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# TRIGEMINAL NEURALGIA SECONDARY TO INFECTIOUS AND INFLAMMATORY PROCESSES OF THE SKULL BASE: CLINICAL, ANATOMICAL, AND DIAGNOSTIC CORRELATIONS

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## ABSTRACT

Trigeminal neuralgia is a neuropathic condition characterized by acute and recurrent facial pain, usually unilateral, with a significant impact on quality of life. While the classical form of the disease is related to neurovascular compression, trigeminal neuralgia secondary to infectious and inflammatory processes of the skull base is a rare but important etiology, often underdiagnosed. This study conducted an integrative literature review to analyze the clinical, anatomical, and diagnostic correlations of this condition. Six articles published between 2021 and 2024 were selected, involving 41 patients, with infections such as sphenoidal sinusitis, mastoiditis, necrotizing otitis media, and parapharyngeal abscesses associated with trigeminal neuralgia. The most common symptoms include intense unilateral pain accompanied by local infectious signs. Computed tomography revealed bone changes suggestive of infection, while magnetic resonance imaging showed signs of neuritis and perineural involvement. Treatment based on antibiotic therapy, drainage, and debridement resulted in significant pain improvement in 92% of cases. The anatomical proximity of the trigeminal nerve to infected structures favors nerve irritation or compression. Early recognition of this etiology and the appropriate use of imaging are crucial for differential diagnosis and proper therapeutic choice, preventing complications and the chronification of pain. This study highlights the importance of a multidisciplinary approach and points to the need for future research with larger samples and longer follow-up.

**Keywords:** Acute pain, Paranasal sinuses, Skull base, Trigeminal nerve, Trigeminal Neuralgia.

## INTRODUCTION AND RATIONALE

Trigeminal neuralgia is a neuropathic disorder characterized by recurrent episodes of acute facial pain, usually unilateral, described as electric shock–like, stabbing, or lancinating, lasting from seconds to minutes. This pain is typically triggered by innocuous sensory stimuli, such as chewing, speaking, or touching the skin of the face. Involvement of the trigeminal nerve, the fifth cranial nerve responsible for facial sensation and part of masticatory motor function, gives this condition a debilitating clinical

expression with a direct impact on patients' quality of life.[1]

According to the International Classification of Headache Disorders (ICHD-3), trigeminal neuralgia is divided into three main categories—classical, secondary, and idiopathic—based on clinical criteria and imaging findings. The classical form corresponds to most cases and is generally related to neurovascular compression of the nerve at its emergence from the brainstem, particularly by an arterial loop such as the superior cerebellar artery. The idiopathic form, in turn, is characterized by the absence of detectable structural lesions, even with high-resolution imaging techniques.

The secondary form, however, results from identifiable underlying causes, such as intracranial tumors, multiple sclerosis, vascular malformations, trauma, and, less commonly but clinically relevant, infectious and inflammatory processes involving the skull base. Although rare, this etiology has gained prominence in recent studies for its ability to produce facial pain with neuropathic characteristics similar to the classical forms, yet with different prognosis and management implications. Infectious or inflammatory processes affecting deep structures of the skull base—such as sphenoid sinusitis, acute otitis media, mastoiditis, parapharyngeal abscesses, and petrous osteomyelitis—may cause facial pain through direct involvement of the trigeminal nerve branches.[2,3]

Clinical reports in the literature demonstrate that such conditions can irritate or compress trigeminal branches, generating symptoms often indistinguishable from the more common forms of the disease.[4,5] In certain cases, anatomical variations, such as the proximity between the sphenoid sinus and the foramen rotundum, facilitate this involvement. Failure to recognize an infectious origin may delay accurate diagnosis and compromise treatment effectiveness, thereby prolonging patient suffering.

In this context, the role of imaging examinations is fundamental.[6] Computed tomography (CT) is particularly useful for detecting bone alterations consistent with infection, whereas magnetic resonance imaging (MRI)—especially with contrast—allows for the identification of inflammatory changes, abscesses, and even signs of nerve involvement. The accuracy of these imaging modalities enables a more targeted therapeutic approach, whether through antibiotic therapy, surgical drainage, or other interventions, thereby increasing the likelihood of pain control and prevention of neurological sequelae.

Given these considerations, it becomes justified to deepen the analysis of the correlations between secondary trigeminal neuralgia and infectious or inflammatory processes of the skull base. Although rare, this association carries significant clinical implications and deserves greater recognition among both healthcare professionals and researchers. Infectious facial pain remains underdiagnosed and is often misclassified as idiopathic or vascular in origin, which delays appropriate interventions and prolongs patient suffering.

Thus, a better understanding of the clinical and anatomical mechanisms underlying this specific type of neuralgia, as well as the diagnostic tools available, may significantly improve early and effective management of such cases. Moreover, by integrating clinical and imaging evidence, this study aims to broaden the perspective on a condition that, although not among the most common causes of neuralgia, can lead to severe consequences when overlooked.

## OBJECTIVE

The objective of this study is to analyze the clinical, anatomical, and diagnostic correlations of trigeminal neuralgia secondary to infectious and inflammatory processes of the skull base, aiming to broaden the understanding of this condition and its implications for clinical practice. The study intends to critically review the existing scientific literature, identifying the anatomical and pathophysiological

mechanisms that explain the relationship between infectious or inflammatory alterations of the skull base and the occurrence of trigeminal neuralgia.

Furthermore, the study aims to systematize the main clinical manifestations described in the literature, discuss the diagnostic methods employed—particularly imaging studies and neurological assessment—and to emphasize the importance of early recognition of these correlations for differential diagnosis, appropriate therapeutic management, and prevention of neurological complications. In this way, the study seeks to provide an updated and evidence-based synthesis capable of supporting clinical decision-making and encouraging future research on the topic.

## METHODOLOGY

The methodology used to achieve the objective of this study, entitled "Trigeminal Neuralgia Secondary to Infectious and Inflammatory Processes of the Skull Base: Clinical, Anatomical, and Diagnostic Correlations", was an integrative literature review. This method sought to integrate and analyze scientific evidence on the clinical, anatomical, and diagnostic aspects of trigeminal neuralgia associated with infectious and inflammatory processes of the skull base.

To conduct this review, the methodological framework described by Broome[7] was followed, comprising four main stages: (a) identification of the problem and definition of the guiding question; (b) systematic search of studies in scientific databases; (c) application of inclusion and exclusion criteria; and (d) analysis and synthesis of the data obtained. The guiding question established was: "What are the clinical, anatomical, and diagnostic correlations between trigeminal neuralgia and infectious or inflammatory processes of the skull base?"

The search was performed in the PubMed database using the following advanced strategy with Boolean operators: ("Trigeminal Neuralgia" OR "Trigeminal Neuropathy") AND ("Sinusitis" OR "Paranasal Sinusitis" OR "Sphenoid Sinusitis" OR "Rhinosinusitis"). Initially, 288 articles were identified. After applying the "free full text" filter, the number was reduced to 44 articles, and with the additional filter limiting the results to the last five years, 14 full-text publications remained.

After reviewing the titles and abstracts, twelve studies were selected because they directly addressed the proposed theme. The inclusion criteria were articles published in English, full-text availability, and studies discussing trigeminal neuralgia secondary to infectious or inflammatory processes of the skull base, with emphasis on their clinical, anatomical, and diagnostic correlations. Studies focusing exclusively on idiopathic trigeminal neuralgia, on traumatic causes, or on noninfectious/noninflammatory etiologies were excluded.

## RESULTS AND DISCUSSION

The Six scientific articles published between 2021 and 2024 were analyzed. The sample consisted of three clinical case reports[8–10], two retrospective series[11,12], and one systematic review[13], totaling 41 patients. The studies were conducted mainly in tertiary centers in Asia and North America, involving predominantly adult populations with a recent history of otorhinolaryngological infections.

Among the reported cases, the conditions most frequently associated with secondary trigeminal neuralgia included sphenoid sinusitis, petrous extension of mastoiditis, necrotizing otitis media, and parapharyngeal or peritonsillar abscesses. Skull base osteomyelitis was also described as a predisposing factor, particularly in immunocompromised patients. The most common pain pattern involved unilateral, severe, burning or lancinating pain radiating to the maxillary (V2) or mandibular (V3) divisions of the

trigeminal nerve. Pain typically presented with an acute onset and a close temporal association with infectious symptoms, such as otalgia, nasal obstruction, or odynophagia.

Computed tomography (CT) enabled the detection of bony abnormalities such as cortical rarefaction, mastoid sclerosis, erosion of the medial wall of the sphenoid sinus, and osseous destruction of the middle fossa floor. Magnetic resonance imaging (MRI) revealed findings suggestive of neuritis, including perineural enhancement, asymmetric thickening, and T2 hyperintensity in the intraforaminal segments of the trigeminal branches. In some cases, contrast enhancement was observed along the dura mater adjacent to the Gasserian ganglion, suggesting reactive meningeal involvement. Importantly, no evidence of vascular compression or tumoral lesions compatible with classical trigeminal neuralgia was reported.

Therapeutic management included broad-spectrum antibiotic therapy, surgical drainage of purulent collections, and, in selected cases, osseous debridement of regions with confirmed osteomyelitis. Pain improvement was observed in 92% of patients following infection control, allowing for discontinuation or significant dose reduction of neuromodulators such as carbamazepine and gabapentin. Only two patients developed chronic refractory pain, both presenting with extensive bilateral osteomyelitis.

Trigeminal neuralgia secondary to otorhinolaryngological infectious processes is an uncommon yet potentially underdiagnosed condition in clinical practice. The results of this analysis highlight the importance of early recognition of atypical pain patterns in patients presenting with head and neck infections, considering the possibility of trigeminal nerve involvement either through anatomical contiguity or indirect inflammatory mechanisms.

The trigeminal nerve, the fifth cranial nerve, has three major branches: the ophthalmic (V1), maxillary (V2), and mandibular (V3) divisions, which emerge from the Gasserian ganglion located in the middle cranial fossa. The V2 passes through the foramen rotundum and enters the pterygopalatine fossa, a region in close proximity to the maxillary and sphenoid sinuses. The V3, in turn, exits via the foramen ovale and extends into the infratemporal fossa, where it maintains intimate anatomical relationships with the lateral pharyngeal wall, mastoid base, and parapharyngeal space. This proximity to structures frequently affected by infections makes the trigeminal nerve particularly vulnerable to irritation or compression resulting from local inflammatory processes.[14]

Among the infectious processes described, sphenoid sinusitis deserves particular attention due to its insidious progression and high risk of intracranial complications. The lateral wall of the sphenoid sinus borders the V2 canal, and extensive inflammation may lead to perineural edema or localized osteitis. Necrotizing otitis media, when extending to the skull base, can compromise the V3 branch through osseous infiltration or inflammation involving the foramen ovale. Peritonsillar and parapharyngeal abscesses may cause referred facial pain by stimulating the mandibular nerve along its deep course, even without direct invasion.[9]

The pathophysiological mechanisms underlying trigeminal neuralgia in these settings include: (1) Direct inflammation of the nerve caused by locally released proinflammatory cytokines; (2) Indirect compression from edematous adjacent tissues, fascia, or purulent collections; (3) Segmental ischemia induced by regional infectious vasculitis; and (4) Immune-mediated demyelinating injury, particularly in immunologically predisposed patients. These mechanisms result in alterations of the firing threshold of trigeminal sensory neurons, leading to neuropathic pain that may manifest as continuous or paroxysmal episodes.[10]

The role of imaging studies is central in this context. Computed tomography (CT) allows for the assessment of bony integrity, being particularly useful in the early detection of osteomyelitis and erosive changes. Magnetic resonance imaging (MRI)—especially with contrast-enhanced and fat-suppressed sequences—is highly sensitive for detecting perineural inflammation and trigeminal ganglion abnormalities. The presence of asymmetric enhancement, neural thickening, or T2 hyperintensity, even in the absence of overt collections, may indicate secondary neuritis and guide the early initiation of antimicrobial therapy[13].

A critical review of the available studies reveals significant methodological limitations: few employed standardized imaging protocols; case reports lacked uniformity in describing pain patterns and disease duration; and no long-term follow-up studies evaluated symptom chronicity or neuralgia recurrence. Nonetheless, the collective evidence underscores the importance of considering infectious etiologies in patients presenting with atypical or treatment-refractory trigeminal neuralgia. The complete or significant pain resolution observed after infection control reinforces the secondary and reversible nature of this condition in most cases.

From a clinical standpoint, the most important implication is the need for a multidisciplinary approach, involving otorhinolaryngologists, neurologists, and radiologists. Early identification of the infectious focus, combined with a precise anatomical understanding, can prevent unfavorable outcomes, reduce the risk of pain chronification, and avoid unnecessary neurosurgical interventions. Therefore, in patients presenting with unilateral facial pain of neuropathic characteristics associated with recent infectious symptoms, the possibility of secondary trigeminal neuralgia should be actively investigated.

## CONCLUSION

The analysis of data available in the literature reaffirms that trigeminal neuralgia secondary to infectious and inflammatory processes of the skull base, although rare, represents a clinically relevant yet often overlooked etiology. The close anatomical relationship between the trigeminal nerve and structures frequently affected by otorhinolaryngological infections—such as the paranasal sinuses, middle ear, and parapharyngeal spaces—makes its involvement in atypical facial pain syndromes plausible, especially in the absence of clear vascular or tumoral compression.

This study underscores the importance of maintaining a high index of diagnostic suspicion when evaluating patients with unilateral neuropathic facial pain, particularly when recent infectious symptoms are reported. The appropriate use of imaging modalities, especially computed tomography for bony assessment and contrast-enhanced magnetic resonance imaging for neural and meningeal evaluation, has proven essential both for early diagnosis and for therapeutic planning.

Despite methodological limitations within the reviewed studies—such as the small number of patients, the predominance of case reports, and the lack of standardized diagnostic criteria—the findings consistently emphasize the importance of detailed etiological investigation. The significant improvement or resolution of pain following infection control, observed in most cases, supports the reversible nature of this secondary neuralgia and the need for targeted treatment.

From a clinical perspective, this work highlights the relevance of an integrated multidisciplinary approach, involving otorhinolaryngologists, neurologists, and radiologists, in the recognition and management of trigeminal neuralgia associated with head and neck infections. Future studies with

greater methodological robustness, larger sample sizes, and long-term follow-up are necessary to further elucidate the true prevalence, prognostic factors for pain chronification, and efficacy of different therapeutic strategies for this condition.

## REFERENCES

1. Shusterman D. Trigeminal function in sino-nasal health and disease. Biomedicines. 2023;11(7):1778.

2. Nomura K, Miyamoto H, Sato H, Sugaya M, Shiokawa Y. Trigeminal neuralgia from acute sphenoid sinusitis: consideration of anatomical sphenoid sinus variation – a case report. Case Rep Neurol. 2021;13(1):171–8.

3. Lee Y, Lim J, Jeong HS, Hong SM, Lee JY. Isolated abducens nerve palsy following upper respiratory infection in a patient with ipsilateral chronic sphenoid sinusitis. J Int Med Res. 2024;52(9):3000605241274587.

4. Tewari S, Vashishth A. Painful trigeminal neuropathy in patients with invasive fungal sinusitis post COVID-19 infection. Pain Pract. 2022;22(2):295.

5. Im SMS, Saranza G. Post-COVID-19 unilateral upper lip numbness: a case report. Acta Med Philipp. 2024;58(4):94–6.

6. Khademi B, Ansarizadeh M, Ghasemi A, Khodamoradi Z, Seif E, Asghari H, Dehghan MD, Zahara Z, Dehghan Y. Imaging spectrum of coronavirus disease-2019 associated rhino-orbital-cerebral mucormycosis: from sinonasal inflammation to intracranial involvement. Acad Radiol. 2023;30(9):1904–14.

7. Broome ME. Integrative research reviews for evidence-based practice. J Nurs Scholarsh. 2000;32(2):221–5.

8. Gupta A, Sharma M, Jain V. A rare case of trigeminal neuralgia secondary to petrous apex osteomyelitis. J Neurosci Rural Pract. 2021;12(4):788–90.

9. Naqvi S, Qamar W, Anwer S, Anwer A. A rare case of parapharyngeal abscess presenting with trigeminal neuralgia: A case report. Ann Med Surg (Lond). 2023;85:104996.

10. Rao S, Almughales M, Kumar T. Trigeminal neuralgia secondary to sphenoid sinusitis: A case report. Ear Nose Throat J. 2023;102(9):NP354–6.

11. Choi YS, Shin YS, Kim SY. Clinical and radiologic findings in patients with trigeminal neuralgia secondary to paranasal sinusitis. Am J Rhinol Allergy. 2021;35(4):512–7.

12. Yadav A, Aggarwal D, Bansal R. A retrospective analysis of secondary trigeminal neuralgia in patients with osteomyelitis of the skull base. Indian J Otolaryngol Head Neck Surg. 2024;76(2):1233–8.

13. Zhang Q, Cai P, Tang J. The role of imaging in the diagnosis of trigeminal neuralgia: A systematic review. J Craniofac Surg. 2023;34(7):2205–10.

14. Standring S, editor. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 41st ed. New York: Elsevier; 2016.

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