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Analysis of Final Diagnosis of Patients with Suspected Nonodontogenic Toothache: A Retrospective Study

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Purpose: The aim of this study is to analyze the final diagnosis and the pain characteristics of patients with suspected nonodontogenic toothache and to contribute to the knowledge on differential diagnosis.

Methods: A retrospective analysis was conducted based on medical records from 185 patients. The following data were collected: age, sex, pain characteristics, radiographic results, initial diagnosis and treatment, and final diagnosis and treatment. The final diagnosis and the pain characteristics of the 3 most common final diagnoses were analyzed.

Results: Myofascial pain (MFP) was the most prevalent diagnosed condition accounting for 37.8% of cases, followed by pulpal pain (P) at 31.4%, and trigeminal neuralgia (TN) at 18.9%. There were significant differences in age, onset of the pain, and pain intensity across the 3 groups (all $p<0.01$). TN group exhibited a lower frequency of spontaneous and continuous pain than the MFP and P groups (all $p<0.001$). The proportion of patients reporting pain alleviating and aggravating factors related to dental pain was significantly higher in the P group than in the MFP and TN groups (all $p<0.001$). A concordance rate of 57.0% was observed between the initial and the final diagnosis. Twenty-six patients underwent tooth extractions and 24 patients had root canal treatments.

Conclusions: It is important to differentiate between dental pain and nonodontogenic toothache to avoid unnecessary dental treatments. Comprehending the pain characteristics of each condition, taking a thorough history taking, and performing diagnostic tests can help differential diagnosis.

Keywords: Diagnosis, differential; Myofascial pain syndromes; Toothache; Trigeminal neuralgia

INTRODUCTION

Dental pain is the most prevalent cause of orofacial pain [1]. Dental pain is attributed to the inflammation of the pulp or periodontal tissues [2]. However, in some cases, dental pain persists despite appropriate treatment for the pulp and periodontal tissues. In such cases, the clinician may proceed with additional irreversible dental treatments including root canal treatment (RCT), re-RCT, or the extraction of the suspected tooth or other adjacent teeth. If the pain remains unresolved, the patient and clinician may become uncertain as to the diagnosis of dental pain. The patient may be referred to an orofacial pain specialist for an evaluation of the nonodontogenic toothache.

The confusion results from heterotopic pain, which is defined as pain in a location inconsistent with the source of the pain [3]. Pain in the orofacial region frequently originates from deep structures. A persistent barrage of

nociceptive input from these deep structures has a potential to excite the central nervous system (CNS), thereby causing a central excitatory effect and resulting in heterotopic pain. If the heterotopic pain occurs in the tooth area, it is referred to clinically as nonodontogenic toothache. There are 3 types of heterotopic pain: central pain, projected pain, and referred pain [3]. Myofascial pain (MFP), sinus and mucosal pain, and cardiac pain are typical examples of referred pain. Other forms of nonodontogenic toothache include neuropathic, neurovascular, and psychogenic pains [4].

Conversely, dental pain may be misdiagnosed as nonodontogenic toothache. In many instances, a toothache may be misdiagnosed due to the absence of discernible pathology in clinical examinations or radiographic images during the acute phase [5,6]. To accurately diagnose such cases, it is essential to have a comprehensive understanding of the distinctive characteristics of dental pain and nonodontogenic toothache.

Prior studies on nonodontogenic toothache have predominantly focused on the prevalence of persistent pain following a RCT [7-9]. However, these studies have not evaluated the underlying causes of persistent pain. Other studies were primarily case reports of nonodontogenic toothache [10-12]. Furthermore, there is a paucity of research comparing the characteristics of pain and final diagnoses in patients with the suspected nonodontogenic toothache. Accordingly, the objective of this study is to analyze the initial and final diagnoses of patients presenting to the Department of Oral Medicine with a suspected nonodontogenic toothache. Also, this study evaluated the characteristics of pain in relation to each final diagnosis. This will help facilitate the diagnosis of patients presenting with nonodontogenic toothache.

MATERIALS AND METHODS

1. Subjects and Study Design

This retrospective study is based on the medical records who presented to the Department of Oral Medicine at Wonkwang University Daejeon Dental Hospital from 2014 to 2022. The study protocol was exempted from review by the Institutional Review Board (IRB) of the Wonkwang University Daejeon Dental Hospital (IRB no. W2212/002-001). The IRB approved the exemptions of written informed consent from the patients.

This study included 321 patients with chief complaints of pain on teeth and gingiva with suspicion of nonodontogenic toothache. Based on the medical records, following data were collected: age, sex, chief complaint, pain location, onset of the pain, pain intensity (visual analog scale [VAS]), pain triggering factors, pain alleviating factors, pain aggravating factors, the radiographic findings, initial diagnosis (diagnosis before being referred or visited to the Department of Oral Medicine), past treatment, the effect of past treatment, final diagnosis by orofacial pain specialist, endodontist, and periodontist, and the effect of treatment after final diagnosis. Cases with inaccurate diagnoses or inaccurate medical records were excluded. A total of 185 patients were included in the analysis. The study design is illustrated in Fig. 1.

2. Demographics and Diagnosis

The age and sex of 185 patients were analyzed. The final diagnoses were categorized and grouped as follows: MFP, pulpal pain (P), periodontal pain (PE), trigeminal neuralgia (TN), persistent idiopathic dentoalveolar pain (PIDAP), and others. A comparison and analysis were conducted between the initial and the final diagnoses.

3. Comparison of Pain Characteristics among the Top 3 Final Diagnoses

Pain characteristics were compared among the 3 most common final diagnoses. The following variables were analyzed: age, onset of the pain, pain intensity (VAS), continuous pain, spontaneous pain, pain on mastication, pain on thermal stimuli, nocturnal exacerbation of pain, pain relief by analgesic, awakening from sleep due to pain, and radiographic findings. For each pain characteristic analysis, patients with missing values were excluded from the analysis. Consequently, the number of patients included in the analysis varies for each pain characteristics item.

4. The Effect of Treatment

A total of 148 patients with confirmed follow-up were evaluated to determine the change in pain levels after the completion of treatment. The patients were classified into 3 categories: improvement, worsening, and no change.

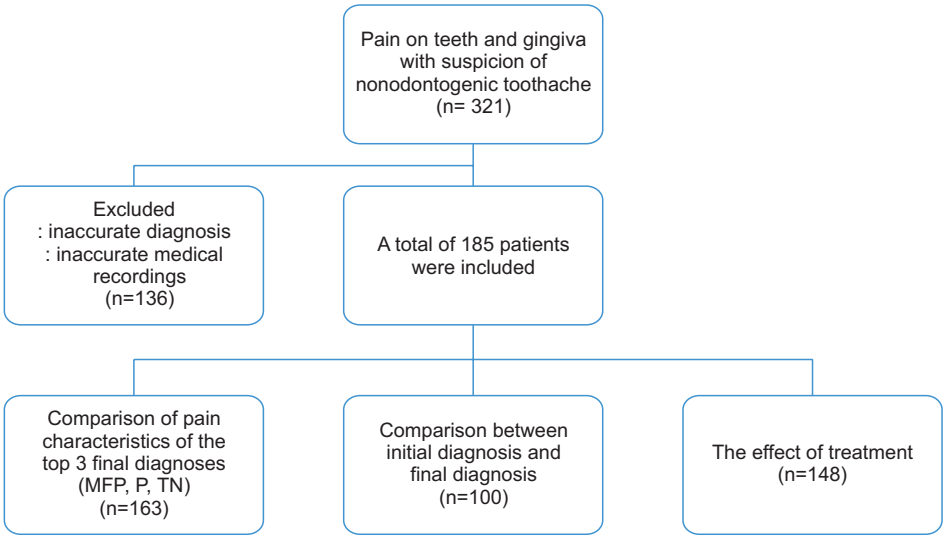

Fig. 1. Study design. MFP, myofascial pain; P, pulpal pain; TN, trigeminal neuralgia.

5. The Analysis of Past Dental and Medical Treatment for Tooth Pain

A review was performed of past dental and medical treatment for tooth pain prior to the patients being referred to an orofacial pain specialist. If a patient received multiple treatments, all of them were recorded. In addition, an analysis was performed on the final diagnosis of patients who underwent tooth extraction and RCT.

6. Statistical Analyses

All statistical analyses were conducted using the SPSS Statistics software, version 29.0 (IBM Co.). A Kruskal–Wallis test was performed for comparison of age, onset of the pain, and pain intensity for the top 3 final diagnoses. A post hoc analysis was performed using the Mann–Whitney U test. The pain characteristics, including continuous pain, spontaneous pain, pain on mastication, pain triggered by thermal stimuli, nocturnal exacerbation of pain, awakening from sleep due to pain, pain relief by analgesics, and pathologic findings on the radiography, were analyzed using a chi-square test. In the event of missing values, the data were excluded from the statistical analysis. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

1. Demographics of Subjects

A total of 185 patients were included in the study. A total of 122 (65.9%) were female and 63 (34.0%) were male. The mean age was 49.8±17.1 years.

Table 1. Demographic distribution of final diagnosis

Final diagnosis	Age (y)	Female	Male	Total
MFP	48.1±17.6	50	20	70 (37.8)
P	45.5±17.4	29	29	58 (31.4)
TN	59.0±12.7	26	9	35 (18.9)
PIDAP	52.1±17.1	11	2	13 (7.0)
PE	51.0±16.5	4	3	7 (3.8)
BMS	56.0±8.5	2	0	2 (1.1)
Total	49.8±17.1	122	63	185 (100.0)

MFP, myofascial pain; P, pulpal pain; TN, trigeminal neuralgia; PIDAP, persistent idiopathic dentoalveolar pain; PE, periodontal pain; BMS, burning mouth syndrome.
Values are presented as mean±standard deviation, number only, or number (%).

2. Distribution of Final Diagnoses

Table 1 presents the distribution of final diagnoses. The most prevalent final diagnosis was MFP, with 70 patients (37.8%), followed by P (n=58, 31.4%), and TN (n=35, 18.9%). Over 90% of the subjects were diagnosed with MFP, P, and TN. The remaining patients were diagnosed with PIDAP (n=13), PE (n=7), and burning mouth syndrome (n=2).

3. The Comparison of Pain Characteristics among the Top 3 Final Diagnoses

A total of 163 patients diagnosed with MFP, P, and TN

were included. The pain characteristics of patients with MFP, P, and TN were compared. The TN group exhibited a significant higher mean age compared to the MFP (p=0.004) and P groups (p<0.001). No statistically significant differences were observed in age between the MFP and P groups (p=0.414). The onset of the pain in the P group was significant shorter than the onset of pain in the MFP (p<0.001) and TN groups (p<0.001). Significant difference was observed in the onset of pain between MFP and TN (p=0.038). The pain intensity in the TN and P groups was significantly higher than the pain intensity of the MFP group (all p<0.001). No significant differences were

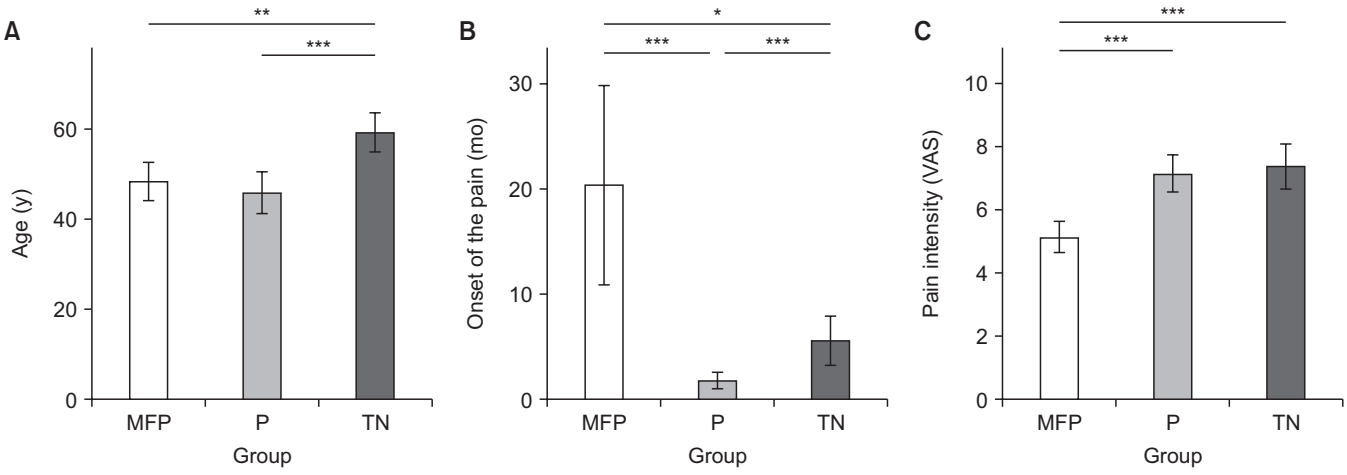

Fig. 2. The comparison of age (A), onset of the pain (B), and pain intensity (C) among MFP, P, and TN groups. Bars present standard errors of the mean. MFP, myofascial pain; P, pulpal pain; TN, trigeminal neuralgia; VAS, visual analog scale. *p<0.05, **p<0.01, ***p<0.001.

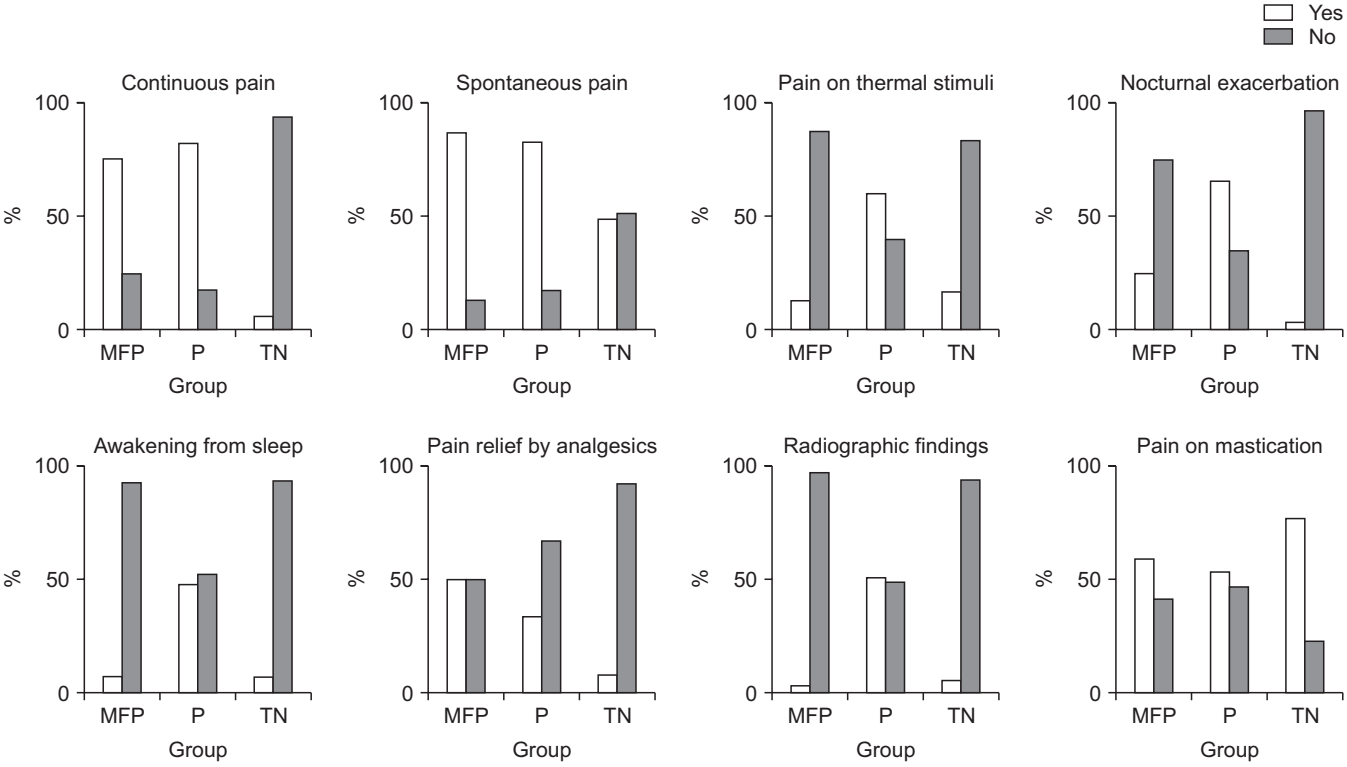

Fig. 3. The comparison of pain characteristics among the 3 final diagnoses. There were significant differences between the 3 groups in continuous pain, spontaneous pain, pain on thermal stimuli, nocturnal exacerbation of pain, awakening from sleep due to pain, pain relief by analgesics, and pathologic findings on radiography (all p<0.001). MFP, myofascial pain; P, pulpal pain; TN, trigeminal neuralgia.

observed in pain intensity between the TN and P groups (p=0.846). The aforementioned results are illustrated in Fig. 2.

Significant differences were found among the 3 groups in all pain characteristics except pain on mastication (all p<0.001). The proportion of patient experiencing pain triggered by thermal stimuli, nocturnal exacerbation of pain, awakening from sleep due to pain, and pathologic findings on radiography is significantly higher in the P group than in the MFP and TN groups (all p<0.001). The results are presented in Fig. 3.

4. Comparison between the Initial and the Final Diagnoses

A comparison between the initial and the final diagnoses is presented in Table 2. A retrospective analysis was conducted on 100 patients whose initial diagnosis was confirmed in the medical records. A concordance rate of 57.0% was observed between the initial and the final diagnoses. Of 100 patients, 37 patients were diagnosed with P (n=32) and PE (n=5). A total of 39 patients were diagnosed with MFP. Of 31 patients initially diagnosed with MFP, 71% were ultimately diagnosed with MFP. Of the 48 patients initially suspected of having nonodontogenic toothache, 43.8% (21 patients) were finally diagnosed with dental pain. Of the 15 patients initially suspected of having TN, 60% were finally diagnosed with TN.

Among 57 patients who were referred from other departments within the same hospital, the initial and final diagnoses were identical in 87.7% of cases (n=50). A total of 57.9% of patients were referred from the Department of Conservative Dentistry. Of the 43 patients who were referred from other clinics or hospitals, the initial and final diagnoses were identical in only 26.2%. Among the 43 patients from local dental clinics or hospitals, 67.5% of patients were diagnosed with P (26 patients) and PE (3 patients).

5. The Effect of Treatment

Among the 148 patients, 140 patients (94.6%) exhibited pain relief, while 8 patients (5.4%) showed no change of pain following treatment. The diagnoses of patients who did not respond to treatment were as follows: PIDAP (n=2), P (n=3), MFP (n=2), and one case TN. No patient exhibited an exacerbation of pain.

Table 3. Past treatments

Previous treatment	Number[a]
Medication	42
Root canal treatment	35
Tooth extraction	27
Periodontal treatment	19
Prosthetic treatment	9
Operative treatment	5
Botulinum toxin injection	3
Oriental medicine	3
Occlusal splint therapy	2
Occlusal adjustment	1
Neurectomy of masseteric nerve	1
No specific treatment	72

[a]If a patient received multiple treatments, all of them were marked.

Table 2. The Comparison between initial and final diagnoses

Initial diagnosis	Final diagnosis (n)						Total (n)
	MFP	P	TN	PIDAP	PE	BMS	
MFP (+TMD)	22	6	2	-	1	-	31
TN	1	4	9	-	1	-	15
Nonodontogenic toothache	16	19	3	7	2	1	48
Neuropathic pain	-	1	-	1	1	-	3
Sialoadenitis	-	1	-	-	-	-	1
Hemangioma	-	1	-	-	-	-	1
PE	-	-	1	-	-	-	1
Total (n)	39	32	15	8	5	1	100

MFP, myofascial pain; TMD, temporomandibular disorder; P, pulpal pain; TN, trigeminal neuralgia; PIDAP, persistent idiopathic dentoalveolar pain; PE, periodontal pain; BMS, burning mouth syndrome; -, not applicable.
Values are presented as number of patients.

6. Past Medical and Dental Treatments for Tooth Pain

A summary of past treatments is provided in Table 3. The most frequently performed treatment was medication. Thirty-five patients underwent RCT, and 27 patients received tooth extraction. The patients who underwent extraction were finally diagnosed with MFP (n=12), TN (n=8), PIDAP (n=6), and P (n=1). The patients who underwent RCT were finally diagnosed with MFP (n=11), P (n=9), TN (n=9), PIDAP (n=4), and PE (n=2).

DISCUSSION

Continuous input of orofacial pain to the CNS from deep structure, including musculoskeletal, neural, vascular, and visceral structures, can result in a central excitatory effect on other unassociated interneurons. This frequently manifests as pain perceived over a larger area than the actual site or even in anatomically distant regions [13]. Given the complexity and variability of orofacial pain, it is imperative to gain an understanding of the characteristics of dental pain and the various conditions that can cause nonodontogenic toothache to ensure an accurate diagnosis.

The most frequently observed diagnosis was MFP. MFP is characterized by the presence of localized, tough bands within the muscles, which are known as trigger points. MFP can induce a central excitatory effect, resulting in heterotopic pain in the tooth area [14]. The specific tooth area is contingent upon the location of the trigger points within the muscles. For example, the masseter muscle affects the ipsilateral mandibular and maxillary molars, while the anterior, middle, and posterior parts of the temporalis muscle affect the anterior, canine, and molar regions of the maxilla respectively [15]. MFP is often associated with nonodontogenic toothache, with 11% of MFP patients reporting tooth pain, frequently originating from the masseter muscle [16].

The diagnosis of MFP is based on the diagnostic criteria for temporomandibular disorder [17]. MFP is the muscle pain that is affected by jaw movement, function, or parafunction and is replicated and spreading with provocation and palpation of the masticatory muscles. If a palpation for more than 5 seconds reproduces a familiar pain and the pain spreads only within the boundary of the palpated muscle, a diagnosis of MFP can be made. If the pain spreads beyond the boundary of the palpated muscle, it is diagnosed as MFP with referral [17]. Referral pain can be reproduced when trigger points are precisely palpated. However, diagnosis can be challenging if it is difficult to locate the trigger points or the trigger points are in an inactive state [18]. The tooth pain caused by MFP is not altered by local stimulation of the tooth but increases with muscle function and palpation of the trigger points. Furthermore, if the tooth pain is not altered by local anesthetic to the tooth but decreases with local anesthetic to the trigger points of affected muscle, a diagnosis of nonodontogenic toothache caused by MFP can be made [19].

P constituted the second most common final diagnosis, occurring in 31.6% of cases. The diagnosis of P is based on the condition of the pulp tissues and apical pain. Depending on the severity of pulp inflammation, P are classified as normal pulp, reversible pulpitis, irreversible pulpitis, and pulp necrosis. Depending on the condition of the apical pain, P are classified as apical periodontitis, apical abscess, and condensing osteitis [20]. Most cases of P were diagnosed as acute irreversible pulpitis in this study. The pain characteristics of P in acute phase are pain response to thermal or chemical stimuli, throbbing quality of pain, high intensity of pain, and continuous and spontaneous pain. The patient usually is unable to clearly locate the affected tooth [21].

TN was the third most diagnosed at 18.9% of the total. TN is a neuropathic pain, characterized by unilateral, episodic, electric shock-like pain triggered by innocuous stimuli [22-24]. If a patient experiences a shooting pain in the tooth area when they are eating, chewing, or toothbrushing their teeth, the pain might be mistaken for a toothache [25]. The diagnosis of TN follows the criteria of International Classification of Orofacial Pain, first edition [2]. The patient experiences severe, sharp or electric shock-like recurrent pain that lasts from 1 second to 2 minutes, and the pain is confined to one or more branches of the trigeminal nerve, and the pain does not spread beyond confined innervated areas.

The characteristics of pain in the 3 groups were compared to identify factors that would help in differential diagnosis. Comparing the MFP and P groups, there was no difference in mean age, but the P group exhibitied a higher pain

intensity. The proportion of patients reporting continuous and spontaneous pain did not differ significantly between the MFP and P groups. The findings of this study highlight the distinct pain characteristics of P, which is characterized by increased sensitivity to thermal stimuli, nocturnal exacerbation of pain, awakening from sleep due to pain, and a higher prevalence of pathologic findings on radiography compared to MFP and TN. These findings align with the established features of P [21].

A comparison of the MFP and TN groups revealed that the mean age of the TN group was higher than that of the MFP group, and the TN group exhibited a higher level of pain intensity than the MFP group. The proportion of patients in the MFP group who reported continuous and spontaneous pain, nocturnal exacerbation of pain, and pain relief by analgesics was significantly higher than that of the TN group.

A comparison of the P and TN groups demonstrated that there is no significant difference in pain intensity. However, notable differences were observed in mean age and onset of the pain. The proportion of patients in the P group reporting continuous and spontaneous pain, pain triggered by thermal stimuli, nocturnal exacerbation of pain, awakening from sleep due to pain, relief by analgesics, and pathologic findings on radiography is significantly higher than that of the TN groups. On occasion, P and TN are indistinguishable due to the similarity in pain intensity. However, the result of this study demonstrated that there are discernible differences in the pain characteristics of the two conditions.

The concordance rate between the initial and final diagnoses was 57.0%. Among the 43 patients referred from other private dental clinics, 26 (67.4%) were diagnosed with dental pain. The concordance rate between the initial and final diagnoses in these patients was 21.6%. It can be challenging for general dental practitioners to differentiate between dental pain and nonodontogenic toothache in the absence of clear clinical signs and pathologic findings on radiography. It is recommended that general practitioners perform a range of diagnostic pulpal tests and inquire about the aforementioned pain characteristics associated with P. Moreover, these findings highlight the necessity for education targeting general practitioners on the subject of nonodontogenic toothache.

In this study, 26 patients had received tooth extractions and 35 had undergone RCT prior to referral. These cases demonstrate that initial misdiagnosis can lead to unnecessary and irreversible dental treatments. Previous studies have frequently reported cases where inappropriate treatments because of incorrect diagnoses [26-28]. In the absence of clear clinical and radiographic evidence of dental pain, it is necessary to observe how the pain changes. P has a tendency to get better or worse over time, but toothache as expressed by MFP or TN rarely changes [3].

Practitioners may have difficulties with differential diagnosis of tooth pain, which can lead to a misdiagnosis and inappropriate treatment. In this study, a higher proportion of patients presenting with suspected nonodontogenic toothache were diagnosed with dental pain than would be expected. This emphasizes the necessity of comprehending the pain characteristics of dental pain and nonodontogenic toothache. A thorough history taking of pain and diagnostic tests should be employed in order to ascertain a differential diagnosis.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

DATA AVAILABILITY STATEMENT

The datasets used in this study are available from the corresponding author upon reasonable request.

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AUTHOR CONTRIBUTIONS

Conceptualization: YJS. Data curation: JYC, YJS. Formal analysis: JYC, YJS. Funding acquisition: YJS. Methodology: JYC, YJS. Project administration: YJS. Visualization: YJS. Writing - original draft: JYC, YJS. Writing - review & editing: JYC, YJS.

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