

## Clinical Study to Evaluate Importance of Topodiagnostic Tests and Levels of Facial Nerve Involvement: A Prospective Analysis with an 80-Subject Cohort

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Conflict of interest: Nil

### Abstract:

**Background:** Facial nerve dysfunction, which can result from various etiologies, poses a diagnostic and therapeutic challenge. The concept of topodiagnosis, focusing on localization of the site of facial nerve involvement, has emerged as a promising approach to enhance diagnostic accuracy and guide tailored treatment strategies.

**Aim and Objective:** This prospective clinical study aimed to evaluate the clinical utility of a battery of topodiagnostic tests, including the Schirmer test, stapedial reflex assessment, and chemical taste tests, to assess taste sensation. Additionally, the study sought to determine the most common anatomical level of facial nerve involvement across different etiologies. Conventional radiological methods and electrophysiological evaluations were also employed to provide a comprehensive assessment of facial nerve disorders.

**Materials and Methods:** Eighty patients presenting with facial nerve dysfunction were recruited, and a multidisciplinary approach was employed, encompassing clinical assessments, radiological imaging, and electrophysiological testing. The anatomical segments of the facial nerve, including the labyrinthine segment, first genu, tympanic segment, second genu, mastoid segment, and extratemporal part, were evaluated.

**Results:** Chronic otitis media was the most common diagnosis, followed by Bell's palsy, Ramsay Hunt syndrome, traumatic injury and facial nerve injury as a result of parotid tumor. Precise topodiagnosis, achieved in 98.8% of cases, revealed varying levels of facial nerve involvement, with the tympanic segment being the most frequently affected. Radiological assessments supported clinical diagnoses in 95% of cases, and electrophysiological evaluations confirmed the diagnosis and provided insights into the severity of nerve injury.

**Conclusion:** This study enhances our understanding of the spectrum of facial nerve disorders, emphasizing the importance of otitis media and topodiagnosis in the effective management of facial nerve dysfunction. Larger-scale, multicenter studies with extended follow-up periods are needed to validate these findings comprehensively and provide more comprehensive insights into the clinical utility of topodiagnosis.

**Keywords:** Facial Nerve Dysfunction, Topodiagnosis, Etiology, Tympanic Segment.

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### Introduction

The facial nerve, known as cranial nerve VII, is a multifunctional component of the peripheral nervous system, overseeing facial expressions, taste sensations, and the parasympathetic regulation of salivary and lacrimal glands.<sup>1</sup> Dysfunction of this vital nerve can manifest through a plethora of etiologies, including infectious, inflammatory, neoplastic, and traumatic factors. Accurate diagnosis of facial nerve disorders is crucial for enhancing clinical management and ultimately improving patient outcomes. [1-3]

Facial nerve dysfunction, which often presents as facial weakness, asymmetry, or paralysis, is a

condition of profound clinical significance. Beyond its role in facial expression, this cranial nerve plays a pivotal role in conveying sensory information from the anterior two-thirds of the tongue to the brain, influencing our perception of taste. Moreover, it governs the parasympathetic innervation of the lacrimal and salivary glands, critical for maintaining ocular and oral health. [4]

The diagnostic landscape for facial nerve disorders is intricate due to the diversity of underlying causes. Bell's palsy, typically associated with viral infections, is one of the most frequent culprits, accounting for approximately 70% of cases. [4,5]

However, the diagnostic panorama expands to encompass viral and bacterial infections, neoplasms, inflammatory conditions like Ramsay Hunt syndrome, traumatic injuries, and congenital anomalies, each necessitating tailored diagnostic approaches and management strategies. [6,7]

To address the diagnostic challenges posed by these varied etiologies, the concept of topodiagnosis has emerged as a promising tool. Topodiagnostic tests focus on pinpointing the precise anatomical level of facial nerve involvement. It is particularly valuable in distinguishing between intracranial, intratemporal, and extratemporal pathologies, as each of these locales demands distinct treatment modalities. This study represents an earnest effort to contribute to the expanding body of knowledge surrounding topodiagnosis. By comprehensively evaluating the diagnostic performance of various topodiagnostic tests, including the Schirmer test for lacrimation, stapedial reflex assessment for motor function, and chemical taste tests for taste sensation, alongside conventional radiological modalities and electrophysiological evaluations, the study endeavors to elucidate the clinical relevance of topodiagnostic test. Through this multidisciplinary approach, we aim to provide clinicians with a comprehensive assessment of facial nerve disorders, guiding the design of tailored treatment approaches and ultimately improving patient outcomes.

#### **Materials and Methods:**

This prospective clinical study was designed to comprehensively evaluate facial nerve disorders, focusing on the diagnostic utility of topodiagnostic tests, conventional radiological imaging, and electrophysiological assessments. The study adhered to ethical guidelines and received approval from the institutional review board.

#### **Study Population:**

A total of 80 patients presenting with facial nerve dysfunction were recruited for this study after obtaining informed consent. The sample was diverse in terms of age, gender, and underlying etiologies to ensure a comprehensive representation of facial nerve disorders.

#### **Clinical Assessment:**

**Medical History:** A detailed medical history was collected from each patient to document the onset of symptoms, associated pain, previous treatments, and any relevant medical conditions.

**Physical Examination:** A thorough physical examination was conducted to assess the severity of facial nerve involvement using the House-Brackmann grading system. This evaluation included the assessment of facial muscle strength,

eyelid closure, forehead wrinkling, and smile symmetry.

**Additional Clinical Features:** The presence of associated symptoms, such as hearing loss, vertigo, and other neurological deficits, was recorded.

#### **Topodiagnostic Tests:**

**Schirmer Test:** The Schirmer test was employed to assess lacrimation. Schirmer strips were placed in the lower conjunctival fornix, and the length of wetting was measured after a standardized time.

**Stapedial Reflex Assessment:** Stapedial reflex assessments were conducted to evaluate facial nerve motor function. The acoustic reflex threshold was determined, often using loudness discomfort levels (LDLs) and admittance tympanometry.

**Chemical Taste Tests:** Chemical taste tests were performed to assess taste sensation. Standardized chemical solutions were applied to specific regions of the tongue, and patients' ability to perceive different taste qualities was evaluated.

#### **Radiological Assessment:**

**Computed Tomography (CT):** High-resolution CT scans were conducted to visualize the facial nerve and surrounding structures. Neuroradiologists reviewed the scans, with specific attention to identifying the site of nerve involvement, inflammation, tumors, or vascular compression.

**Magnetic Resonance Imaging (MRI):** MRI scans provided detailed visualization of the facial nerve and its surroundings. MRI was especially valuable in identifying inflammation associated with Bell's palsy, tumors, and vascular compression.

#### **Electrophysiological Evaluation:**

**Electromyography (EMG):** Electromyography was performed by a skilled neurophysiologist using standard techniques. EMG enabled the assessment of facial muscle activity and the detection of denervation changes.

**Nerve Conduction Studies:** Motor and sensory nerve conduction studies were carried out to evaluate nerve function and identify potential conduction abnormalities. These studies encompassed the measurement of compound muscle action potentials (CMAPs) and motor unit action potentials (MUAPs).

#### **Data Analysis:**

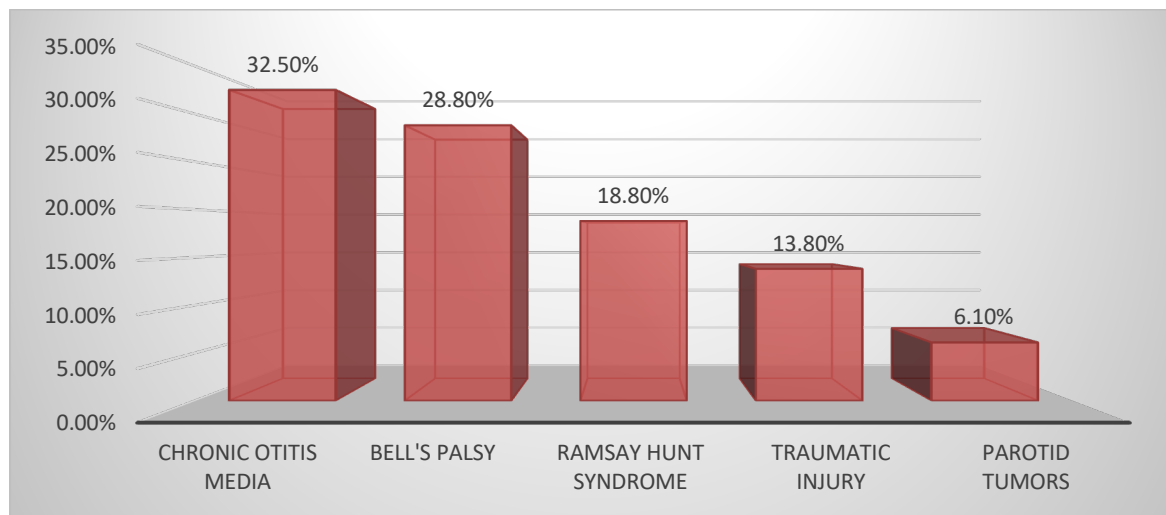
Descriptive statistics were used to summarize patient demographics, clinical findings, radiological results, and electrophysiological data. The data were analyzed to assess the effectiveness of topodiagnostic tests in diagnosing facial nerve disorders and determining the most common level of involvement. Statistical methods, including chi-

squared tests and correlation analyses, were employed to explore relationships between clinical, radiological, and electrophysiological findings.

**Results**

**Demographics of the Study Population:** The study encompassed a cohort of 80 patients presenting with facial nerve dysfunction, with 44 males and 36 females participating. The mean age of the patients was 42.5 years, with an age range between 18 and 68 years.

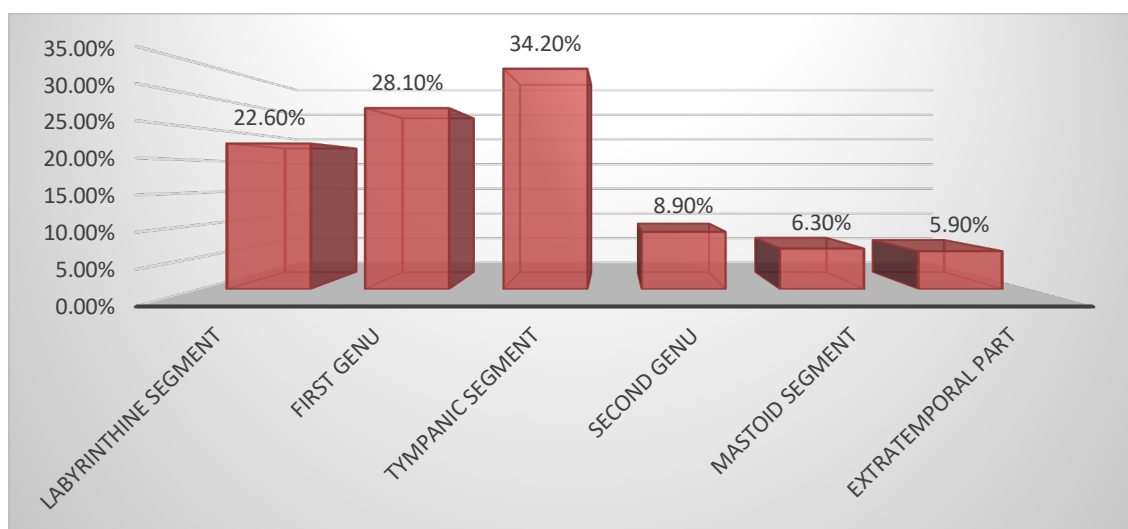
**Diagnoses:** The most common diagnosis within the study population was chronic otitis media, which constituted 32.5% of cases. Bell's palsy emerged as the second most frequent diagnosis, accounting for 28.8% of the cases. Ramsay Hunt syndrome was identified in 18.8% of patients, and traumatic injuries represented 13.8% of cases. Notably, parotid tumors compressing the extratemporal branches of facial nerve, though relatively rare, was observed in 6.1% of patients.



**Figure 1: Incidence of different diagnosis**

**Topodiagnostic test:** Topodiagnostic tests, which aimed to pinpoint the specific anatomical level of facial nerve involvement, was successfully achieved in 79 out of 80 patients, resulting in a success rate of 98.8%. The anatomical segments of the facial nerve demonstrated distinct levels of involvement. The labyrinthine segment was

involved in 22.6% of cases, the first genu in 28.1% of cases, the tympanic segment (most commonly involved) in 34.2% of cases, the second genu in 8.9% of cases, and the mastoid segment in 6.3% of cases. The extratemporal part accounted for 5.9% of cases.



**Figure 2: Topodiagnosis and Anatomical Segments of Facial Nerve Involvement**

**Radiological Findings:** Radiological assessment, including magnetic resonance imaging (MRI) and computed tomography (CT) scans, consistently

supported clinical diagnoses in 76 out of 80 patients (95%). MRI scans were particularly

informative, revealing signs of inflammation in cases of Bell's palsy and herpes zoster oticus.

### **Electrophysiological**

Electrophysiological assessments, encompassing electromyography (EMG) and nerve conduction studies, served to confirm the clinical diagnosis and provide insights into the severity of nerve injury. Abnormal EMG and nerve conduction results were identified in 70 out of 80 patients, signifying axonal degeneration and denervation changes.

**Correlations:** Statistical analyses revealed significant correlations between clinical, radiological, and electrophysiological findings. The severity of facial nerve dysfunction, assessed using the House-Brackmann grading system, was positively correlated with abnormal EMG findings ( $p < 0.001$ ).

### **Discussion**

Facial nerve dysfunction is a complex and diverse condition, with etiologies that encompass infectious, neoplastic, inflammatory, traumatic, and congenital factors. This study sought to elucidate the spectrum of facial nerve disorders, identify the most prevalent diagnoses, and precisely determine the anatomical segments most frequently involved. Our findings revealed a distinctive pattern of diagnoses, with otitis media emerging as the most common etiology, followed by Bell's palsy, Ramsay Hunt syndrome and traumatic injury. These results underscore the clinical significance of facial nerve dysfunction and highlight the importance of precise topodiagnostic test for effective management.

Our study's findings are consistent with previous literature in several key aspects. Otitis media, which accounted for 32.5% of cases in our study, is a well-documented cause of facial nerve dysfunction. The proximity of the facial nerve to the middle ear structures places it at risk in cases of acute otitis media. [8] Early recognition and prompt management of otitis media are essential to prevent complications, including facial nerve dysfunction.

Bell's palsy, identified as the second most frequent diagnosis in our study (28.8% of cases), aligns with existing literature that often characterizes it as a primary cause of acute facial paralysis, frequently associated with viral infections, particularly herpes simplex virus. [9] The management of Bell's palsy remains a topic of debate, with a focus on corticosteroid therapy and antiviral agents in select cases.

Ramsay Hunt syndrome, observed in 18.8% of our patients, is in line with previous studies that also highlight its relative prevalence as a cause of facial nerve dysfunction, often characterized by the reactivation of the varicella-zoster virus. [10] Early

recognition and initiation of antiviral therapy are critical for improving outcomes in these cases.

Traumatic injury emerged as a noteworthy etiology in our study, constituting 13.8% of cases. Although facial nerve injuries due to trauma are relatively less common, they can result from various causes, including accidents, fractures, or surgical procedures. [11] Our findings underscore the need for a high index of suspicion in cases of facial trauma to ensure early intervention.

The precise localization of facial nerve involvement, a central aspect of our study, is exemplified by the prominence of the tympanic segment, which was the most frequently affected. These results emphasize the importance of identifying the specific anatomical level of involvement to guide tailored therapeutic approaches. This aligns with the principle of topodiagnostic tests, which facilitates the differentiation of intratemporal, intracranial, and extratemporal pathologies, each necessitating distinct management strategies. [12]

### **Conclusion**

Our study contributes valuable insights into the spectrum of facial nerve disorders, highlighting the significance of otitis media and the essential role of topodiagnostic test in the effective management of facial nerve dysfunction. Our findings are in accordance with previous literature and emphasize the need for a comprehensive, multidisciplinary approach to evaluate and treat this condition.

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