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PRIMARY CAUSES OF TOOTHACHE AND THEIR DIFFERENTIAL DIAGNOSIS: A COMPREHENSIVE CLINICAL REVIEW

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Abstract. Toothache is one of the most common complaints in dental and medical practice and represents a significant cause of discomfort, reduced quality of life, and healthcare utilization. Despite its frequent occurrence, tooth pain is not a single disease entity but a symptom arising from a wide range of odontogenic and non-odontogenic conditions. Accurate identification of the underlying cause is essential for effective management, prevention of complications, and avoidance of unnecessary or inappropriate treatment. This article aims to provide a comprehensive review of the main causes of toothache and to discuss the principles of differential diagnosis relevant to clinical practice. The review highlights common odontogenic causes such as dental caries, pulpitis, periapical pathology, periodontal disease, cracked tooth syndrome, and pericoronitis, as well as non-odontogenic sources including temporomandibular joint disorders, sinusitis, neuropathic pain, and referred pain from systemic conditions. Emphasis is placed on the clinical characteristics of pain—such as onset, duration, intensity, provoking and relieving factors—and their diagnostic significance. Diagnostic tools including patient history, clinical examination, pulp vitality tests, percussion, palpation, and radiographic imaging are discussed as integral components of the diagnostic process.

Keywords: Toothache, dental pain, pulpitis, differential diagnosis, dental caries, periodontal disease, referred pain, periapical pathology, temporomandibular disorders, oral diagnosis

Introduction

Toothache is a prevalent clinical symptom that affects individuals of all ages and socioeconomic backgrounds. It is often the primary reason patients seek urgent dental care and, in some cases, medical attention in emergency settings. Dental pain can range from mild sensitivity to severe, debilitating discomfort, significantly impacting daily activities such as eating, speaking, and sleeping. Despite its common occurrence, toothache presents a diagnostic challenge because it can originate from a variety of local and systemic conditions.

Traditionally, toothache has been associated mainly with dental caries and pulpal inflammation. However, advances in clinical research have demonstrated that pain perceived in the teeth may arise not only from odontogenic structures but also from surrounding tissues or even distant anatomical sites. The trigeminal nerve's complex sensory distribution allows for the phenomenon of referred pain, which can mislead both patients and clinicians. Consequently, misdiagnosis may result in unnecessary dental procedures or delayed treatment of the true underlying condition.

Differential diagnosis is therefore a critical component of dental practice. It involves the systematic evaluation of all possible causes of tooth pain based on clinical findings, patient history, and diagnostic tests. A structured diagnostic approach helps clinicians distinguish between reversible and irreversible conditions, odontogenic and non-odontogenic pain, and acute versus chronic pathologies. This approach is particularly important in managing conditions such as irreversible pulpitis, cracked tooth syndrome, and neuropathic pain disorders, which may present with similar symptoms but require vastly different treatment strategies.

The aim of this article is to review the main causes of toothache and to outline the principles of differential diagnosis that guide clinical decision-making. By integrating current literature and clinical knowledge, this paper seeks to enhance understanding of dental pain mechanisms and support accurate, patient-centered diagnosis and management.

Literature Review

Previous studies have consistently identified dental caries as the leading cause of toothache worldwide. According to epidemiological data, untreated caries remains highly prevalent, particularly in developing regions, and is strongly associated with pulpal and periapical pain. Research by Ingle and colleagues emphasized the role of pulpal inflammation as a dynamic process, progressing from reversible pulpitis to irreversible pulpitis and necrosis if left untreated.

Periodontal disease has also been widely studied as a source of dental pain, although it is more commonly associated with chronic discomfort rather than acute pain. Studies indicate that periodontal abscesses can produce severe localized pain and are often confused with endodontic infections. Additionally, cracked tooth syndrome has gained increased attention in the literature due to its diagnostic complexity and variable clinical presentation.

Non-odontogenic causes of toothache have been explored extensively in medical and dental research. Temporomandibular joint disorders (TMD), maxillary sinusitis, trigeminal neuralgia, and atypical facial pain are frequently cited as conditions that may mimic dental pain. Literature highlights that failure to recognize these conditions often leads to unnecessary dental interventions.

Recent reviews stress the importance of comprehensive history-taking and the use of adjunctive diagnostic tools such as cone-beam computed tomography (CBCT) in complex cases. Overall, the literature supports a multidisciplinary and systematic approach to the diagnosis of toothache, emphasizing that accurate differentiation between possible causes is essential for effective treatment.

Main Body

Toothache is one of the most common reasons patients seek dental care and represents a complex diagnostic challenge due to its diverse etiologies. Dental pain can significantly affect quality of life, interfering with eating, speaking, sleeping, and overall well-being. Clinically, toothache can be broadly classified into odontogenic and non-odontogenic causes. Odontogenic pain originates from the teeth or their supporting structures, whereas non-odontogenic pain arises from adjacent or distant anatomical structures but is perceived by the patient as dental in origin due to shared neural pathways and referred pain mechanisms.

Understanding this distinction is critical, as misdiagnosis may lead to inappropriate treatment, unnecessary dental procedures, and persistence of symptoms.

Odontogenic Causes

Dental caries remains the most prevalent cause of toothache worldwide. The carious process begins with demineralization of enamel caused by acidic byproducts of bacterial metabolism. As the lesion progresses into dentin, bacterial toxins and inflammatory mediators stimulate odontoblasts and pulpal nerve endings. In early stages, patients typically report sensitivity to thermal (especially cold) or sweet stimuli. This pain is usually short-lived and subsides once the stimulus is removed. However, if caries is left untreated and advances toward the pulp, inflammation intensifies, leading to more severe pain. Pulpitis represents inflammation of the dental pulp and is a common sequela of deep caries, trauma, or restorative procedures. It is classified as either reversible or irreversible.

Reversible pulpitis is characterized by brief, sharp pain in response to stimuli such as cold or sweet foods, with no spontaneous pain. Removal of the irritant and placement of an appropriate restoration often results in complete resolution.

Irreversible pulpitis, on the other hand, presents with spontaneous, lingering pain that may be exacerbated by heat and relieved temporarily by cold. The pain may radiate and is often difficult for the patient to localize. At this stage, pulpal damage is irreversible, and root canal treatment or extraction is required.

If irreversible pulpitis remains untreated, pulpal necrosis may occur. Necrotic pulp tissue can lead to microbial invasion of the periapical tissues, resulting in apical periodontitis, which may be acute or chronic. Acute apical periodontitis is often associated with severe pain on biting or percussion, while chronic forms may be asymptomatic and detected radiographically. Progression may result in periapical abscess formation, characterized by intense pain, swelling, pus discharge, and possible systemic involvement such as fever and lymphadenopathy.

Periodontal diseases are another important odontogenic source of toothache. While chronic periodontitis is often painless, acute periodontal conditions such as periodontal abscesses can cause significant discomfort. These abscesses arise due to bacterial accumulation within periodontal pockets and are associated with localized swelling, tenderness, tooth mobility, and pain on mastication. In severe cases, patients may present with systemic signs, emphasizing the need for prompt intervention.

Cracked tooth syndrome is a frequently underdiagnosed condition that presents with sharp pain during chewing or upon release of biting pressure. The pain is often intermittent and difficult to localize, making diagnosis challenging. Cracks may not be visible on conventional radiographs, requiring careful clinical examination, bite tests, transillumination, or cone-beam computed tomography (CBCT). Early diagnosis is crucial to prevent pulpal involvement.

Pericoronitis commonly affects partially erupted third molars, particularly mandibular wisdom teeth. It results from bacterial accumulation beneath the operculum of soft tissue covering the tooth. Clinically, patients experience localized pain, swelling, bad taste, difficulty chewing, and sometimes trismus. In severe cases, infection may spread to adjacent fascial spaces, posing a risk to airway patency.

Non-Odontogenic Causes

Not all dental pain originates from the teeth. Temporomandibular joint disorders (TMDs) frequently present with pain perceived in the posterior teeth. This pain may be accompanied by muscle tenderness, joint sounds (clicking or crepitus), headaches, and limited mandibular movement. Unlike odontogenic pain, TMD-related discomfort often worsens with jaw movement rather than thermal stimuli.

Maxillary sinusitis is a classic example of referred dental pain. The roots of maxillary premolars and molars are often in close proximity to the maxillary sinus floor. Inflammation of the sinus lining can cause a dull, aching pain in these teeth. Patients may also report nasal congestion, facial pressure, and pain that worsens when bending forward.

Neuropathic pain conditions, such as trigeminal neuralgia, produce severe, paroxysmal, electric shock-like pain that follows the distribution of the trigeminal nerve. These episodes are often triggered by light touch, speaking, or chewing and may be mistaken for dental pain. Importantly, clinical and radiographic examination typically reveals no dental pathology, and dental treatment does not alleviate symptoms.

Systemic and referred pain conditions must also be considered. Cardiac ischemia, for instance, can refer pain to the jaw, teeth, or ear, particularly on the left side. Similarly, cervical spine disorders and ear pathologies may mimic dental pain. These examples highlight the necessity of comprehensive medical history-taking and interprofessional collaboration.

Differential Diagnosis

Accurate differential diagnosis of toothache relies on careful evaluation of pain characteristics, including onset, duration, intensity, quality, and triggering or relieving factors. Clinical examination should include inspection, palpation, percussion, periodontal probing, and occlusal assessment. Diagnostic tests such as thermal testing, electric pulp testing, and radiographic evaluation are indispensable.

A stepwise diagnostic approach, combining multiple tests rather than relying on a single finding, has been shown to reduce diagnostic errors and improve treatment outcomes. Clinicians must remain cautious and avoid irreversible treatments until a definitive diagnosis is established.

Research Methodology

This article is based on a narrative review methodology, chosen to provide a comprehensive and integrative overview of the etiology and diagnostic considerations of toothache. A structured literature search was conducted across major academic databases, including PubMed, Google Scholar, and ScienceDirect. Search terms included combinations of keywords such as “toothache,” “dental pain,” “odontogenic pain,” “pulpitis,” “referred pain,” and “differential diagnosis.”

The inclusion criteria encompassed peer-reviewed articles, review papers, clinical guidelines, and authoritative textbooks published in English, with a primary focus on adult populations. Studies addressing the pathophysiology, clinical presentation, and diagnostic strategies of dental pain were prioritized. Both observational studies and systematic or narrative reviews were

included to ensure a balanced representation of empirical evidence and expert consensus.

Exclusion criteria involved case reports with limited generalizability, pediatric-focused studies, and articles that primarily addressed treatment modalities without sufficient emphasis on diagnosis. After initial screening of titles and abstracts, full-text articles were reviewed for relevance and quality.

Data from selected sources were synthesized qualitatively and organized into thematic categories, including odontogenic causes, non-odontogenic causes, and diagnostic approaches. This method allowed for integration of clinical insights with evidence-based recommendations applicable to general dental practice.

Results

The review findings indicate that odontogenic causes, particularly dental caries and pulpitis, remain the predominant sources of toothache in clinical practice. Numerous studies consistently report that pulpal and periapical diseases account for the majority of dental pain presentations.

However, a significant proportion of patients presenting with toothache were found to have non-odontogenic etiologies, including temporomandibular disorders, sinus-related pain, and neuropathic conditions. These cases were especially prone to misdiagnosis when clinicians relied solely on pain location rather than comprehensive assessment.

Evidence demonstrated that diagnostic accuracy improved substantially when multiple diagnostic tools were employed concurrently. Thermal testing, percussion, and radiographic examination were particularly effective in differentiating reversible pulpitis, irreversible pulpitis, and periapical pathology. Furthermore, detailed medical and dental history-taking played a crucial role in identifying referred and systemic causes of pain.

Overall, the results emphasize that a structured and methodical diagnostic protocol reduces unnecessary dental interventions, enhances patient satisfaction, and leads to more predictable clinical outcomes.

Conclusion

Toothache is a complex and multifactorial clinical symptom with a broad spectrum of potential causes. While odontogenic conditions such as dental caries, pulpitis, periodontal disease, and pericoronitis account for the majority of cases, non-odontogenic sources of pain must always be carefully considered. Failure to recognize referred or systemic causes may result in misdiagnosis, ineffective treatment, and ongoing patient discomfort.

Differential diagnosis is therefore central to effective management of dental pain. A systematic and evidence-based approach—incorporating comprehensive history-taking, meticulous clinical examination, and appropriate diagnostic testing—is essential. Understanding the biological mechanisms of dental pain, as well as recognizing characteristic pain patterns, allows clinicians to distinguish between conditions with similar clinical presentations.

This review highlights the importance of continuous professional education and interdisciplinary collaboration in the diagnosis of toothache. Dentists must remain vigilant and open to non-dental causes of pain, referring patients to appropriate medical specialists when necessary. By adopting

structured diagnostic strategies and integrating emerging diagnostic technologies, clinicians can improve diagnostic accuracy, minimize unnecessary procedures, and ultimately enhance patient care.

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