (e.g. the temporalis muscle is preferred over the term ‘temporal muscle’, even though there is no such term as ‘deltoideus’ muscle as there is only the deltoid muscle; the scalenus anterior muscle is preferred over the anterior scalene muscle but the term ‘sternocleidomastoideus’ muscle is not used, etc.). A simple remedy is to name all muscles in English using names without the Latin endings such as *-is* or *-eus*, if possible (even though other names cannot be changed, e.g. anconeus muscle). One of the parts of the levator ani muscle (which is another example of Latin names in English terms) is now termed *musculus puboanal* (puboanal muscle in English), although the previous version of anatomical terminology used the term *musculus puborectalis* (puborectal muscle) Like in the case of the ischio-anal fossa, this change is consistent with some previous modifications.

Some authors prefer the name pubovisceral muscle over the name pubococcygeal muscle as the former refers to the origin and insertion of this muscle.

DIGESTIVE SYSTEM

It has recently been suggested that the Latin term *ventriculus* should be added as a synonym for the Greek term *gaster* (stomach in English) since it is used by many clinicians, albeit there is no such modification in the current version of terminology [3], thereby espousing the use of the Greek word, which can be found in compounds such as names of pertinent ligaments, vessels and lymph nodes, instead of the use of the Latin word which is already used for other structures. Nonetheless, the Latin term *ventriculus* is still used in clinical names. The term for the fundus of the stomach, i.e. *fundus gastricus* [2] and the name for the body of the stomach, i.e. *corpus gastricum* [2] have been changed into *fundus gastris et corpus gastris*, respectively [3]. Similarly, the name *fornix gastricus* was replaced by the term *fornix gastris* [3]. This form of declension is not present in the term *canalis gastricus* (gastric canal in English). The name *musculus sphincter pyloricus* was replaced by the term *musculus sphincter pylori*, a traditional name for this structure. The name *sulcus venae cavae (hepar)* was modified by adding the adjective *inferioris*. Three names for lateral flexures of the rectum were added to the list of official terms.

CARDIOVASCULAR SYSTEM

Some authors suggest that the Greek word *cardia* should be added as a synonym for the heart (*cor* in Latin) as it is already used in several preferred names for veins, including *vena cardiaca magna*, *vena cardiaca media*, *vena cardiaca parva*, *venae cardiaca anterior* and *minimae*. The term *anastomosis arteriovenosa* (arteriovenous anastomosis) refers to the specific type of anastomosis at the arteriole and venule level. Therefore, it has been suggested that the name arteriovenular anastomosis would be a better option, but none of this was endorsed. Nevertheless, there are several interesting changes in the terminology concerning the heart. For example, the terms *sulcus* and *ramus interventricularis posterior* have been changed into *sulcus et ramus interventricularis inferior* [3] as these terms are more adequate and many clinicians prefer them. The term *cuspis* (cusp) might refer to a commissure, i.e. pointed end where two curves meet. Therefore, *valva atrioventricularis dextra* (the right atrioventricular valve) consists of three leaflets: *foliolum anterosuperius* (anterosuperior leaflet), *foliolum inferius* (inferior leaflet) and *foliolum septale* (septal leaflet), while *valva atrioventricularis sinistra* (the left atrioventricular valve) consists of two leaflets, i.e. *foliolum*

aorticum (aortic leaflet) and *foliolum murale* (mural leaflet) [3]. Interestingly, *valva trunci pulmonalis* (the pulmonary valve) consists of three semilunar leaflets: *valvula semilunaris adjacens dextra* (the right adjacent semilunar leaflet), *valvula semilunaris adjacens sinistra* (the left adjacent semilunar leaflet) and *valvula semilunaris nonadjacens* (non-adjacent semilunar leaflet). The aortic valve has the following leaflets: *foliolum coronarium dextrum* (the right coronary leaflet), *foliolum coronarium sinistrum* (the left coronary leaflet) and *foliolum nonadjacens* (non-adjacent leaflet) [3]. Although these changes are justified, this part of new terminology is rather complicated, so it breaks with the rule ‘the terminology must be as simple as possible’. Moreover, it should be noted that two English names for two crests of the heart are inconsistent with each other, i.e. *crista terminalis* (crista terminalis in English) and *crista supraventricularis* (supraventricular crest in English). It is noteworthy that the current meaning of the term thoracic aorta, which was formerly defined as the thoracic part of the descending aorta, is understood as the ascending aorta, the aortic arch and the thoracic (part of the) descending aorta. Therefore, this new term ‘thoracic descending aorta’ (*aorta thoracica descendens* in Latin) is now used to name the first part of the descending aorta, i.e. the descending aorta without the abdominal aorta. The second part of the descending aorta, which was referred to as the abdominal part of the descending aorta, is now officially termed the abdominal aorta (*aorta abdominalis* in Latin), which is a traditional name. To those who prefer simple and traditional names and definitions, however, the new term ‘thoracic descending aorta’ might appear awkward.

NERVOUS SYSTEM

The term *neura* (neurons in English) is currently used as a plural form of *neuron*. Any neuronal process extending from the cell body is called *processus neuralis* (*neuritus*). The terms *neurolemma* and *axolemma* refer to the plasmalemma of the neuron and the axon, respectively. The term gliocyte (glial cell, *gliocytus* in Latin) has been added as a synonym. *Corpus gliocyticum* is termed glial cell body in English. Similarly, the name ependymocytes is used as a synonymous name for ependymal cells (*ependymocytus* in Latin), and the terms astroglia and oligodendroglia (*astrocyti et oligodendrocyti* in Latin, astrocytes and oligodendrocytes in English) have been included in both versions of terminology. The name *microglia* (microgliocyte) has been merged with the preferred term *microgliocytus* (microglial cell). A number of other important terms have been incorporated in the new version of terminology, including *claustrum hematoliquorosum* (blood-cerebrospinal fluid barrier) and *claustrum hematoencephalicum* (blood-brain barrier). The English term arachnoid mater was

shortened to arachnoid, but not the terms *dura mater* and *pia mater*. This decision was motivated by the fact that only the first part of the name occurs in derivatives such as arachnoid barrier cell layer, arachnoid granulations (*granulationes arachnoideae*), arachnoid trabeculae (*trabeculae arachnoideae*) and so forth. Thus, this part of terminology has been reorganised. A number of terms have been simplified. For example, *facies inferomedialis hemispherii cerebri* (previously known as *facies inferior et facies medialis*) has been incorporated in the new version of terminology to match the term *facies superolateralis*. *Clastrum* has been excluded from the basal nuclei and included in the claustrum-insular complex (*complexus claustrinsularis* in Latin) next to the insula. The term ‘corpus striatum’ has been added as a synonym to the official term basal nuclei (*nuclei basales*). Several modern terms have been replaced by the traditional names, e.g. the terms *nucleus interpositus anterior et posterior* have been replaced by the older names *nucleus emboliformis* and *globosus*, respectively. *Nucleus dentatus* (dentate nucleus in English) has one synonym, i.e. *nucleus lateralis cerebelli* (the lateral cerebellar nucleus). Similarly, *nucleus fastigii* (fastigial nucleus) is the preferred name for the *nucleus medialis cerebelli* (the medial cerebellar nucleus).

CONCLUSIONS

The new version of anatomical terminology includes both modern and traditional terms, which shows that the anatomical language is alive and changing. Some of these changes hark back to the older and traditional names that are still used by many clinicians. Other parts of terminology have been reorganised and extended (or simplified) to meet the present needs. In general, clinically and didactically useful terms have been endorsed by the FIPAT, and there is a clear trend towards greater precision and coherence, which is important in clinical practice.

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Table 1. Comparison of selected terms from the previous version of Terminologia Anatomica [2] and the most recent version [3], showing the most characteristic features of new terminology such as greater precision and the use of modern and traditional terms.

Previous terminology	New terminology
General terms	
<i>Cingulum membri inferioris</i>	<i>Cingulum pelvicum; Cingulum membri inferioris</i>
<i>Cingulum membri superioris</i>	<i>Cingulum pectorale; Cingulum membri superioris</i>
<i>Collum; Cervix</i>	<i>Cervix; Collum</i>
<i>Extensor</i>	<i>Extensorius</i>
<i>Flexor</i>	<i>Flexorius</i>
<i>Os (for mouth)</i>	<i>Ostium orale</i>
<i>Peripherals</i>	<i>Periphericus</i>
Skeletal system	
<i>Cavitas glenoidalis</i>	<i>Fossa glenoidalis; Cavitas glenoidalis¹</i>
<i>Facies articularis calcanea...</i>	<i>Facies articularis calcanearis...</i>
<i>Femur; Os femoris</i>	<i>Os femoris; Femur</i>
<i>Fibula</i>	<i>Fibula; Os fibulare</i>
<i>Foramen mandibulae</i>	<i>Foramen inferioris alveolare; Foramen mandibulae</i>
<i>Incisura scapulae</i>	<i>Incisura scapulae superior</i>
–	<i>Incisura scapulae inferior; Incisura spinoglenoidalis</i>
<i>Linea intermedia</i>	<i>Zona intermedia</i>
–	<i>Sulcus popliteus</i>
<i>Talus</i>	<i>Os tali; Talus</i>
<i>Tuberculum dorsale</i>	<i>Tuberculum dorsale radii</i>
Hip bone	Coxal bone
Muscular system	
<i>Diaphragma</i>	<i>Diaphragma respiratorium seu thoracoabdominale</i>
–	<i>(Musculus pterygoideus proprius)</i>
<i>Musculus puborectalis</i>	<i>Musculus puboanalis</i>
<i>Platysma</i>	<i>Musculus platysma</i>
<i>Trigonum clavipectorale</i>	<i>Trigonum deltopectorale; Trigonum clavipectorale</i>
Digestive system	
<i>Corpus gastricum</i>	<i>Corpus gastris</i>
–	<i>Flexura lateralis superior (rectum)</i>
–	<i>Flexura lateralis intermedia (rectum)</i>
–	<i>Flexura lateralis inferior (rectum)</i>
<i>Fornix gastricus</i>	<i>Fornix gastris</i>
<i>Fundus gastricus</i>	<i>Fundus gastris</i>
<i>Musculus sphincter pyloricus</i>	<i>Musculus sphincter pylori</i>
<i>Sulcus venae cavae (hepar)</i>	<i>Sulcus venae cavae inferioris (hepar)</i>
Urinary system	
<i>Hilum renale</i>	<i>Hilum renis</i>

Cardiovascular system

<i>Arteria dorsalis nasi</i>	<i>Arteria externa nasi</i> ²
<i>Arteria inferior anterior cerebelli</i>	<i>Arteria cerebelli inferior anterior</i> ³
<i>Arteria inferior posterior cerebelli</i>	<i>Arteria cerebelli inferior posterior</i>
<i>Arteria superior cerebelli</i>	<i>Arteria cerebelli superior</i>
<i>Cuspis anterior</i>	<i>Foliolum anterosuperius</i>
<i>Cuspis posterior</i>	<i>Foliolum inferius</i>
<i>Cuspis septalis</i>	<i>Foliolum septale</i>
<i>Rami corticales inferiores</i>	<i>Pars corticalis inferior</i>
–	<i>Rami striati breves</i>
–	<i>Ramus duralis</i> (from the PCA)
–	<i>Ramus meningeus</i> (from the PCA)
<i>Ramus interventricularis posterior</i>	<i>Ramus interventricularis inferior</i>
<i>Ramus sinus cavernosi</i>	<i>Ramus sinus cavernosi...</i> (subdivided)
<i>Rete calcaneum</i>	<i>Rete calcaneare</i>
<i>Sulcus interventricularis posterior</i>	<i>Sulcus interventricularis inferior</i>
<i>Vena azygos</i>	<i>Vena azygos; Vena azyga</i> ⁴
<i>Vena hemazygos</i>	<i>Vena hemiazygos; Vena hemiazyga</i>
<i>Vena hemiazygos accessoria</i>	<i>Vena hemiazygos accessoria; V. hemiazyga ccessoria</i>
[Artery of Adamkiewicz]	<i>Arteria radicularis magna</i> (Great radicular artery) ⁵
Inferior labial branch	Inferior labial artery (from the facial artery)
Superior labial branch	Superior labial artery
Lymphoid system	
<i>Hilum splenicum</i>	<i>Hilum splenis</i>
Nervous system	
Arachnoid mater	Arachnoid; Arachnoid mater
<i>Nucleus interpositus anterior</i>	<i>Nucleus emboliformis; N. interpositus anterior</i>
<i>Nucleus interpositus posterior</i>	<i>Nucleus globosus; N. interpositus posterior</i>
<i>Ramus colli (nervus facialis)</i>	<i>Ramus cervicalis</i>
<i>Stria medullaris thalami</i>	<i>Stria medullaris prethalami</i>

¹The term glenoid fossa (*fossa glenoidalis*) is also used in scientific writing.

²This term was added to match the names of corresponding structures, including the vein and nerve.

³This term was added to match the names of other arteries, including *arteria cerebri anterior, media et posterior*.

⁴The new edition of Netter's with Latin terminology uses the terms *vena azyga, hemiazyga et hemiazyga accessoria*.

⁵Traditionally, the artery of Adamkiewicz was called *arteria radicularis anterior*. Currently this eponym is used for *arteria radicularis magna* (great radicular artery).