

Babinski's Clinical Differentiation of Organic Paralysis From Hysterical Paralysis

Effect on US Neurology

Michael S. Okun, MD; Peter J. Koehler, MD, PhD

Background: The formalized neurological examination developed near the end of the 19th century, and clinicians searched for signs to differentiate weakness due to structural lesions of the central nervous system (organic paralysis) from weakness caused by hysteria. Joseph F. F. Babinski worked in the shadow of his mentor, Jean M. Charcot, until 1893, but then developed independent studies to examine patients with both types of weakness.

Objectives: To elucidate the role of Babinski in differentiating organic paralysis from hysterical paralysis and to describe his influence on 2 US neurologists, Charles Gilbert Chaddock and Charles Franklin Hoover.

Design: Primary and secondary sources were studied to outline the discoveries of Babinski and to determine his influence on US neurology.

Results: Babinski described toe extension in cases of organic paralysis and specifically stated that this sign did not occur in cases of hysterical paralysis. Chaddock and Hoover were influenced by the work of Babinski and disseminated his discoveries to US neurologists, each developing additional techniques to differentiate the 2 forms of paralysis. Each considered his technique superior to the Babinski toe sign.

Conclusions: Although Babinski was only modestly appreciated by his contemporary peers of French neurology, his influence on US neurology was substantial. The Babinski, Chaddock, and Hoover signs that demonstrate whether structurally related upper motor neuron weakness exists continue to be useful maneuvers in separating these forms of paralysis from psychogenic weakness.

Arch Neurol. 2004;61:778-783

From the Departments of Neurology, Neurosurgery, and History, University of Florida McKnight Brain Institute, Gainesville (Dr Okun); and the Department of Neurology, Atrium Medical Center, Heerlen, the Netherlands (Dr Koehler).

NEAR THE END OF THE 19TH century, physicians focused increasingly on the neurological examination to help differentiate various forms of weakness. A particular emphasis concerned clinical signs that could separate hysterical paralysis from weakness due to structural lesions of the central nervous system, generally termed organic paralysis, the term to be used in this article. In England, heated discussions took place^{1,2} and many pages were written on what Erichsen³⁻⁵ described as "railway spine." In France, Jean M. Charcot and his colleagues gradually discovered that male hysteria was a real clinical entity and that there was an important relationship between traumatic experiences and hysteria. Charcot could not find organic lesions in these patients and, therefore, postulated the existence of a functional disorder.^{6,7} Gradually, physicians became aware that it was necessary to find

symptoms and signs to differentiate between hysterical and organic paralysis. Charcot's pupil, Joseph F. F. Babinski, who worked at the Salpêtrière, Paris, France, when the study of hysteria was at its summit, was one of the many physicians who attempted to identify clinical signs for these disorders. He moved to the Pitié Hospital, Paris, in 1890, where his endeavors culminated in the finding of perhaps the most important sign (the extensor plantar sign, or the Babinski sign).⁸ In this article, we describe the search for objective signs to differentiate between hysterical and organic paralysis and detail the work of Babinski in this field. We also address the impact the work had in the United States by examining 2 US physicians, Charles Gilbert Chaddock and Charles Franklin Hoover, who participated in the search for ways to differentiate between hysterical and organic paralysis. Chaddock and Hoover believed that they discovered more reliable signs than the Babinski sign.⁹⁻¹³

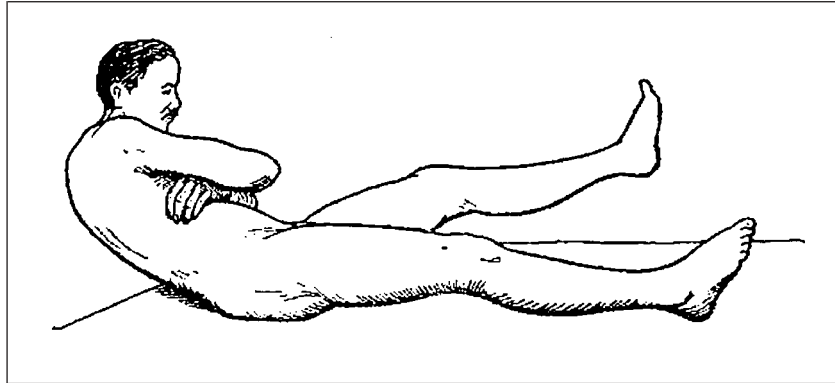
BABINSKI DIFFERENTIATES ORGANIC FROM HYSTERICAL PARALYSIS

Charcot described in his writings and often displayed at his lessons at the Salpêtrière many ways to discern organic from hysterical paralysis. The third volume of his book,¹⁴ which was translated by Sigmund Freud in 1886 (occurring a year previous to the French edition), contains several lessons on the subject. In fact, when Freud stayed at the Salpêtrière in the winter of 1885 to 1886, Charcot commissioned him to study the difference between the entities. This study resulted in an article,¹⁵ published in 1893, that included excellent lessons, teaching the distinction between organic and hysterical paralysis.¹⁶

Babinski, best known for the 1896 “Babinski sign” of extensor toes with plantar stimulation,⁸ played an important role in separating organic from hysterical illness. His toe phenomenon was among several signs he discovered to differentiate organic from hysterical affections. The first of his signs described the difference between an organic and a hysterical contracture of the hand.¹⁷ This description was followed by others, including the Babinski trunk-thigh test,¹⁸ hypotonia,^{19,20} and floppiness of the arm in patients with organic paralysis.²¹ One of the major implications of his toe phenomenon was that he believed that its presence absolutely excluded hysteria.

HEMIPLEGIA: THE BABINSKI TRUNK-THIGH TEST

Always searching for better signs to diagnose patients at the bedside, Babinski is credited with the 1897 trunk-thigh test (**Figure**).^{18,22} He observed that when a recumbent patient with leg weakness was asked to sit up with his or her arms across the chest, an important sequence of movements occurred with regard to the legs. He noted that there was involuntary flexion of the paretic limb in patients with organic hemiplegia (because of the lack of extensor action of the thigh, ie, the gluteus maximus) and that both legs would flex in the presence of organic



The trunk-thigh test, credited to Joseph F. F. Babinski.

Table 1. The Babinski Differentiation of Organic Hemiplegia From Hysterical Hemiplegia

Organic Hemiplegia	Hysterical Hemiplegia
Paralysis is unilateral	Paralysis is not always unilateral or limited; may be bilateral in the face
Not systematic; bilateral movement does not affect facial weakness; voluntary (if unilateral)	Sometimes systematic; face normal with bilateral movement
Platysma sign present (when opens mouth or bends head); combined flexion of the thigh and trunk; absence of arm swing with gait	Unconscious or subconscious voluntary movements unaffected (absence signs listed on the left)
Tongue slightly deviated to the side of paralysis	Tongue only sometimes slightly deviated; deviation may be pronounced; deviation may be to the opposite side
Muscular hypotonia: lack of a nasolabial fold; lowering of the eyebrow; exaggerated passive flexion of the forearm; pronation of the hand	Lack of hypotonia: facial spasm (vs weakness); no exaggerated flexion of the forearm; no pronation
At onset, deep tendon reflexes decreased; later, deep tendon reflexes increased; may be clonus present	No reflex changes
Cutaneous reflexes affected: abdominal/cremasteric reflex lost; extensor toes (Babinski sign) may be accompanied by fanning of other toes	All cutaneous reflexes intact
The form of the contracture may not be reproduced voluntarily; claw hand; increase in passive extension	The form of the contracture may be reproduced voluntarily
Regular disease course: disappearance of the motor disturbance is progressive over time when it occurs; otherwise, there is permanence without fluctuation	Capricious disease course: variability of motor troubles; transitory remissions

paraplegia. In essence, Babinski noted that the action of the leg was to flex in patients with organic hemiplegia, which was opposite of what occurred in a normal circumstance in which extension of the leg allowed flexion of the trunk. Babinski also noted that only the healthy leg would flex in hysterical hemiparesis and that often neither leg was flexed (these observations held for the chronic, but not acute, disease state). He also made the important observation that retention of some

movement was indicative of organic disease.^{19,21,22}

Babinski ultimately disagreed with Charcot with respect to the pathophysiological features of hysteria, and even chose a new name for this entity in 1900 (from Greek): *pithiatism* (persuasion and curable).^{19,22} This new term, although more thoughtful than the previous words used to describe hysteria, never gained acceptance in the medical community. Babinski and Froment²² reviewed the important

Table 2. Some Other Signs of Organic Hemiplegia Described Near the Turn of the Century

Neurological Examination Sign	Description
Raimiste sign (1909)	During the period of flaccidity, the elbow is placed vertically on the table; the hand rapidly flexes and pronates
Souques interosseal phenomenon (1907)	When the patient raises the affected arm, there is extension and abduction of the fingers
Klippel-Weil sign (1909)	Involuntary flexion of the thumb with passive straightening of the flexed fingers
Strümpell tibialis anticus phenomenon	Voluntary flexion of the limb causes dorsiflexion and adduction of the foot
Raimiste-associated adduction and abduction (1909)	When the patient lies on his or her back and makes an effort to adduct and abduct the good leg vs resistance, there is associated adduction and abduction of the affected leg
Marie-Foix associated movements (1916)	General synkinesis: contraction of all the muscles on the affected side with effort Imitation synkinesis: involuntary movements on the affected side reproduce voluntary movements on the unaffected side Coordination synkinesis: voluntary contraction of certain muscle groups in the paralyzed limb give rise to involuntary contractions of functionally synergistic muscles
Neri sign (1907)	Flexion of the knee accompanies flexion of the trunk on the paralyzed side
Dorsal reflex of Mendel-Bekhterev (1904)	Percussion of the lateral dorsal cuboid produces flexion of the toes
Reflex hyperkinesia of Claude (1910)	Painful stimulation by pricking, pinching, or pressure of the muscles sometimes causes reflex movements in the paralyzed upper limb
Raichline, Marie, and Meige adduction reflex of the foot	Stimulation of the skin of the inner border of the foot causes adduction

distinctions between organic and hysterical hemiplegia (**Table 1**). Babinski noted the differences in the examination results of the 2 disorders, including the extent of paralysis and whether unconscious or subconscious voluntary movements were affected, and also included observations on tone and reflexes. Babinski differed from Chavigny²³ and others who believed that there were special characteristics or stigmata of hysterical disease, including fixed contractures, reflex changes, and special forms of anesthesia. Babinski noted important differences in the examination results of the hysterical patient and the hemiplegic patient. In the patient with hysterical paralysis, he believed there was a lack of change in the deep tendon reflexes, no extensor toe, no exaggeration of reflexes of defense (pinching the dorsum or other regions of the foot), no amyotrophy, and no sphincter troubles; he believed there were trophic changes, including bedsores. Babinski and

Froment^{22(p192)} unequivocally stated that “hysteria had no appreciable action on the tendon reflexes, having no more power to exaggerate them than it has to weaken or abolish them.” Babinski also reviewed the important signs, described mainly in the first decade of the 20th century (**Table 2**), that if present were evidence of organic hemiplegia.

THE CHADDOCK SIGN

At least 2 US physicians, Chaddock and Hoover, joined the search for signs differentiating organic from hysterical disease and were influenced by Babinski. Chaddock (1861-1936) was born in Jonesville, Mich.²⁴ After the completion of his studies in 1885 at the University of Michigan (Ann Arbor), he worked at the Northern Michigan Asylum in Traverse City. In 1892, he became professor of nervous and mental diseases at the Marion-Sims College, which later merged with Beaumont Medical College into the Medical Department of St Louis Uni-

versity, St Louis, Mo. He often visited Europe, in particular, Paris, France, where he worked under Babinski from 1897 to 1899. He translated some of the work of Babinski into English. Chaddock was influenced greatly by Babinski. Although his first publications predominantly dealt with psychiatric subjects, his articles from 1895 to 1905 reflect the transition to more neurologically orientated work. From 1898 onward, Chaddock wrote almost exclusively on neurological subjects, in particular, on the topical subject: the differential diagnosis between organic and functional nervous diseases. His instructor, Babinski, persevered vigorously in a search for reliable neurological signs for this purpose. Realizing its importance, Chaddock introduced Babinski's *Phénomène des Orteils* in the United States in 1899, the same year that James Stansfield Collier (1870-1919), associated with the National Hospital in London, England, published an article on this subject in *Brain*. After 1914, Chaddock became less active clinically, probably because of increasing deafness. Chaddock, being heavily influenced by Babinski, wrote 3 articles¹¹⁻¹³ on the external malleolar sign in 1911. He presented the first lecture on this topic to the St Louis Neurological Society on May 20, 1911. In a preliminary publication,^{11(p742)} he wrote: “a sign . . . I have found in extension of one or more, or all, of the toes, with or without fanning of them, when the external inframalleolar skin area is irritated, in cases of organic disease of the spinocortical reflex paths. I shall call it the external malleolar sign.”

At that time, Chaddock had observed the sign in 245 patients. Beginning in 1900, he had searched for the earliest signs indicating a lesion of the corticospinal tract and the explanation for the Babinski extension reflex. Chaddock¹¹ believed his own reflex had advantages over the plantar reflex, because dorsiflexion of the foot, as a withdrawal reaction to painful stimuli, occurred less often by using his technique. Many neurologists have subsequently confirmed this experience.

At first, Chaddock¹¹ still considered his reflex a variant of the Babinski reflex. Following extensive examination of many patients, in whom he examined the occurrence of both

types of reflexes, he made important observations. He observed that these reflexes could not always be elicited simultaneously. Thus, he found that his reflex was often—he posed as a rule—observed bilaterally in combination with a unilateral Babinski response. He explained this phenomenon by the occurrence of lesions of the crossed and the ipsilateral motor nerves. He also studied the temporal relationship with respect to the appearance and disappearance of his reflex compared with the Babinski reflex.¹¹

A similar argument led him to study the upper limbs as well: scratching the skin at the ulnar side over the tendons of the long palmar and radial carpal flexor muscles caused a short-lasting contraction of the hypothenar muscles. In cases of upper motor neuron disease, he observed that with active flexion at the wrist there was some spreading and extension of the fingers and opposition of the thenar and hypothenar muscles. Subsequently, Chaddock studied the combined occurrence of his reflex, which he called the wrist sign, and the Babinski reflex. He studied these reflexes over and over, searching for patterns that may make them more useful. He believed certain combinations, unilateral or bilateral, had a localizing significance; however, no important findings came from this work. He sent the articles to Babinski for comments, and received an answer from Babinski's brother, Henri, whom he got to know during his many stays in Paris. In a postscript to one of the letters, Henri replied:

Mon frère me charge de vous faire savoir qu'il a vérifié vos observations sur les réflexes. Il trouve votre travail très intéressant et sera enchanté d'en causer avec vous quand vous viendrez à Paris [My brother asked me to let you know that he confirmed your observations on the reflexes. He believes your work is very interesting and will be delighted to discuss it with you when you come to Paris].^{11(p742)}

Following a career as a mining engineer, Henri had applied himself to the art of cooking and had published a cookbook using the pen name Ali Bab.²⁵ In this letter, he asked Chaddock to promote his book in the United States. Considering the relationship with Babin-

ski and his brother, we find it remarkable that Babinski did not mention the Chaddock reflex in his later work.

Japanese physician Kisaku Yoshimura (1879-1945), who had studied in Tokyo, Japan, and in Germany before becoming director of the Hiroshima Prefectural Hospital, Hiroshima, Japan, had described exactly the same reflex as Chaddock in 1906.²⁶⁻²⁸ The 56-page article was published in Japanese. He, too, had observed this reflex to be more reliable than the plantar reflex. Yoshimura wrote:

The extension of the big toe may be obtained by stimulating the dorsolateral aspect of the foot (from the posterior portion of the skin beneath the external malleolus anteriorly along the external edge of the foot). . . . In examining for Babinski's phenomenon, the stimulation of the dorsum should never be forgotten. Even if the stimulation of the sole provokes the flexion of the big toe, toe extension may be obtained by dorsolateral stimulation.^{29(p1180)}

The Chaddock reflex is still considered a sensitive and reliable examination technique for demonstrating a pyramidal lesion. It is also useful because of the occurrence of the previously mentioned withdrawal reactions seen with the Babinski method.³⁰ In a relatively recent study including 13 patients with 24 pyramidal tract lesions (2 with hemiparesis), Tashiro³¹ observed the Babinski reflex in 19 (79%), the Chaddock reflex in 24 (100%), and the reversed Chaddock reflex (reversing the stimulus direction), a reflex described by himself, in 21 (88%) of the tests.

A description of the Chaddock reflex may be found in most textbooks. Scratching the lateral border of the foot is still valuable, and it remains useful to teach the reflex to every resident and student of medicine. The Chaddock reflex is really the same as the Babinski reflex, with the major difference being the stimulus that is applied to elicit the response.

THE HOOVER SIGN

The second US physician to be discussed is Hoover. Originally trained

for the Methodist ministry, Hoover (1865-1927) became a general internist. Expelled from Ohio's Wesleyan University, Delaware (1882-1885), for refusing to apologize after attending a prohibited play by William Shakespeare, he later graduated from Harvard University, Boston, Mass (1887), and entered medical school, graduating in 1892.³² Hoover made several trips to Europe to further his medical training, including studying in universities in Vienna, Austria, and Strasbourg, France (1890-1892). Bored during medical school, he sought excitement and felt the need to be part of what he believed was more important work in medicine. As a result, he traveled to Vienna and worked under internist Edmund von Neusser (1852-1912). It was during this time that Hoover acquired what would become a lifelong interest in respiratory and cardiac physiology. He returned to Europe after medical school graduation for 2 additional years of study, and worked under Friedrich Kraus (1858-1936) in Vienna and the former pupil of Charcot, Pierre Marie (1853-1940), in Paris from 1905 to 1906.³² Because most work done by this Ohio internist was on the cardiac and respiratory system, it remains unknown whether Marie and Hoover spoke about the Babinski sign or other methods to differentiate hysterical from organic paralysis; however, the later publications by Hoover^{9,10} reflected his appreciation of the importance and shortcomings of this sign. Hoover returned from Europe at the insistence of his father and was first employed as a teacher for physical diagnosis at Cleveland City Hospital, Cleveland, Ohio, later becoming a professor of medicine at Western Reserve, Cleveland, winning many honors and accolades, including election to the presidency of the American Association of Physicians (1928). He was well known for his altruistic practice of medicine, and tended to many patients whom he knew could not pay for his services. His most famous work was ironically not a contribution to internal medicine, but rather one to neurology. It was the description of a sign used to differentiate organic from hysterical hemiplegia.⁹

In his 1908 landmark article, Hoover⁹ described 4 patients with hysterical hemiplegia. Hoover⁹ observed the following:

If a normal person lying on a couch in the dorsal position, be asked to lift the right foot off the couch with the leg extended, the left heel will be observed to dig into the couch as the right leg and thigh are elevated. If you place your hand under the tendo-achillis of the left side and sense the muscular resistance offered by the left leg you will observe that the left heel is pressed onto the couch with the same force which is exhibited in lifting the right leg off the couch.

He also observed that this “will always occur if the healthy person makes a free and uninhibited effort to lift the right leg.”⁹ Hoover also observed that the opposite was true. When asked to press the leg downward, the opposite lower extremity should elevate. This short and elegant article⁹ was the birth of the modern-day Hoover and reverse Hoover signs. The Hoover sign was present when the alleged paralyzed leg would dig into the couch when lifting the healthy leg. Hoover believed strongly that his sign was superior to the Babinski sign for differentiating organic from hysterical hemiplegia. He noted that the Babinski sign “depends on the affected side for its exhibition.”⁹ He believed that the unsatisfactory nature of the Babinski sign was made up for by his own observations, which were dependent on the function of the healthy side, and gave the Hoover sign a broad application.⁹

Hoover¹⁰ showed his familiarity with the work of Babinski and his interest in the differentiation of hysterical and organic paralysis in an article that he read before the Academy of Medicine of Cleveland on March 19, 1909. “If paresis of one lower extremity is due to an interruption of the crossed pyramidal path, we expect with confidence to find the knee jerk exaggerated and the dorsal flexion of the great toe to follow irritation of the plantar surface in the method described by Babinski.”^{10(p317)}

Hoover^{10(p317)} also commented about the importance of signs to differentiate between organic and non-organic paralysis:

But suppose the patient has met with an accident and promptly thereafter has hemiplegia or paresis of a leg and the pa-

tellar reflex is not exaggerated and Babinski’s plantar phenomenon is absent, the knee reflex is little modified or unchanged, and there is no tenderness of accessible nerve trunks and of course within a short time, no trophic signs will be apparent in the skin muscles. How are we to determine whether our patient has a functional or genuine paresis?

Hoover^{10(p318)} further commented that:

Any physician who has experience on the witness stand realizes how unsatisfactory his differential diagnosis seems to the minds of inquiring lawyers and juries who are looking for direct and decisive information and wish to be relieved of the burden of sifting medical evidence in addition to treating evidence of facts. All the methods thus far employed have depended on the affected part for their exhibition.

The brilliance of the Hoover sign was that it represented the only examination maneuver available to differentiate hysterical from organic hemiplegia without relying on the affected limb. The Hoover method was validated by Jean Lhermitte shortly after its introduction.¹⁰

Hoover was referred to by a competent judge as the best physical diagnostician in the world. Walter Wesselhoeft of Cambridge, Mass, speaking of Weir Mitchell, said, “Mitchell could see right through you, Hoover could feel right through you.”^{32(p298)} The importance of the sign was recognized in France. For example, Lhermitte (1877-1959),^{33(pp566-567)} who worked at the Salpêtrière, in 1908 noted the following:

Ce mouvement d’opposition de la jambe saine vient de faire l’objet d’une remarque clinique de M. Hoover, professeur de diagnostic physique à la Western Reserve University de Cleveland [This opposition movement of the healthy leg was recently the object of a clinical note by Mr Hoover, professor of physical diagnosis at the Western Reserve University of Cleveland].

Lhermitte³³ emphasized its importance because it could distinguish organic from hysterical paralysis in the absence of the Babinski sign. Lhermitte mentioned that these opposition movements had previously been discussed by Joseph Grasset and Amans Gaussel in France and by Zyg-

munt Bychowski in Germany. Furthermore, he noted that Hoover’s studies were confirmed by Philip Zener of the Medical College of Ohio in Cincinnati.³³ Lhermitte³³ called it *le phénomène de Hoover* (“the Hoover phenomenon”).

CONCLUSIONS

At the end of the 19th and the beginning of the 20th centuries, when it was realized that afflictions such as railway spine and hysteria did not have an organic basis, the awareness of the importance for objective differentiation between organic and hysterical paresis increased. Although many clinicians introduced examination techniques to address this special need for neurology, few maneuvers are still useful and used in modern neurology. Babinski is considered one of the most important neurologists to describe signs that differentiate between organic and hysterical paralysis. As noted by Lhermitte,³³ Babinski mainly applied signs that resulted from ipsilateral synkinesias (or associated movements). He influenced 2 US physicians: Chaddock, who found a variant of his toe sign, which may be more sensitive; and Hoover, who described an important neurological examination technique that was based on contralateral synkinesias and could differentiate organic from hysterical paralysis, even in the absence of the Babinski sign. Both signs, the Chaddock reflex and the Hoover sign, are still useful and used in the practice of modern neurology.

Accepted for publication March 11, 2003.

We thank the Departments of Neurology, Neurosurgery, and History, University of Florida, and the University of Florida McKnight Brain Institute, Gainesville, for supporting this study.

Corresponding author: Michael S. Okun, MD, Movement Disorders Program, University of Florida McKnight Brain Institute, 100 S Newell Dr, Room L3-100, Gainesville, FL 32610 (e-mail: okun@neurology.ufl.edu).

REFERENCES

1. Caplan EM. Trains, brains, and sprains: railway spine and the origins of psychoneuroses. *Bull Hist Med.* 1995;69:387-419.
2. Fischer-Homberger E. Railway spine and traumatic neuroses: the psyche and the spinal cord. *Gesnerus.* 1970;27:96-111.
3. Erichsen J. *On Railway and Other Injuries to the Nervous System.* London, England: Walton & Maberly; 1866.
4. Erichsen J. *On Concussion of the Spine, Nervous Shock, and Other Obscure Injuries of the Nervous System in Their Medical and Medico-Legal Aspects.* London, England: Longmans Green & Co; 1882.
5. Erichsen J. *Nervous Shock and Other Obscure Injuries to the Nervous System in Their Clinical and Medico-Legal Aspects.* Revised ed. New York, NY: William Wood & Co; 1886:57.
6. Micale MS. Charcot and the idea of hysteria in the male: gender, mental science and medical diagnosis in late nineteenth-century France. *Med Hist.* 1990;34:363-411.
7. Goetz CG, Bonduelle M, Gelfand T. *Charcot: Constructing Neurology.* New York, NY: Oxford University Press Inc; 1995.
8. Babinski J. Sur le reflexe cutané plantaire dans certaines affections organiques du système nerveux. *C R Soc Biol.* 1896:207-208.
9. Hoover CF. A new sign for detection of malingering and functional paresis of the lower extremities. *JAMA.* 1908;51:746.
10. Hoover CF. The significance of coordinated reflexes in differentiating between functional and anatomical diseases of the nervous system. Presented at: Academy of Medicine of Cleveland; Cleveland, Ohio; March 19, 1909.
11. Chaddock CG. A preliminary communication concerning a new diagnostic nervous sign. *Interstate Med J.* 1911;18:742-746.
12. Chaddock CG. An explanation of the external malleolar sign made with a view to incite study of it to determine its place in semiology. *J Mo State Med Assoc.* 1911;8:138-144.
13. Chaddock C. The external malleolar sign. *Interstate Med J.* 1911;18:1026-1038.
14. Charcot J. *Leçons sur les Maladies du Système Nerveux Faites à la Salpêtrière.* Paris, France: Delahaye & Lecrosnie; 1887.
15. Freud S. Quelques considérations pour une étude comparative des paralysies motrices organiques et hystériques. *Arch Neurol (Paris).* 1893;26:29-43.
16. Koehler P. Freud's study of hysteric and organic paralyzes as commissioned by Charcot. *Neurology.* 2000;(suppl 3):A173-A174.
17. Van Gijn J. *The Babinski Sign: A Centenary.* Utrecht, the Netherlands: University of Utrecht; 1996:30-35.
18. Babinski J. De quelques mouvements associés du membre inférieur paralysé dans l'hémiplégie organique. Paris, France: Société Médicale des Hospitiaux; 1897.
19. Babinski J. Diagnostic différentiel de l'hémiplégie organique et de l'hémiplégie hystérique. *Gazette Hôpitaux.* 1900;73:521-527, 533-537.
20. Babinski J. Relâchement des muscles dans l'hémiplégie organique. *C R Soc Biol.* 1896:471-472.
21. Babinski J. Monoplégie brachiale organique (mouvements actifs et mouvements passifs). *Rev Neurol.* 1909;17:218-220.
22. Babinski JJ, Froment J. *Hystérie-pithiatisme et troubles nerveux d'ordre réflexe en neurologie de guerre.* 2nd ed. English trans ed. Paris, France: Buzzard; 1918.
23. Chavigny P. *Diagnostic des maladies simulées.* Paris, France: Baillière; 1906.
24. O'Leary J, Moore WL. Charles Gilbert Chaddock: his life and contributions. *J Hist Med Allied Sci.* 1953;8:301-317.
25. Bab A. *Gastronomie pratique: Études culinaires.* Paris, France: Flammarion; 1928.
26. Tashiro K, Rose F, ed. *Charles Gilbert Chaddock, Kisaku Yoshimura and the Babinski Reflex: Neuroscience Across the Centuries.* London, England: Smith-Gordon; 1989:165-169.
27. Wartenberg R. *The Examination of Reflexes.* Chicago, Ill: Year Book Medical Publishers Inc; 1945.
28. Wartenberg R. The Babinski reflex after fifty years. *JAMA.* 1947;135:763-766.
29. Tashiro K. Kisaku Yoshimura and the Chaddock reflex. *Arch Neurol.* 1986;43:1179-1180.
30. Landau W, Clare MH. The plantar reflex in man, with special reference to some conditions where the extensor response is unexpectedly absent. *Brain.* 1959;82:321-355.
31. Tashiro K. Reversed Chaddock method: a new method to elicit the upgoing great toe [letter]. *J Neurol Neurosurg Psychiatry.* 1986;49:1321.
32. Thwing C. *Friends of Mine.* New York, NY: Macmillan Co; 1933.
33. Lhermitte J. De la valeur du phénomène de "l'opposition complémentaire" comme moyen de diagnostic entre les hémiplégies organiques et les hémiplégies fonctionnelles. *Sem Med.* 1908:565-567.