Jules Tinel (1879-1952) and Paul Hoffmann (1884-1962)

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A 45-year-old female presented with a 2-month history of numbness and tingling in her right hand. The symptoms, which were localized to the fingers, occurred throughout the day and wakened the patient at night. She reported that the symptoms were partially relieved by “shaking” her hand. The patient also reported weakness in her right hand, causing her difficulty in carrying her briefcase. Physical examination revealed asymmetric weakness on thumb adduction with evidence of thenar atrophy. Sensation to two-point discrimination testing was impaired in the first and second fingers of the patient’s right hand. She had a negative Phalen sign but a positive Hoffmann-Tinel sign.

Jules Tinel, a French neurologist, and Paul Hoffmann, a German physiologist, served as physicians for opposing sides during the First World War and both described the findings of the sign that bears their names. Hoffmann further described the sign as a diagnostic maneuver used to localize levels of nerve damage and assess the course and adequacy of nerve regeneration after peripheral nerve injury.

In modern medical practice the Hoffmann-Tinel sign, also referred to as Tinel’s sign, is most commonly used with suspected cases of entrapment neuropathies affecting either the median nerve within the carpal tunnel or the ulnar nerve in the postcondylar groove (table 1). The Tinel sign is elicited in suspected cases of carpal tunnel syndrome by tapping or percussing on the distal wrist crease over the median nerve (figure 1). A positive sign is defined as the occurrence of paresthesias in the distribution of the median nerve in the hand. Classic, probable and unlikely patterns of carpal tunnel within the hand are identified depending upon the number of digits involved (e.g., at least two digits in classic carpal tunnel, only one digit in probable carpal tunnel).¹ Hoffmann recommended that when testing for the Hoffmann-Tinel sign, light pressure should be applied, since increased pressure may elicit a positive sign even in patients with a normal nerve.² Thus, in the assessment of carpal tunnel syndrome, a greater percussion force results in improved sensitivity but lower specificity of the Hoffmann-Tinel sign.³

Dr. Paul Hoffmann described the sign in March of 1915 in *On a Method of Evaluating the Success of a Nerve Suture*.^{2,4} Several months later in October

Figure 1. Hoffmann-Tinel sign is elicited by percussing using the extended index finger (A) or blunt end of a reflex hammer (B) over median nerve.

1915, Dr. Jules Tinel published his work on the sign in *The Sign of Tingling in Lesions of Peripheral Nerves*.⁵ Interestingly, neither Hoffmann nor Tinel was aware of the other's publication, possibly a result of the wartime blockade of international communication.⁶

Ironically, various authors have proposed that neither physician should be credited with the original description of the phenomenon.⁷ In 1909, Trotter and Davies discussed their findings that sensations elicited distal to the point of nerve resection are referred to the area or point of nerve resection. Unlike Hoffmann and Tinel, however, Trotter and Davies failed to comment on the clinical relevance of their observation.⁸

Why the sign has classically been referred to as Tinel's sign and not Trotter, Davies or Hoffmann's sign is not entirely clear. Perhaps it is because Tinel had greater notoriety than Hoffmann, and his description was more thoroughly documented. Tinel's paper was also published in a widely circulated journal and was engrained within the writings of surgical and medical textbooks published in the earlier part of the century.^{2,6} It can also be postulated that Tinel had the good fortune of being on the victorious side during the war, and

thus, his publication may have been perceived as being more prestigious by the medical community.^{6,7,9}

Dr. Jules Tinel

Dr. Jules Tinel was born in Rouen, France in 1879 to a family of physicians and surgeons.^{7,9} As a young man, he was an athlete and scholar.⁶ He organized both a gymnastics team and a literary magazine, the latter reflecting his love of journalism. Tinel completed his undergraduate education at a local Catholic institution, and as a physician, he wrote several papers with distinct religious undertones, including *Confession and Psychiatry*.⁶

Tinel received his medical degree in Rouen and, following completion of his required military duties, he undertook postgraduate training in Paris.⁹ During that time, he developed an affinity for neurology. His first publication was a dissertation on central nervous system regeneration.⁶ Subsequently, he was appointed Chief of Neurology at the Hospital Henri-Rousselle in Paris⁹ and throughout his career continued to publish research on various neurologic subjects, including viral encephalitis, senile dementia and vascular headaches.⁶ His most famous works include *Les Blessures des Nerfs (Nerve Wounds)*,⁷ published in 1916, and *Le Systeme Nerveux Vegetatif (The Vegetative Nervous System)*, an early description of the physiology of the autonomic nervous system published in 1936.⁷

Tinel was keenly aware of European politics throughout his career. During the Second World War, working in concert with the French resistance movement, he organized an underground network that transported wounded allied pilots to safety in Spain. He was arrested, imprisoned for the offense and later released.^{6,7}

Tinel suffered a series of strokes that ultimately left him mute,⁶ but despite this handicap, he maintained an active research laboratory until his declining health resulted in his death. Jules Tinel died in March 1952 at the age of 73.

Dr. Paul Hoffmann

Dr. Paul Hoffmann did not enjoy the same enduring name recognition as Tinel. It has only been through retrospective accounts by medical historians that Hoffmann, a German physiologist and physician, has begun to receive due credit for the sign which he was the first to describe in detail.²

Hoffmann was born in Dorpat, Russia in 1884,⁴ the son of a German physician. He received his medical degree from the University of Berlin in 1909 and subsequently became a prolific researcher and writer. He published 32 articles prior to the beginning of the First World War.² His early research focused on the study of muscle action potentials and the electrophysiology of reflexes. Some authors have described him as the "originator of modern neurophysiology in Germany."^{2,9} In fact, he was the first to describe the Hoffmann reflex (H-reflex), a monosynaptic reflex pathway whereby stimulated afferent

Table 1. Application of the Tinel sign.

Peripheral nerve recovery after injury and repair

Carpal tunnel syndrome

Cubital tunnel syndrome

Radial nerve entrapment

Tarsal tunnel syndrome

Pronator compression

Medial plantar neuropathy

Superficial peroneal neuropathy

Thoracic outlet syndrome

Cervical radiculopathies

Peripheral-polyneuropathies

Cervical plexus injuries

Lateral femoral cutaneous entrapment

Traumatic prepatellar neuroma

Bowler's thumb

sensory nerves (Ia) synapse with anterior horn cells within the spinal cord and subsequently activate muscle fibers innervated by these motor units. The reflex provides important electromyographic information regarding proximal conduction velocity.

He described the sign used to assess nerve regeneration, which was performed by lightly percussing with an extended finger in a localized area over the proximal nerve stump or by percussing distally to proximally along the segment of nerve injury or repair. The sign was considered positive if percussion at these sites caused a tingling phenomenon, which radiated in the sensory distribution of the peripheral

The Hoffmann sign, or Hoffmann reflex, a quick flexion of the thumb and other fingers when the index finger is snapped or stretched, is a routine part of the neurologic examination, and its presence indicates pyramidal tract disease (i.e., a "Babinski of the upper extremity"). This sign or reflex was discussed and used *not* by Paul Hoffmann but by Johann Hoffmann, another German neurologist of the early 20th century.

nerve.² Interestingly, Hoffmann had actually cautioned his readers that the presence of paresthesias indicated the regeneration of sensory fibers and not necessarily motor fiber recovery.² However, being less widely recognized than Tinel, it is likely that this detail was overlooked by many of Hoffmann's contemporaries.

Hoffmann published two descriptive articles on nerve regeneration with the first actually appearing months before Tinel's. In 1917, he was appointed Associate Professor at the University of Berlin and lectured throughout Europe for many years. He became Director of the Institute for Physiology at the University of Freiburg in 1924 and maintained this position until his retirement in 1954.^{2,9} In 1962, Dr. Paul Hoffmann died at the age of 77.²

The Hoffmann-Tinel Sign

Originally both the actual physiologic underpinnings and the clinical information garnered from the use of the Hoffmann-Tinel sign were frequently misunderstood and widely refuted. Tinel had emphasized that a positive sign predicted future nerve recovery. However, physicians began to notice that this was not the case, since some patients recovered full neurologic function without ever exhibiting a positive sign.^{10,11}

It was not until 1946 that the true value of the Hoffmann-Tinel sign became fully appreciated. Researchers, including Nathan, Rennie and Napier, emphasized that it was not the presence of paresthetic phenomenon alone that predicted nerve regeneration.^{12,13} To predict nerve regeneration, it is important to assess whether or not the tingling that is elicited progresses distally across the site of the lesion. If the locale of the sign remains static, the presence of an obstructing neuroma is indicated and surgical exploration is warranted.^{12,13}

Although the precise pathophysiologic mechanism remains unknown, compression of a peripheral nerve does result in structural changes (i.e., demyelination and remyelination), which lead to various degrees of focal axonal degeneration and regeneration. These changes are believed to cause the nerve to become sensitive to mechanical stimuli such as pressure or percussion. Thus, one would surmise that percussion or pressure over the nerve (i.e., eliciting the Hoffmann-Tinel sign) may be a useful clinical examination tool, in some cases, for the diagnosis of various entrapment neuropathies, particularly during periods of axonal loss and regeneration of peripheral sensory nerve fibers.¹⁴

The popularization of the Hoffmann-Tinel sign for the diagnosis of carpal tunnel syndrome was largely due to Phalen, who in the 1950s credited only Tinel.¹⁵ In 1966, Phalen, who had since developed a sign for the diagnosis of carpal tunnel syndrome, established a diagnostic triad for this syndrome which consisted of a positive Tinel's sign, a positive Phalen's sign and paresthesias within the median nerve distribution.¹⁶ The Phalen's test is performed by asking the patient to place both elbows on a table while keeping both forearms vertical and flexing both wrists at 90 degrees for 60 seconds. A positive test is defined as the occurrence of pain or paresthesias in at least one finger innervated by the median nerve.^{17,18} Phalen reported a sensitivity of Tinel's sign of 73% in 452 patients using clinical presentation as the diagnostic standard.¹⁷

Table 2. Diagnostic accuracy of the Tinel sign.*

Number of patients	Reference	Sensitivity (%)	Specificity (%)	Positive likelihood ratio (95% CI)	Negative likelihood ratio (95% CI)
115	Gerr ³²	25	67	0.7 (0.4-1.3)	1.1 (0.9-1.4)
110	Golding ²⁷	26	80	1.3 (0.6-2.6)	0.9 (0.7-1.2)
80	Heller ³³	60	77	2.7 (1.2-5.9)	0.5 (0.3-0.8)
110	Katz ²¹	59	67	1.8 (1.2-2.7)	0.6 (0.4-0.9)
228	Kuhlman ²³	23	87	1.8 (1.0-3.4)	0.9 (0.8-1.0)
172	Buch-Jaeger ³⁴	42	64	1.1 (0.8-1.7)	0.9 (0.7-1.2)
Pooled results				1.4 (1.0-1.9)	0.8 (0.7-1.0)

* Adapted from reference 10

Sensitivity and Specificity of the Hoffmann-Tinel Sign

The diagnostic accuracy of the Hoffmann-Tinel sign, as compared to other tests for the diagnosis of carpal tunnel syndrome, has been studied by several groups whose reported results have varied widely.^{10,19-23} Nerve conduction studies have been accepted by most clinicians and researchers as the diagnostic standard for carpal tunnel syndrome.²⁴ However, investigations evaluating the diagnostic accuracy of nerve conduction studies report sensitivities ranging from 49% to 84% and specificities ranging from 95% to 99% in diagnosing carpal tunnel syndrome.²⁴ Authors have attempted to strengthen the validity of their findings by ensuring that subjects' clinical symptoms are consistent with nerve conduction study results.^{1,19,20,22,23}

The best predictors for carpal tunnel syndrome include decreased sensation to pain in the median nerve distribution, classic or probable findings on the hand (Katz) diagram and weakness on active thumb adduction.¹⁰ Neither the Hoffmann-Tinel sign or Phalen's sign are useful in establishing the diagnosis of carpal tunnel syndrome in patients presenting with electrodiagnostic evidence of hand paresthesias.¹⁰ Clinical trials using various combinations of clinical symptoms and nerve conduction studies as the standard for comparing diagnostic tests for carpal tunnel syndrome have reported mixed results with sensitivities for the Hoffmann-Tinel sign ranging from 23% to 72% and specificities ranging from 55% to 94% (table 2).^{10,23,25-30} One of the more recent trials reported a positive predictive value of 0.75 and a negative predictive value of 0.41 for Tinel's sign.²³

The low sensitivity of the Hoffmann-Tinel sign may be attributed to performance, methodology and statistical factors.¹⁹ Milder cases of carpal tunnel syndrome might not

have the degree of axonal loss and regeneration of nerve fibers that would be required to elicit a positive Hoffmann-Tinel sign. Continued compression of an entrapped nerve leads to progressive axonal loss and an absence of the Hoffmann-Tinel and other signs on provocative testing.¹⁹ A final factor that may contribute to the poor sensitivity of this diagnostic sign is the variability in technique used to elicit the Hoffmann-Tinel sign²³ and may result in false positive or false negative signs. A negative test, therefore, does not necessarily exclude the diagnosis,²⁰ and it is imperative that clinicians be critical of both positive and negative findings when eliciting the Hoffmann-Tinel sign.

More recently, there has been renewed interest in utilization of the Hoffmann-Tinel sign for yet another clinical application. Various authors have reported relief of pain and restoration of sensation in diabetic neuropathy by performing decompression of the tibial nerve and distal branches.³¹ In 2004, Lee and Dellon³¹ reported that the Hoffmann-Tinel sign had sensitivities of 88% and 95%, specificities of 50% and 95% and positive predictive values of 88% and 93% in identifying patients with diabetic and idiopathic symptomatic neuropathies, respectively, who would benefit from tibial nerve decompression.

Jules Tinel, a political activist and academic physician, and Paul Hoffmann, a physician and influential researcher of neurophysiology, are unknowingly and forever intertwined in medical history. Both men are recognized for being passionate about their work and for making solid and important contributions to the science of neurology. The diagnostic sign that rightfully bears both their names continues to redefine itself in clinical medicine. Both physicians' stories are timeless, and no matter what the eventual role of their sign is, the intriguing tale of its origin should not be forgotten.

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