Historical note

Arq Neuropsiquiatr 2011;69(5):836-837

The pyramidal syndrome and the pyramidal tract

A brief historical note

Fernando Rezende-Cunha[1], Ricardo de Oliveira-Souza[2,3]

ABSTRACT

The discovery of the pyramidal syndrome and tract is briefly reviewed with emphasis on a few key historical aspects. The pursuit of the relationship between the lateralized deficits resulting from contralateral head trauma begins in the fourth century BC with the Hippocratic School and continues until the present day.

Key words: history of neurology, pyramidal tract, pyramidal syndrome, pyramidal decussation.

A síndrome piramidal e o feixe piramidal: breve nota histórica

RESUMO

Os autores fazem uma breve nota histórica da síndrome piramidal e do feixe piramidal no homem. Os achados de deficiências motoras decorrentes de traumatismo craniano começam a partir do século IV AC com o pai da medicina Hipócrates (460-377) e vão até os dias atuais.

Palavras-Chave: história da neurologia, feixe piramidal, síndrome piramidal, decussação das pirâmides.

One side of the brain controls the opposite side of the body

References to motor paralysis and seizures resulting from a contralateral head injury consistently first appeared in the Western medical record in the fourth century before the Christian Era (BCE) in the writings of Hippocrates (460-377 BCE) and his followers[1,2]. Aretaeus, a Greek physician born in Cappadocia who practiced in Rome and Alexandria in the second century BCE, went a step further and distinguished paralysis due to a head injury from paralysis due to spinal injuries, an observation that led him to postulate that some kind of crossing must take place above the craniovertebral junction. However, where exactly the crossing occurred remained a mystery for centuries[3].

One critical step towards the unraveling of the exact site at which the crossing took place was given when the locus of damage was consistently transferred from "the head" to the brain, which occurred in the eighteenth century only[4]. Valsalva and Morgagni, around 1707, were the first to apply the concept of the crossed association between brain injury (not just head trauma!) and contralateral neurologic symptoms (weakness, seizures, and loss of vision). In 1709, Domenico Mistichelli (1675-1715), professor of medicine at the University of Pisa, first mentioned and illustrated the pyramidal decussation. In chapter VIII of his "Trattato Dell'Apoplessia", Mistichelli explained how an injury of one side of the head resulted in paralysis of the opposite side of body. He speculated that the phenomenon of crossed hemiplegia was explained by the crossing of the "nerves" in the bulbar pyramids. Soon thereafter, François Pourfour du Petit (1664-1741), a French military surgeon serving in Flanders, observed sol-

Correspondence
Fernando Rezende Cunha
Praia do Flamengo 224 / apto 402
22210-030 Rio de Janeiro RJ - Brasil
E-mail: ferneura@ig.com.br

Received 15 September 2010
Received in final form 21 April 2011
Accepted 28 April 2011

[1]Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro RJ, Brazil; [2]Instituto D'Or de Pesquisa & Ensino, Rio de Janeiro, Rio de Janeiro RJ, Brazil; [3]Hospital Universitário Gaffrée e Guinle, Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro RJ, Brazil.

diers with paralysis of the side of the body contralateral to that of an injury to the head. Petit published his observations as a small pamphlet entitled "Lettres d'un Médecin", one of the rarest texts of medicine. William Osler (1849-1919) read the "Lettres" of Petit and commented on it with Thomas, professor of neurology at Johns Hopkins, in the beginning of the twentieth century[5].

It may seem odd that the pyramidal crossing and its clinico-anatomical significance were still debated by the second half of the nineteenth century by such eminent scholars as Franz Joseph Gall (1758-1828), John Cheyne (1777-1836) and Vicq d'Azyr (1748-1794). Charles Bell (1774-1842), for example, made no reference to the pyramidal crossing in his "Idea of a New Anatomy of the Brain" published in 1811. However, in 1853, Moritz Heinrich Romberg (1795-1873), in a lecture on cerebral localizations, stated, "The most established fact and rarely threatened by a single exception, is the law of crossing conduction". Speaking to the Royal Society of London in 1834, Bell downplayed the work of those who preceded him and demanded priority for the discovery.

Despite the thoroughly documented evidence, Craigie denied the decussation of the pyramids in the 1851 edition of his "Elements of General and Pathological Anatomy", stating that the only unambiguously demonstrated crossing hitherto was the decussation of the restiform processes[5]. The definitive word about decussation of the pyramids as an established anatomical fact and substrate of the Law of Crossed Conduction had to wait the development of techniques for tracing the secondary degenerations in the central nervous system, which reached its full development in the second half of the nineteenth century.

The controversy comes to an end... or does it?

In 1850, Waller described the non-inflammatory degeneration of the distal segment ("anterograde degeneration") to the section of a peripheral nerve fiber separated from its trophic center (i.e., the neuronal body). The myelin sheath also degenerated into an interrupted chain of lipid stained fragments by the technique of Marchi[6]. Realizing the importance of this phenomenon, Waller extended its applications to the tracing of the myelinated tracts in the central nervous system of patients who had suffered brain damage and survived long enough for the degeneration to take place.

Türck and Charcot were the first to chart the descending course of the pyramidal tracts with the new techniques. Ludwig Türck (1810-1868), an Austrian laryngologist, described the degeneration of the pyramidal tract on a patient with contralateral hemiplegia due to a deep cerebral hemorrhage[7]. A few years later, Jean-Martin Charcot (1825-1893) published the case of a "hysterical contracture of the four members" with degeneration of the lateral funiculus of the spinal cord[8]. Maybe this represents one of the first clinico-anatomical cases of amyotrophic lateral sclerosis[9]. The observation of secondary degeneration in cases of hemiplegia formalized the definition of pyramidal tract as "the ensemble of nerve fibers that cross at the bulbar pyramids"[10].

The exponential growth of data on the internal structure of the central nervous system in the short period that spans the last decades of the nineteenth century is shown by the work of Dejerine, which definitely settled any possible remaining quibble on the association of hemiplegia with an injury of the pyramidal tract.

The beginning of the twentieth century was marked by an extravagant documentation of diagnostic signs of hemiplegia, as well as of the cortical origin and spinal destination of the pyramidal tract fibers. However, the development of experimental neurophysiology and its influence on clinical interpretations allied with the lack of diagnostic tools allowing the *in vivo* rendering of the human central nervous system have led to a reductionist view in which distances between humans and other primates, and even among humans and quadrupeds, were hardly taken into account. The epitome of this period was the growing influence of the "extrapyramidal system" on neurological thought, an intricate concept which will be dealt with in a forthcoming article.

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