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Anatomical terminology and nomenclature: past, present and highlights

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Abstract The anatomical terminology is a base for medical communication. It is elaborated into a nomenclature in Latin. Its history goes back to 1895, when the first Latin anatomical nomenclature was published as *Basiliensia Nomina Anatomica*. It was followed by seven revisions (*Jenaiensia Nomina Anatomica 1935*, *Parisiensia Nomina Anatomica 1955*, *Nomina Anatomica 2nd to 6th edition 1960–1989*). The last revision, *Terminologia Anatomica*, (TA) created by the Federative Committee on Anatomical

Terminology and approved by the International Federation of Associations of Anatomists, was published in 1998. Apart from the official Latin anatomical terminology, it includes a list of recommended English equivalents. In this article, major changes and pitfalls of the nomenclature are discussed, as well as the clinical anatomy terms. The last revision (TA) is highly recommended to the attention of not only teachers, students and researchers, but also to clinicians, doctors, translators, editors and publishers to be followed in their activities.

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Introduction

Anatomy can be considered as the first exact medical field; its terminology is a crucial base for it as well as for every scientific discipline. The origins of anatomical terminology date back to the ancient period, more than 2,500 years ago, and were made in the common languages of that time, Greek and later Latin. This principle has endured until now and serves as a base for the anatomical nomenclature. As the medical progress accelerated, the terminological body was extended, what is most obvious in the last 100 years. From the systematic point of view, anatomy (like other scientific fields) uses a special vocabulary, but unlike many others, the anatomical terminology and nomenclature are distinguished very strictly. Terminology is understood as a system of terms used in a given scientific field, whereas nomenclature, covering the terms created within the scope of terminology, is a normalized system of exactly defined terms arranged according to certain classification principles; nomenclature is approved by the scientific field

commission and widely accepted by the professional community. As clinical anatomy is the up-to-date field of meeting between anatomists and clinicians, the same language is strongly required for permitting current exchanges, common works and studies. A brief summary of the past and the present of the anatomical terminology and nomenclature is presented in the following.

The anatomical nomenclature is official in the Latin version only. The last revision of the Latin anatomical nomenclature was created by the Federative Committee on Anatomical Terminology (FCAT) and approved by the International Federation of Associations of Anatomists (IFAA) as the only valid official nomenclature of anatomy in 1997. It was published a year later as the *Terminologia Anatomica (TA)* [6].

The ancient Greek and Latin languages, in which there is almost no progress and the importance of their political power is vanishing, meet the demands of the scientific terms, which have to be explicit, exact, comprehensible and internationally acceptable. They possess many possibilities to create words, which can be used in various language combinations. These advantages are the reasons why Latin, above all, has been the base for the anatomical nomenclature from the nineteenth century onwards.

The official terms of the TA used in this article are written in italics and with quotation marks; the unofficial, old or incorrect terms are in normal font and with quotation marks.

Nomenclature development

Greek and Latin medicine established the foundations of anatomical terminology, which varied with different authors. Most of the anatomical terms are different from colloquial words and have changed since the oldest times. Hippocrates of Kós (ca. 460–370 BC), in Greece, introduced terms such as acromion, bronchus and peritoneum. Aulus Cornelius Celsus (25 BC–50 AD), in Rome, used cartilago, patella or sutura, and Rufus of Efesos (late first century AD) issued a book called *On the Naming of the Parts of the Body*, which is considered to be the earliest treatise on anatomical terminology [20]. Claudius Galenos of Pergamon (129/130–199/200) introduced new terms such as aponeurosis, coccyx, epiphysis, hypophysis, epididymis, pylorus, tarsus and thymus [20, 22]. Jacobus Berengarius Carpensis (Jacopo or Giacomo Berengario da Carpi, Iacopo Barigazzi, Carpi, 1460–1530) compiled anatomical terms in his *Isagogae breves* [2].

The first comprehensive anatomy book, including perfect and marvellous depictions of the human body, was written by Andreas van Wesel (or Andreas Vesalius Bruxellensis, 1514–1564) as *De fabrica corporis humani libri*

septem, published in 1543 in Basel (Switzerland) [24]. He completed it with a qualitative commentary and replaced all the Greek and Arabic terms with Latin ones only, adopting terms used by previous authors. The description was provided with ordinal numbers for muscles, bones, blood vessels and nerves. In osteology alone, he included more than 700 structures. He formed the Latin specialized language, which had never been used before. His knowledge was based on the Latin translations of ancient medical books done by Johannes Winter (Guenther) von Andernach (1505–1574) [11, 20, 27].

One of the true fathers of anatomical terminology was Vesalius' teacher Jacques Dubois, better known as Jacobus Sylvius (1478–1555). He used the terms for bones introduced by Hippocrates and Galenos, but invented new ones for muscles, blood vessels and nerves, i.e. “*pectoralis*” or “*intercostalis*” [23]. He preferred descriptive terms to ordinal ones in contradistinction to Vesalius [22]. The other father of anatomical terminology was Gaspard (Caspar) Bauhin (1560–1624), who insisted on the introduction of descriptive terminology in order to stop the confusion over the ordinal one. He contributed with a new type of descriptive terms for muscles referring to their origins and insertions [1, 22]; the citation stated by Sakai was incorrect in his otherwise perfect and thorough study. In the seventeenth to nineteenth century, the deep specification of anatomical terms brought many new words into its terminology, often synonyms for the same structure [22].

In the following centuries, the number of terms increased rapidly and reached 50,000 at the end of the nineteenth century. Nevertheless, these terms were often synonyms, applied or created by various authors [5, 20]. The history of conceptual nomenclature in natural science was started by Carl von Linné (1707–1778) in his *Systema naturae*, issued in 1735. Friedrich Gustav Jakob Henle (1809–1885) was the first to simplify the anatomical terminology. He introduced the terms for appropriate direction and orientation (medialis × lateralis) instead of the inexact internus × externus, defined the median plane and applied only one name to every structure complete with footnote synonyms. But his effort brought too many new terms and even aggravated the terminological chaos [9]. Jones Quain (1796–1865), Carl Gegenbaur (1826–1903) and Jean-Léo Testut (1849–1925) also tried to make the anatomical terminology consistent. The first attempt to solve this problem was a book by Joseph Hyrtl (1810–1894), called *Onomologia anatomica* and published in 1880 in Vienna [10] (see Figs. 1 and 2).

Finally, the society of German-speaking anatomists (Anatomische Gesellschaft) created the first Latin anatomical nomenclature, which was approved after 12 years of hard work in 1895 at the society meeting in Basel (Switzerland). According to the place of the congress venue, it has been

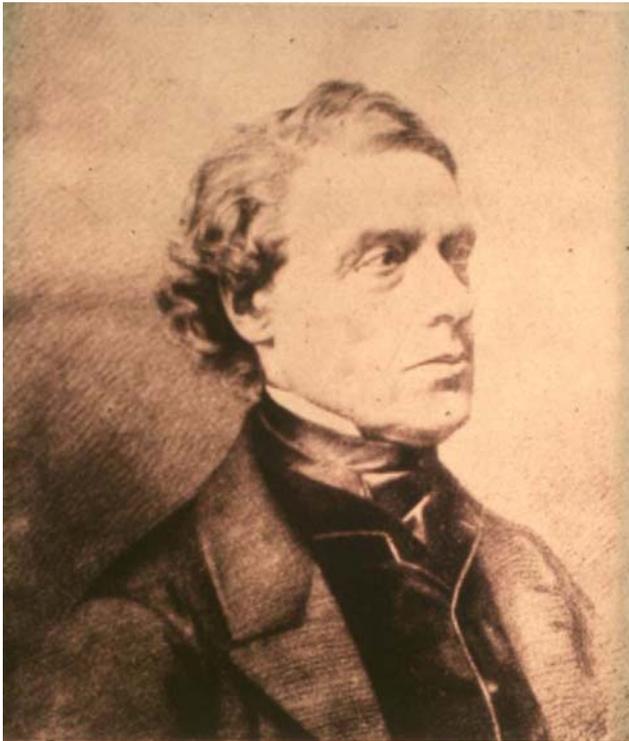


Fig. 1 Joseph Hyrtl

named the *Basiliensia Nomina Anatomica* (BNA, B.N.A.). It was published by the society in the same year in Leipzig (Germany). It was not accepted worldwide though, especially not in France and Great Britain. In 1903, the IFAA was founded and started to work on a revision of the BNA from 1905. But the work continued very slowly, so the Anatomical Society of Great Britain and Ireland published its own modification in 1933 called *Birmingham Revision*. The Anatomische Gesellschaft reacted and 2 years later approved its own revision, called *Jenaiensia Nomina Anatomica* (INA, I.N.A.), which was focused more on veterinary anatomy, the horizontal-position-of-the-body description and performed many language interventions.

The International Anatomical Nomenclature Committee was established by IFAA in 1936 to revise the BR and INA, but due to the World War II it began to operate only as late as 1952. Its main task was to create a Latin anatomical nomenclature, which could be accepted internationally. The IANC returned to the BNA and strictly refused to accept the INA changes. The committee elaborated a proposal of the nomenclature, which was discussed at the sixth congress of IFAA in Paris. Finally, it was accepted and approved as the first official international anatomical terminology and it was named the *Parisiensia Nomina Anatomica* [4, 8, 12, 14, 20]. No eponyms were incorporated in the PNA. The quick progress in medical science compelled the IFAA to revoke the IANC meetings and a new revision was



Fig. 2 Onomatologia anatomica

approved and published in 1961 as the *Nomina Anatomica* (N.A., NA), more exactly, its 2nd edition [15]. Next revisions followed in 1966 (3rd edition of NA) [16] and in 1977 (4th edition), which was combined with the first Latin histological and embryological nomenclatures and called NA, *Nomina Histologica, Nomina Embryologica* [17]. In 1983, the 5th edition of NA appeared [18]. A deep crisis broke in the IANC during the 1980s. The committee published the 6th edition of NA without the approval of IFAA [19]; therefore, this revision was not accepted within the worldwide professional community.

As the situation between the IFAA and the IANC was untenable, the IFAA decided to appoint a new commission. The FCAT (later changed to Federative International Committee on Anatomical Terminology—FICAT) was elected in Rio de Janeiro (Brazil) in 1989 and after 8 years of intensive work it presented its new, extended and revised proposal of the Latin anatomical terminology to the IFAA. It was approved in São Paulo (Brazil) by the IFAA with a recommendation to translate it into national languages. This nomenclature is thus the only official Latin anatomical

terminology and was published as the *TA*, with the subtitle *International Anatomical Terminology (TA)* [6, 21, 26] in 1998 (see Fig. 3). The nomenclature of the lower limbs was extended in 2001 in terms of a consensus document of the International Union of Phlebology, IFAA and FICAT, established in Rome (Italy) due to the needs of the anatomists and phlebologists involved in investigation and treatment of venous diseases [3]. As the last achievement so far, FICAT issued the *Terminologia Histologica*, subtitled *International Terms for Human Cytology and Histology* [7].

Terminologia Anatomica

The book containing the recent revision of the Latin anatomical nomenclature, the *TA*, is composed of several anatomical system chapters. It begins with General Anatomy, followed by Special Anatomy, and is divided into 15 sub-chapters. The terms are arranged in three columns, with Latin terms accompanied by the terms currently used in the English-speaking countries. Alongside each pair of terms

there is a unique identification number. The order in which the terms are set follows naturally the anatomy through each system. Indentation and heading styles are used to indicate relations between the two terms. The table containing the terms is followed by an index of the most common eponyms (with the identification number of the appropriate non-eponymous term) and comprehensive index of Latin. The Latin list of terms is recommended as a basis for creating lists of equivalent terms in the individual national languages. In the Preface, the FCAT invites constructive comments, for future editions' considerations, to be sent via e-mail: <http://www.leser.service@thieme.de> or by mail. There is a version of the book with CD-ROM available [6] (Table 1).

The total amount of the items contained in the *TA* is 7,635, but some of them have one or rarely two synonyms, e.g. “*myelencephalon*; *medulla oblongata*; *bulbus*” or “*valva atrioventricularis sinistra*; *valva bicuspidalis*.” In case of more synonyms, the first one is highly recommended by the FCAT. If we compare the total amount of Latin items in the older nomenclatures, *BNA* (4,311), *INA* (4,329), *PNA* (4,822), *TA* (7,635), it is obvious that there is a trend of extension and petrification of the nomenclature going hand-in-hand with research progress [12].

Although the Latin anatomical nomenclature is stabilized and has been available for more than 113 years, both the anatomical specialists and other medical experts and doctors tend to use obsolete, insufficient and incorrect terms or even misuse them. The most striking examples are summarized in Table 2.

Let us analyze some of them in the following paragraph. The term “*os naviculare*” is very frequently used for two different bones, but they have to be differentiated although their shape is similar. The *TA* singles out the “*os scaphoideum*” as a carpal bone and leaves the term “*os naviculare*” for a bigger tarsal bone. The term “*ventriculus*,” used for stomach, is considered as obsolete and *TA* reduces its synonyms only to “*gaster*.” On the other hand, the terms

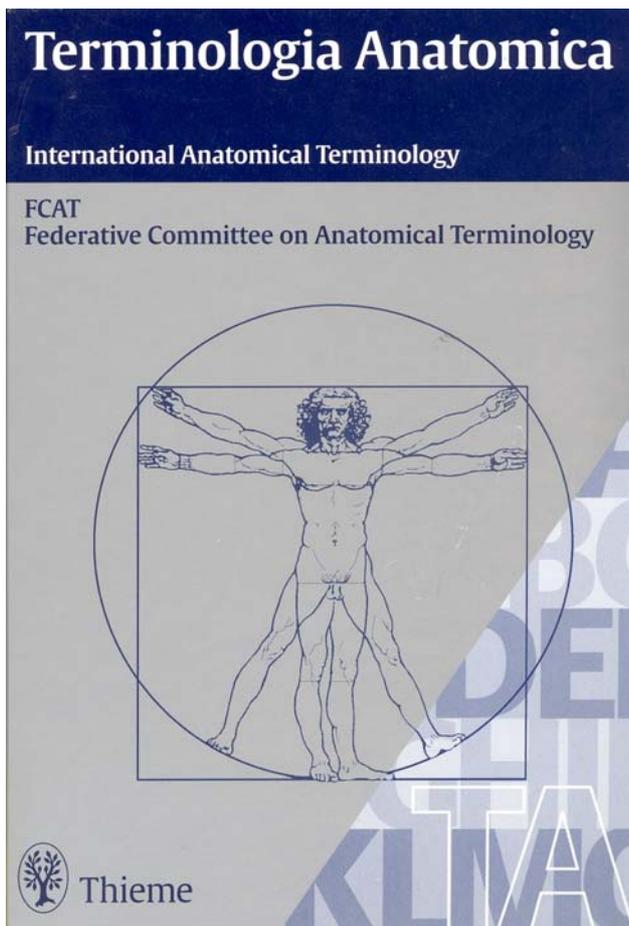


Fig. 3 *Terminologia Anatomica*

Table 1 Part of the *Terminologia Anatomica (TA)*

Identifying number	Latin terms	English terms
A02.5.04.001	Femur; os femoris	Femur; thigh bone
A02.5.04.002	Caput femoris	Head
A02.5.04.003	Fovea capitis femoris	Fovea for ligament
A02.5.04.004	Collum femoris	Neck
A02.5.04.005	Trochanter major	Greater trochanter
A02.5.04.006	Fossa trochanterica	Trochanteric fossa
A02.5.04.007	Trochanter minor	Lesser trochanter
A02.5.04.008	(Trochanter tertius)	(Third trochanter)
A02.5.04.001	Femur; os femoris	Femur; thigh bone
A02.5.04.002	Caput femoris	Head

Table 2 Examples of the incorrect Latin anatomical nomenclature usage

Outdated term	Year of change	Valid term
Arteria femoralis communis	Clinical term	Arteria femoralis
Arteria femoralis profunda	Clinical term	Arteria profunda femoris
Arteria femoralis superficialis	Clinical term	Arteria femoralis
Introitus vaginae	Clinical term	Ostium vaginae
Arteria mesaraica	Since 1895	Arteria mesenterica
Plexus solaris	Since 1895	Plexus coeliacus
Arteria ilica	1935–1955	Arteria iliaca
Arteria mesenterica caudalis	1935–1955	Arteria mesenterica inferior
Arteria mesenterica cranialis	1935–1955	Arteria mesenterica superior
Chorda uteroinguinalis	1935–1955	Ligamentum teres uteri
Chorda uteroovarica	1935–1955	Ligamentum ovarii proprium
Arteria anonyma	Since 1935	Truncus brachiocephalicus
Arteria haemorrhoidalis	Since 1935	Arteria rectalis
Arteria hypogastrica	Since 1935	Arteria iliaca interna
Arteria mammaria interna	Since 1935	Arteria thoracica interna
Arteria maxillaris interna	Since 1935	Arteria maxillaris
Arteria maxillaris externa	Since 1935	Arteria facialis
Arteria spermatica (interna)	Since 1935	Arteria testicularis
Arteria spermatica externa	Since 1935	Arteria cremasterica
Gyrus fusiformis	Since 1935	Gyrus occipitotemporalis lateralis
Vena anonyma	Since 1935	Vena brachiocephalica
Ansa nervi hypoglossi	Since 1955	Ansa cervicalis
Glandula thyreoidea	Since 1955	Glandula thyroidea
Canalis pterygopalatinus	Since 1955	Canalis palatinus major
Gyrus hippocampi	Since 1955	Gyrus parahippocampalis
Ligamentum laciniatum	Since 1955	Retinaculum musculorum flexorum /pedis/
Nervi digitales volares	Since 1955	Nervi digitales palmares
Nucleus amygdalae, amygdala	Since 1955	Corpus amygdaloideum
Os multangulum majus	Since 1955	Os trapezium
Os multangulum minus	Since 1955	Os trapezoideum
Os naviculare (manus)	Since 1955	Os scaphoideum
Praeputium	Since 1955	Preputium
Ligamentum carpi transversum	Since 1955 /1998	Retinaculum (musculorum) flexorum /manus/
Ganglion semilunare	Since 1960	Ganglion trigeminale
Hilus	Since 1977	Hilum
Articulatio mediocarpea	Since 1998	Articulatio mediocarpalis
Centrum tendineum perinei	Since 1998	Corpus perineale
Nervi erigentes	Since 1998	Nervi splanchnici pelvici
Nervus statoacusticus	Since 1998	Nervus vestibulocochlearis
Processus costarius	Since 1998	Processus costalis
Tonsilla pharyngea	Since 1998	Tonsilla pharyngealis
Ventriculus	Since 1998	Gaster

“*fibularis*,” and “*peroneus*” are now rated as synonyms. *BNA* only mentioned “*peronaeus*”, on the contrary, *INA* recognized “*fibularis*”, and *PNA* permitted both as “*peroneus sive fibularis*.” *TA* itemizes both but prefers the term “*fibularis*” for muscles, nerves and vessels. Only the calf bone is termed “*fibula*”, the Greek term “*perone*” is

omitted. The term “*vesicula seminalis*” is still valid, but *TA* prefers “*glandula vesiculosa; glandula seminalis*.” As for the spleen, *TA* has introduced and prefers the term “*splen*,” although “*lien*” is still valid; this involves derived adjectives too: “*splenicus*” is preferred to “*lienalis*.” The same change occurred with the terms “*omentalis*”, which is

preferred to “*epiploicus*”; but the noun “epiploon” is not used anymore, and the only valid term for the peritoneal duplicatures is now “*omentum*”. Concerning the limb retinacula, the term “*ligamentum transversum carpi*” was replaced with “*retinaculum flexorum*” (in *INA* in 1935) and then with “*retinaculum musculorum flexorum*” (in *PNA* in 1955). Especially, the gynecological anatomy tends to use obsolete terms, such as “*arteria hypogastrica*”, replaced (since 1935 in *INA*) by the term “*arteria iliaca interna*”, and “*chorda uteroinguinalis*” and “*chorda uteroovarica*” (introduced by *INA* in 1935) substituted (in 1955 in *PNA*) with the original terms “*ligamentum teres uteri*” and “*ligamentum ovarii proprium*”. The frequently used term “*spermaticus*” is reserved for two structures only, the “*funiculus spermaticus*” and “*fascia spermatica interna et externa*”, but the supplying vessels and nerves are called “*testicularis*” and “*cremastericus*.”

There are many new terms in the *TA*, e.g. 1,082 ones in the chapter Nervous System, concerning the recently discovered nuclei and their subnuclei and divisions, tracts and fibers. Some of them bear names derived from the structures already described in older editions of the nomenclature as “*nuclei raphes*” in the reticular formation of the brainstem, other terms receive a brand new name, e.g. “*sagulum*” (short Roman coat) for a cell area in the lateral part of the tegmentum pontis. There are new terms in other chapters of *TA*, too. To distinguish between the juncture connecting the vertebral body of two adjacent vertebrae and the juncture connecting the articular processes of two adjacent vertebrae, a new term has been introduced. It is derived from “*zygapophysis*”, a synonym of “*processus articularis vertebrae*”, enabling thus to discern the “*articulationes zygapophysiales*” between articular processes and “*symphysis intervertebralis*” between the vertebral bodies.

An important part of nomenclature development represents orthographic and grammar changes in Latin and originally Greek words. The diphthong -ae- has remained in several terms, i.e., “*caecum*”, “*taenia coli*”, “*locus caeruleus*” (which was incorrectly stated as “*locus coeruleus*” in *PNA*) and “*haema*” (a Latinized term from the former Greek “*haima*”), which was introduced and preferred to “*sanguis*” by the 2nd edition of *NA* in 1966 [13]. In other terms, the diphthong -ae- has been successively simplified to the sound -e- due to the difficulties of English-speaking people in pronouncing it. For example, the term “*glutaeus*” was replaced with “*gluteus*”. The same process implicated the prefix prae-, i.e., instead of “*bursa subcutanea praepatellaris*” the term “*bursa subcutanea prepatellaris*” is preferred since 1955. A similar process is traceable in the position of three vowels in direct contact, such as in the term “*thyroideus*” and “*chorioideus*”, which were superseded by “*thyroideus*” and “*choroideus*”, respectively. Only the term “*hyoideus*” has survived, probably because

of the shortness of the first vowel [13]. Such changes do not concern only vowels, but also a number of doubled consonants, being thus a source of many mistakes. In *TA*, the terms “*mamma*” and “*mamilla*” and derived adjectives are stated with -ll-. On the contrary, the terms “*anulus*” and “*anularis*” contain -n- due to their origin in the Latin expression for a circle (anus), and not in the expression for a year (annus). As for the grammar, many mistakes occur in journal articles, e.g. “*vasa vasora*” instead of “*vasa vasorum*”, in which the plural genitive is not used properly, or “*vasa cerebralis*” instead of “*vasa cerebralia*”, in which the adjective is in singular and not in plural.

The process of the anatomical nomenclature development follows the results of both the basic and clinical research. But the incorporation of the clinical anatomy terms into the nomenclature is very slow, and even the latest revision, *TA*, does not reflect the needs of clinical anatomists and surgeons. A good example of the cooperation of the FCAT and clinical anatomy can be the term “*tractus iliopubicus*” or “*Thomson’s ligament*”, introduced in 1998 due to necessity for a correct anatomical description in the inguinal region and hernia surgery. Likewise, the term “*trigonum cystohepaticum*” or “*Calot’s triangle*”, indispensable to gallbladder surgery, was embodied in the *TA* in 1998. Clinical research can contribute to the changes of the terms, too, such as in the case of Bauhin’ valve. The former term “*valva ileocaecalis*” was replaced in accordance with studies revealing the real purpose of the ileocaecal transition to be a functional sphincter, and the term was changed to “*ostium ileale caeci*”. But the terms for many other important structures, which usage is fundamental for clinicians, still remain unnoticed by the *TA*, e.g., “*arteria femoralis communis*”, “*arteria femoralis superficialis*”, “*arteria femoralis profunda*”, “*tuberculum vastoadductorium (trochanteris majoris femoris)*”, “*fissura scalenorum*”, “*fossa obturatoria*”, etc. Some expressions, especially in the gynecological and urological anatomy, have not ever been included in any Latin anatomical nomenclature, but they have valid synonyms in *TA*, such as “*introitus vaginae*”, with the official term “*ostium vaginae*”, or “*verumontanum*”, with the official term “*colliculus seminalis*”.

The list of eponyms, names of persons, whether real or fictitious, who have or are thought to have given rise to the name of a particular structure in the human body, forms another part of the terminology. Although using eponyms saves space and time due to shortening of the terms, they have not been incorporated in the official Latin anatomical nomenclature since 1955 and are not regarded as an equal part of it [6]. Only three eponyms have surpassed this decision and have entered the nomenclature and changed into proper terms: Purkyně or Purkinje for “*stratum purkinjense*” (for the middle cellular layer of the cerebellar cortex), Golgi for “*complexus golgiensis; apparatus golgiensis*”

(for a type of cell organelles) and Egyptian god of sun Ammon-Ra for “*cornu ammonis*” (as a synonym for “*hippocampus proprius*”). It is worth mentioning that the generally well-known term “*tendo Achillis*” (Achilles tendon) has not been incorporated in *TA* and remains only as “*tendo calcaneus*.” On the other hand, there is an index of 392 most common anatomical eponyms at the end of *TA* to prevent any misapprehension in communication.

Discussion

The role of the Latin nomenclature as a base for understanding is still irreplaceable not only in anatomy, but in medicine as a whole. The principles of medicine come from Greek and Latin world, and although English is now the main language of communication, most of the anatomical and medical terms stem from Greek and Latin. A number of synonyms in the Latin anatomical nomenclature has been successively reduced, and a unique, uniform and coherent list of terms has been created and adopted. Unfortunately, this consensus does not exist in English now, but it seems to be a great and important task for the future, for both anatomists and clinicians. As a proof of the fact that the nomenclature in anatomy, and its development, brings very complex and difficult topics, interfering with peculiarities in various languages, is the terminology of fascias analyzed in particular by Wendell-Smith [25]. It is to be emphasized that the Latin anatomical nomenclature is regularly updated and new planned revisions will reflect the needs of clinicians [3] and maintain the role of clinical anatomy. These two facts can serve as a criterion of quality and functionality of the Latin anatomical nomenclature.

Illation

Anatomical terminology serves as a base for the description of the human body, not only for educational and forensic purposes, but above all for diagnostic and therapeutic procedures. That is why the terminology, and especially the nomenclature, rightfully has to come through a development, following accelerating scientific research and progress of diagnostic techniques and therapeutic methods. Each revision of the anatomical nomenclature needs to be introduced among both students and doctors to prevent misunderstandings and mistakes in medical clinical documentation and scientific publications. The authors highly recommend following the last revision of the Latin anatomical terminology (*TA*) in any educational, scientific, translating, editing, revising and publishing activities.

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