

Tinel's sign – significance, mechanism, and diagnostic application: A Literature Review

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Abstract

The Hoffmann-Tinel sign, commonly referred to as Tinel's sign, is a time-honored, non-invasive clinical test used to assess the function of peripheral nerves. First described in 1915, it remains widely employed in neurology, neurosurgery, and orthopedics for diagnosing compressive neuropathies and monitoring nerve regeneration. The sign is elicited by mechanical stimulation of a damaged or regenerating nerve, which evokes ectopic impulses perceived as tingling or electric shock-like sensations in and along the nerve's sensory distribution.

This review explores the physiological basis, technique, and diagnostic applications of Tinel's sign in conditions such as carpal tunnel syndrome, cubital tunnel syndrome, thoracic outlet syndrome, and post-traumatic nerve injuries. Although limited by variability in sensitivity and specificity, subjective interpretation, and the absence of standardized protocols, Tinel's sign remains a cost-effective and clinically valuable component of neurological assessment. When interpreted alongside electrodiagnostic studies and imaging, it contributes to early diagnosis, localization of pathology, and tracking of nerve recovery. Future research should focus on standardizing evaluation methods and assessing the potential integration of Tinel's sign into AI-supported diagnostic systems.

Keywords: Tinel sign, peripheral nerve injury, nerve regeneration, clinical examination, diagnostic technique

Introduction

The Hoffman-Tinel sign, although originally described by Paul Hoffman, is commonly known as Tinel's sign [1]. It was defined in 1915 as the "pins and needles" feeling, known as paresthesia, experienced in the distal cutaneous distribution of an injured peripheral nerve induced by tapping the innervation of a given nerve corresponding to its course at the site of potential damage [2,3]. It's known as a classic non-invasive clinical test widely used in neurology, neurosurgery, and orthopedics [4]. This sign plays an important role in the diagnosis of compression syndromes and the assessment of nerve regeneration [5] following nerve damage. This article discusses the physiological basis of Tinel's sign, its mechanism, technique of performance, clinical applications, significance in various medical specialties, and limitations associated with its interpretation. Having established the historical and clinical significance of Tinel's sign, we now delve into the underlying physiological and pathophysiological mechanisms.

Materials and methods

A comprehensive literature review was conducted using various databases with keywords "Tinel's sign", "peripheral nerve injury", "nerve entrapment syndrome", "nerve compression function tests".

Physiological basis of Tinel's sign

In a healthy individual, tapping over a nerve typically does not produce any abnormal sensations beyond the point of contact [4]. However, when a nerve is entrapped, damaged or undergoing regeneration, such mechanical irritation can trigger generation of ectopic action potentials, which are abnormally generated at the site of injury and transmitted along the nerve to the sensory distribution area [6,7]. Patients perceive these as unusual sensory sensations—most commonly described as tingling, electric shock-like feeling, or numbness. This sign is not specific to one condition but generally signals nerve irritation or regeneration. Importantly, the location of the positive sign can indicate the site of pathology or entrapment [8,9].

Pathophysiological basis of Tinel's sign

Following peripheral nerve injury, Wallerian degeneration occurs in the distal segment of the axon, leading to the breakdown of axon structures and myelin sheaths [10-13]. In the following weeks, the regenerative process begins, with axonal sprouts emerging along the remaining basal lamina of Schwann cells, guided by a supportive microenvironment [7,14-16]. During this period, the injured nerve undergoes a number of pathological changes that contribute to the neuropathic symptoms. These include the development of

mechanical hypersensitivity at the site of lesion and ectopic sites of impulse formation capable of producing spontaneous and abnormal discharge(s) [11,17]. At the same time, axonal excitability is decreased, due to increased membrane instability and increase in voltage-gated sodium channel regulation, in particular Nav1.3, Nav1.7, and Nav1.8 [17,18]. These channels increase neuronal sensitivity and facilitate abnormal firing pathways. In addition, there are marked changes in membrane receptor expression and local release of proinflammatory mediators that further sensitize the regenerating nerves and contribute to chronic hyperexcitability [10,11,14]. Together, these mechanisms underlie clinical manifestations of neuropathic pain and positive mechanistic signs such as Tinel's sign [11, 17,18].

Technique of performance

To elicit Tinel's sign, the examiner gently presses along the anatomical pathway of the suspected nerve with his fingers or with a reflex hammer. A positive sign is the sensation of tingling or shock radiating distally from the sensory distribution of the nerve [3, 19]. There is currently no standardized method for performing this test. A study by Lifchez [20] showed significant variability in technique and force generated by examiners, which may explain differences in clinical sensitivity and specificity. Standardized protocols are needed to improve reliability and interobserver consistency.

Diagnostic Applications and Significance

Table 1.

Clinical Characteristics of Common Peripheral Nerve Entrapment Syndromes

Summary of anatomical locations, affected nerves, diagnostic percussion sites, and characteristic distribution of paresthesias for major peripheral nerve entrapment conditions encountered in clinical practice.

Syndrome	Nerve Involved	Tinel's Sign Location	Sensory Distribution
Carpal tunnel syndrome	Median nerve	Volar aspect of wrist	Thumb, index, middle fingers, and radial half of ring finger
Cubital tunnel syndrome	Ulnar nerve	Posterior to medial epicondyle	Ulnar half of hand (ring and little fingers)
Tarsal tunnel syndrome	Posterior tibial nerve	Posterior and inferior to medial malleolus	Plantar surface of foot
Guyon's canal syndrome	Ulnar nerve	Ulnar aspect of wrist (hook of hamate)	Ring and little fingers (variable motor involvement)
Radial tunnel syndrome	Posterior interosseous nerve	Proximal forearm (arcade of Frohse)	Dorsal web space between thumb and index finger
Common peroneal neuropathy	Common peroneal nerve	Lateral aspect of fibular neck	Lateral leg and dorsum of foot
Anterior tarsal tunnel syndrome	Deep peroneal nerve	Anterior to medial malleolus (beneath extensor retinaculum)	First web space between great and second toes

Note: Tinel's sign refers to the percussion test performed at the specified anatomical location to elicit paresthesias in the corresponding sensory distribution. Clinical diagnosis should incorporate patient history, physical examination findings, and electrodiagnostic studies when indicated. Sensory distributions may vary among individuals and overlap between different nerve territories.

Abbreviations: N/A

Source: Clinical examination and electrodiagnostic correlation

Entrapment Neuropathies

Using Tinel's test at particular anatomical sites leads to distinct patterns of paresthesia corresponding to various nerve compression syndromes, as shown in Table 1 [4,9,21-23]. This table gives an overview of the clinical characteristics associated with the different nerve compression syndromes, identifying the precise locations where percussion may cause symptoms and the corresponding paresthesia sites. In order to improve diagnostic accuracy, it underlines the importance of conducting targeted percussion tests at specific nerve compression points [24,25]. For example, percussion to the medial elbow may cause symptoms due to the

involvement of the ulnar nerve, while tapping over the volar wrist frequently results in paresthesia in the areas supplied by the median nerve. By identifying these patterns, the clinician can more accurately identify nerve entrapments and provide more effective, targeted treatment. All things considered, this table is a useful source for the clinical assessment of nerve compression syndromes.

Table 2.

Comprehensive Summary of Nerve Compression Function Tests

Diagnostic performance characteristics, procedural details, and clinical applications of standardized examination techniques for peripheral nerve entrapment syndromes. Sensitivity and specificity values represent pooled estimates from systematic reviews where available.

Test	Nerve	Procedure	Positive Sign	Sensitivity	Specificity	Clinical Notes
Tinel's Sign [11-13,21,22,31,49,58]	<i>Median Ulnar Tibial</i>	Tap over the nerve at compression site	Tingling/paresthesia in nerve distribution	~50-60% <i>(range 45-59%)</i>	~70-80% <i>(range 56-80%)</i>	Indicates nerve irritation or regeneration, useful for localization
Phalen's Test [4,27,35,45]	<i>Median</i>	Hold wrists in full flexion for 30-60 sec	Numbness/tingling in nerve distribution	~68-73% <i>(range 50-70%)</i>	~58-73% <i>(range 33-80%)</i>	Common, easy test. Increases pressure in carpal tunnel
Durkan's Test [4,27,37]	<i>Median</i>	Apply direct pressure over carpal tunnel for 30 sec	Numbness/tingling in nerve distribution	~70% <i>(range 67-71%)</i>	~90% <i>(range 22-95%)</i>	Most sensitive and specific clinical test for carpal tunnel syndrome
Elbow Flexion Test [38]	<i>Ulnar</i>	Full elbow flexion + wrist extension for 60 sec	Numbness in 4th/5th fingers	~75%	~99% <i>(range 96-100%)</i>	Provocative test for cubital tunnel syndrome
Scratch Collapse Test [4,40-43,57]	<i>Various</i>	Light touch over suspected site, followed by resisted external shoulder rotation	Transient loss of resistance strength	~30-40% <i>(range 32-69%)</i>	~60-70% <i>(range 32-94%)</i>	Highly operator-dependent; controversial reliability
Reverse Phalen's [44-46]	<i>Median</i>	Hold wrist in full extension for 30-60 sec	Median distribution symptoms	~33-40%	~80%	Less sensitive than Phalen's but used for comparison

Note: Sensitivity represents the proportion of patients with confirmed nerve compression who test positive. Specificity represents the proportion of patients without nerve compression who test negative. Reference numbers in brackets correspond to published studies contributing to pooled estimates. Clinical diagnosis should incorporate multiple test findings, patient history, and electrodiagnostic confirmation when indicated. Test performance may vary based on examiner experience, patient population, and severity of nerve compression.

Abbreviations: sec = seconds

Source: Systematic review and meta-analysis of diagnostic test accuracy studies

Table 2. provides an overview of the basic clinical tests used to diagnose nerve entrapment syndromes, with details of their methods and diagnostic usefulness. It includes tests like Tinel's sign, Phalen's, and Durkan's, each designed to provoke symptoms at specific nerve sites. The table highlights the sensitivity and specificity of these assessments and helps clinicians determine their reliability. For instance, Phalen's test shows high sensitivity for carpal tunnel syndrome, while Durkan's test offers high specificity. Additional tests, such as the elbow flexion test and scratch collapse test, are also included, providing a comprehensive guide for clinical evaluation. Overall, the table serves as a practical reference for the selection and interpretation of nerve compression tests in patient assessments.

Post-traumatic Nerve Regeneration Monitoring

In trauma or surgery involving peripheral nerves, Tinel's sign serves as a tool to:

Monitor nerve regeneration: In post-traumatic or post-surgical settings, the sign moves distally as the nerve heals and axons regenerate.

Predict reinnervation progress: A migrating Tinel's sign typically indicates functional axonal regrowth [7,8,21].

Differentiate neuroma formation from true regeneration: A stationary, intensely positive sign may suggest a neuroma or scar trapping regenerating axons.

Thoracic Outlet Syndrome & Plexopathies

Thoracic outlet syndrome (TOS), a condition caused by compression of the neurovascular structures—most commonly the brachial plexus as they pass through the thoracic outlet, can be evaluated clinically with the use of Tinel's sign [26]. Gentle percussion is applied over the supraclavicular fossa, which is where the brachial plexus traverses between the anterior and middle scalene muscles, in order to elicit the sign in TOS. The neck, shoulder, and upper limb may experience tingling or paresthesia if the response is positive. While not specific to TOS, a positive supraclavicular Tinel's sign should lead to additional evaluation, including differential diagnoses [26–28], such as cervical radiculopathy [29], brachial plexitis (Parsonage-Turner Syndrome) [30], Pancoast Syndrome [31], peripheral nerve entrapment, or multiple sclerosis [32].

Differential Considerations

Tinel's sign is most effective when used in combination with other supportive diagnostic tests such as:

Electrodiagnostic studies (NCS/EMG): For pinpointing the exact site of entrapment or lesion, grading the severity, differentiating between mononeuropathy, plexopathy, and radiculopathy, ruling out systemic causes like diabetic neuropathy or demyelinating diseases [28,29,33].

Additional nerve compression tests and nerve tension tests: For increased clinical accuracy (vide Table 2) [9,27,28,33-47].

Ultrasound or MRI: For identifying space-occupying lesions (e.g., ganglion cysts, lipomas) causing compression.

A negative Tinel's sign does not exclude the presence of neuropathy. On the other hand, a positive sign may appear in asymptomatic patients, especially after repeated tapping.

Because of these factors, Tinel's sign should be interpreted in the context of other findings, including clinical symptoms, physical examination, and, when necessary, electrodiagnostic studies like nerve conduction velocity (NCV) or electromyography (EMG) [28,33].

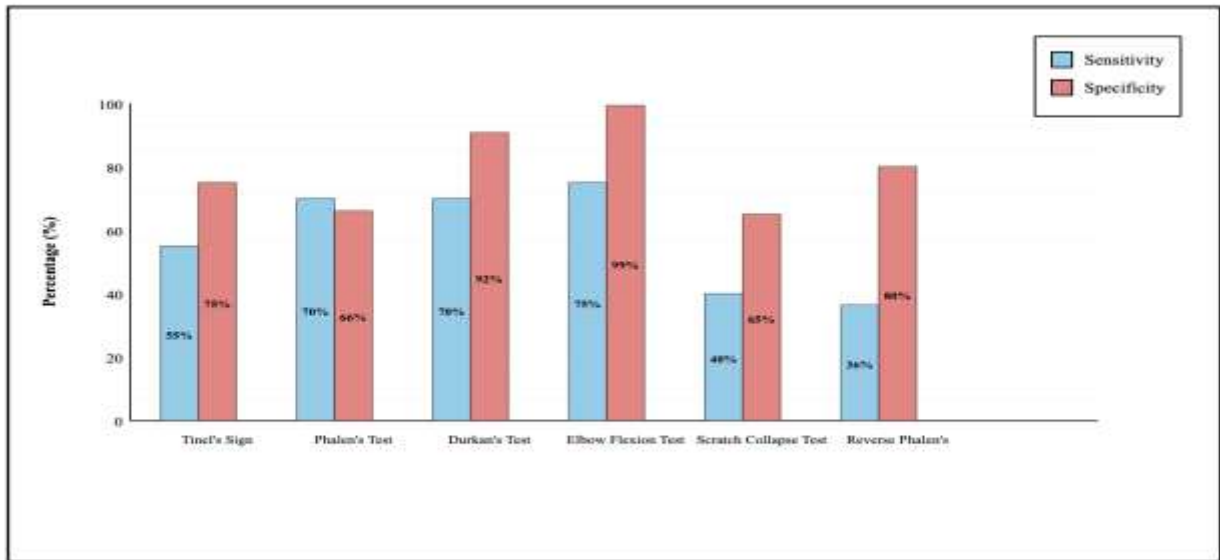
Limitations

Low Sensitivity and Specificity [4,9,35,36]

Tinel's sign is often not sensitive enough to detect all cases of nerve entrapment (as presented in Figure 1.), particularly in early or mild forms of disease. It can also be non-specific, producing positive results in other neuropathic conditions unrelated to the nerve being tested, such as generalized neuropathies or psychogenic symptoms.

Figure 1.**Sensitivity and Specificity of Clinical Tests for Nerve Compression Syndromes**

Comparative diagnostic performance of commonly employed clinical examination techniques in the evaluation of peripheral nerve entrapment conditions. Data represent pooled estimates from systematic review and meta-analysis.



Note: Sensitivity represents the proportion of patients with nerve compression who test positive (true positive rate). Specificity represents the proportion of patients without nerve compression who test negative (true negative rate). Clinical diagnosis should incorporate multiple examination findings, patient history, and electrodiagnostic studies when indicated. Test performance may vary based on examiner experience and patient population characteristics.

Abbreviations: N/A

Source: Systematic review and meta-analysis of diagnostic test accuracy studies

Interpretation

Tinel's Sign demonstrates moderate specificity but lower sensitivity, indicating it is more reliable for confirming compression syndromes when positive but less effective for ruling it out when negative. Tinel's is useful for localization of nerve irritation or regeneration, but is not very reliable as a standalone diagnostic tool.

Phalen's Test offers a balanced profile with moderate sensitivity and specificity, making it a commonly used diagnostic maneuver. Easy and quick to perform, often used as a first-line screening test for carpal tunnel syndrome.

Durkan's Test exhibits a very high specificity, indicating a strong likelihood of carpal tunnel syndrome when the test is positive. Its positive result strongly indicates the presence of median nerve compression.

Scratch Collapse Test has the highest sensitivity among the tests, making it valuable for screening purposes. Highly variable and operator-dependent. Lower reliability. Should not be used in isolation, but may have niche utility when localizing compression sites.

Elbow Flexion Test exhibits the highest specificity, indicating a strong likelihood of cubital tunnel syndrome when the test is positive. The false positives are rare.

Reverse Phalen's Test has low sensitivity but reasonable specificity. Less commonly used; often employed as a complementary test to Phalen's.

These findings suggest that no single test is definitive for diagnosing nerve compression syndromes. Therefore, a combination of these physical examination maneuvers should be employed to enhance diagnostic accuracy.

Subjective Interpretation

The response depends heavily on the patient's subjective report of tingling or pain, which can vary widely [4,9,29,34-36]. It may yield false positives in patients with heightened sensitivity or false negatives in those with advanced nerve damage where sensation is lost.

Variable Reproducibility

The results can vary depending on the examiner's technique, the amount of force used, and the exact anatomical site of tapping [4,9,20,29,34-36]. There is no standardized method for performing the test, which diminishes the reliability between different examiners.

Limited Localization Value

While a positive Tinel's sign indicates nerve irritability, it does not precisely localize the site or extent of the lesion. It cannot distinguish between different causes of neuropathy (e.g., entrapment vs. demyelinating disease) or levels of involvement (e.g., plexus vs. peripheral nerve).

Limited Use in Certain Nerve Injuries

In cases of proximal nerve injuries (e.g., brachial plexus lesions or cervical radiculopathies), the sign may not be observed at all or may be overlooked if only distal sites are tested [29,30]. It is also of limited value in central nervous system disorders, where the pathology is not in the peripheral nerve.

Possibility of false positive result

Heightened Nerve Sensitivity

Some individuals inherently exhibit heightened sensitivity in peripheral nerves, which predisposes them to experience tingling with even minimal stimulation. This amplified response does not necessarily indicate pathology, yet it may still yield a positive Tinel's sign.

Psychogenic or Functional Symptoms

Individuals experiencing anxiety, somatization disorders, or functional neurological symptoms may report paresthesia as a reaction to the tapping stimulus, despite the absence of any organic lesions.

Normal Regenerating Nerves

In cases of nerve injury, Tinel's sign may become positive during the regeneration phase, even prior to clinically evident or problematic symptoms. Although this represents a genuine physiological response, it may be misinterpreted as an ongoing entrapment or compression rather than a sign of recovery.

Poor Localization or Technique

Incorrect identification of the nerve's pathway or inconsistent pressure may result in tingling sensations unrelated to the intended nerve, thereby leading to misleading outcomes. Adjacent nerve structures or soft tissues can generate abnormal sensations unrelated to nerve pathology.

Overlap with Other Conditions [4,29-32,36]

Conditions such as diabetic polyneuropathy, fibromyalgia, or cervical radiculopathy may cause widespread or non-specific paresthesia, resulting in false positives when Tinel's sign is applied.

The importance of Tinel's sign in various medical specialties

Neurology

In neurological practice, Tinel's sign remains a clinically important tool for assessing and monitoring peripheral nerve disorders, especially in diabetic polyneuropathy, alcoholic polyneuropathy, or posttraumatic neuropathy [29]. Although the sensitivity and specificity of the sign vary depending on the type of neuropathy and patient population, its simplicity, low cost, and availability ensure its continued importance in neurological assessment. Its primary diagnostic function is to determine nerve conduction and the progress of nerve regeneration over time. At follow-up appointment, it can serve as a non-invasive marker of axonal regrowth, providing valuable prognostic information for future clinical decisions. To increase diagnostic accuracy, Tinel's sign should be taken into consideration in a comprehensive evaluation strategy, including history taking, physical examination, and confirmatory tests such as electromyography and imaging procedures.

Orthopedics and traumatology [4,5,9,29]

In orthopedic practice, Tinel's sign is mainly used to diagnose conditions such as carpal tunnel syndrome and cubital tunnel syndrome. The presence of a positive sign can help identify which nerve is being compressed and identify the site of compression. The simplicity of the test and the immediate feedback make it a valuable tool in the orthopedic clinic when interpreted in a broader clinical and diagnostic context. In the orthopedic context, where musculoskeletal injuries are often accompanied by nerve damage, Tinel's sign plays a key role in the early phase of diagnosis, helps to determine the need for imaging or electrodiagnostic studies, and facilitates the planning of further treatment. The presence of this sign can suggest both nerve irritation due to scar tissue or implants and ongoing nerve regeneration, which is particularly valuable in cases of postoperative or posttraumatic follow-up.

Neurosurgery

In the field of neurosurgery, Tinel's sign holds both diagnostic and prognostic value, particularly in the evaluation and monitoring of peripheral nerve injuries, nerve entrapment syndromes, and intraoperative neuromonitoring. It serves as a tool supporting neurosurgeons during patient qualification for surgery, or more precisely, identification of the exact location of the lesion, which allows for the adjustment of the optimal surgical plan. After surgical procedures, such as decompression, neuroanastomosis, or nerve repair, a positive Tinel's sign enables tracking of nerve regeneration or indicates ineffective surgical treatment [29]. In cases such as traumatic nerve transections, iatrogenic nerve injury, or compressive neuropathies, a positive Tinel's sign, elicited proximal to the site of injury, can guide surgical planning. Furthermore, the postoperative use of Tinel's sign can provide insight into the functional status of the nerve after surgery [48].

Rehabilitation and physiotherapy

Physiotherapists use Tinel's sign as a diagnostic tool to localize nerve disorders, assess the effectiveness of surgical interventions and personalize physical therapy. By inducing the Tinel sign, physical therapists can adapt neurodynamic exercises [49,50] to the specific location of the patient's nerve disorders and monitor progress throughout the treatment process. A persistent positive sign may indicate the need to modify the location and scope of exercises performed [8,21]. Research is ongoing into the physiotherapeutic treatment of the mechanical entrapment interface using pain modalities, soft tissue mobilization, and neural mobilization [51].

Occupational medicine

Among people who work manually (such as office workers, machine operators) [52-54], Tinel's sign may serve as an essential element of preventive examinations. In particular, as a useful indicator of early symptoms of carpal tunnel syndrome and excessive nerve strain. As part of health prophylaxis, it seems important to promote the use of workstations appropriately adapted to human anthropometric features (ergonomic workstation) among employees. From the point of view of an occupational physician, including Tinel's sign in a routine examination and educating patients about the etiology of the disease may be beneficial in preventing cumulative trauma injury [4,29,55,56].

Conclusion

Tinel's sign is a simple, non-invasive, and cost-effective tool for the assessment of peripheral nerve pathology. Despite varied sensitivity and subjectivity, it retains significant diagnostic and prognostic value, particularly in detecting entrapment neuropathies and monitoring nerve regeneration. Especially if used as a bedside technique, Tinel's sign offers immediate insight into nerve irritability and regeneration, supporting preliminary diagnosis and guiding therapeutic decisions across multiple specialties, including neurology, orthopedics, and neurosurgery. While it should not be a standalone diagnostic standard, it remains an important component of a multimodal approach to nerve assessment. Combined with neurological examination and radiology, the test maintains its position as an indispensable tool for clinicians. In the context of further research, the paramount issues seem to be the standardization of the method and interpretation of the Tinel sign. The necessity to assess the role it plays in combination with the rapidly developing AI-assisted technologies presents a pressing matter. Such developments may further strengthen its role in modern clinical practice.

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