

# Frequency of pulpal and periapical disorders prior to orthodontic treatment

## Frecuencia de los trastornos pulpares y periapicales antes del tratamiento de ortodoncia

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### Abstract

#### Introduction and objective:

Orthodontic forces can aggravate a pre-existent pulpal condition. The aim of the present study was to determine the frequency of pulpal disorders in patients prior to orthodontic treatment.

#### Materials and methods:

Transversal study. 37 patients (19 female, 18 male) who met the following criteria were included: Patients with permanent dentition (including second molars) with full root formation, with a complete set of periapical radiographs, and no previous orthodontic treatment. Patients using pacemakers or with history of previous orthodontic treatment were excluded. Clinical testing of pulpal vitality and sensitivity, as well as periapical condition, was performed. Relative and absolute frequencies for pulpal and periapical diagnoses were described. Also, stratification by gender, age, arch, and area was implemented.

#### Results:

981 teeth were analyzed, 48.6% of the teeth showed pulpal or periapical disorders (477/981). Pulpless teeth were found mostly in female patients (72.2%), patients with 41 years of age on average (26%), and patients exhibiting three or more restorations (2.8%). 20.5% teeth were affected with periapical conditions (39/942). The first left maxillary molar showed the highest frequency of pulpal and periapical disorders. 73.5% exhibited poorly-performed obturation or condensation techniques from the 34 affected teeth (25/34). 74.3% of affected teeth were in the maxilla and 64.1% were in the posterior area of the mouth.

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**Conclusion:**

A detail clinical and radiological examination of pulpal and periapical status should be performed before the onset of orthodontic treatment.

**Key words:**

Dental pulp, periapical tissue, orthodontics, prevalence, endodontics

## Resumen

**Introducción y objetivo:**

Las fuerzas de ortodoncia pueden agravar una condición pulpar preexistente. El objetivo del presente estudio fue determinar la frecuencia de los trastornos pulpares en los pacientes antes del tratamiento de ortodoncia.

**Materiales y métodos:**

Estudio transversal. 37 pacientes (19 mujeres, 18 hombres) que se reunieron se incluyeron los siguientes criterios: Los pacientes con dentición permanente (incluyendo segundos molares) con la formación de raíces por completo, con un juego completo de radiografías periapicales, y ningún tratamiento ortodóncico anterior. Se excluyeron los pacientes que utilizan marcapasos o con antecedentes de tratamiento ortodóncico anterior. Las pruebas clínicas de vitalidad y sensibilidad pulpar, así como la condición periapical, se llevó a cabo. Se describen las frecuencias relativas y absolutas para diagnósticos pulpares y periapicales. Además, se llevó a cabo la estratificación por sexo, edad, arco, y el área.

**Resultados:**

Se analizaron 981 dientes, 48,6% de los dientes mostraron trastornos pulpares o periapicales (477/981). Los dientes sin pulpa se encuentran sobre todo en pacientes de sexo femenino (72,2%), los pacientes con 41 años de edad en promedio (26%), y los pacientes que presentan tres o más restauraciones (2,8%). El 20,5% de los dientes se vieron afectados con condiciones periapicales (39/942). El primer molar superior izquierdo mostró la mayor frecuencia de trastornos pulpares y periapicales. 73,5% exhibió técnicas de obturación, o de condensación realizados pobremente de los dientes afectados (25/34). 74,3% de los dientes afectados se encontraban en el maxilar y el 64,1% se encontraba en la zona posterior de la boca.

**Conclusión:**

Una detallada exploración clínica y radiológica del estado pulpar y periapical se debe realizar antes del inicio de un tratamiento de ortodoncia.

**Palabras clave:**

Pulpa dental, tejido periapical, ortodoncia, endodoncia, prevalencia.

## Introduction

The application of orthodontic forces produces changes to the neurovascular system of the dental pulp, hence neurotransmitters are released that might alter the blood flow and cellular metabolism, which in turn may cause pain. The type of response depends on the load applied, pulpal conditions (pulpal vitality, presence of an inflammatory process, or necrosis), previous dento-alveolar trauma, and apex maturation status, among others (1,2). Age has an important influence on pulpal and periapical response. Adults have a diminished response comparing with young patients; therefore a more careful evaluation should be performed before the onset of orthodontic treatment in order to address their pulpal and periodontal status (2).

The prevalence of pulpal disorders has been studied in different populations. In Spain 61.1% presented apical periodontitis and 40.6% had at least one root-filled tooth (3), while in Kosovar population the prevalence of apical periodontitis is less with 12.3% and only 2.3% had endodontic treatment (4). In Jordania apical periodontitis is higher with 83.7% and 63.3% had endodontically treated tooth (5). The prevalence of apical periodontitis increased with age in all the previous studies (3-5).

Tooth movement due to orthodontic treatment can cause inflammatory and degenerative pulpal response, like: vitality loss, apex remodeling, and reversible superficial resorption (6,7). Keeping in mind that pulpal disorders are associated with several factors, it is essential that the orthodontic specialist performs a comprehensive clinical and radiographic evaluation of the pulpal status before the onset of the orthodontic treatment in order to avoid attributing pulpal pathological conditions to the orthodontic treatment itself. Therefore, an interdisciplinary approach between orthodontic and endodontic specialists is recommended before the orthodontic treatment begins since forces that

will be applied might aggravate pre-existent pulpal conditions.

A change in the orthodontic approach may be necessary if such conditions are present. The objective of this research was to determine the frequency of pulpal disorders in patients prior to orthodontic treatment.

## Materials and methods

This transversal study was part of an ongoing cohort study with the purpose of determining the incidence of pulpal and periapical disorders in patients undergoing orthodontic treatment. This study was considered as low risk according to resolution 8430 of 1993 by Ministerio de Salud de Colombia and the Ethics Committee of the Universidad Cooperativa de Colombia approved it. (Act. Number: 0800-008) All participants signed a written consent form prior to joining this investigation.

Universe: all the patients who were admitted to initiate orthodontic treatment in the Orthodontic postgraduate Clinic at Universidad Cooperativa de Colombia, Envigado, from March 20<sup>th</sup>, 2012, to March 31<sup>st</sup>, 2013.

Inclusion criteria: patients initiating orthodontic treatment, younger than 18 years of age had to show full root formation, had a full set of periapical radiographs, and signed a written consent form as authorization to participate.

Exclusion criteria: patients with pacemaker or history of previous orthodontic treatment, patients undergoing endodontic and rehabilitation treatments, and patient with a chief complaint different of orthodontic treatment.

Sample: patients who fulfilled the inclusion and exclusion criteria.

Procedures: two evaluations, radiographic and clinical, were performed. The former comprised an analysis of anatomical structures in the full set of periapical radiographs to observe carious lesions, defective restorations, and previous endodontic treatments. The pulpal and peri-radicular tissues from each tooth were also analyzed. Then, one of the authors performed a clinical test that included a vitality test using a device (Dental Tooth Nerve Vitality Pulp Tester®-X. Pac-Dent International Inc - California USA) on each tooth, including maxillary and mandibular second molars. The electrode was placed on the buccal surface of the tooth. The dental structure had to be dry; the electrode was not allowed to come into contact with metallic restorations, exposed dentin, or soft tissues in order to avoid obtaining incorrect results. A range from 0 – 40 were considered a positive response and from 40–80 were a negative response for all type of tooth, according to manufactured recommendation. In addition, a cold sensitivity test was performed using Endo-Frost® (Roeko – Langenau, Germany). A cotton swab was used to apply it on the middle third of the buccal surface of each tooth. Three type of response were considered for examination result: 1. Normal pulp when the response to the stimulus is provided by the sensitivity test and the response is not pronounced and it does not linger, 2. Pulpitis: when there is an exaggerated response that produces pain, reversible when mild pain of short duration was reported and irreversible when severe pain that lingers and 3. Pulp necrosis, pulpless tooth, and root canal therapy: absence of response to sensitivity test (8). The clinical evaluation included an analysis of the remaining healthy dental structure, restored teeth, and presence of carious lesions that could be detected clinically.

Variables: Each patient provided the following information: age, gender, level of education (primary, secondary, professional), socioeconomic status (1 to 6), place of residence (urban or rural area), occupation, previous trauma, changes in

tooth color, pain, previous endodontic treatment, status of endodontic obturation (overextension, underextension, overfilling, underfilling), affected tooth, amount of affected teeth, periodontal ligament space, alveolar bone with radiolucent, radiopaque or resorpted zones, normal or obliterated root canal, presence of dental calculus, and other radiological findings. The outcome variables in this study were pulpal diagnosis (normal pulp, symptomatic and asymptomatic irreversible pulpitis, pulpal necrosis, and previously treated, previously initiated therapy) and periapical diagnosis (normal apical tissues, symptomatic apical periodontitis, asymptomatic apical periodontitis, acute apical abscess, chronic apical abscess, and condensing osteitis) (9).

Prior to initiating the study, a calibration in radiological reading, low temperature evaluation, and vitality testing was performed. Further, a pilot test that involved the two graduate students and the endodontic specialist was completed with the purpose of evaluating the collection instruments and the agreement between observers for radiological and clinical evaluations and diagnosis of the first four patients. The inter-observer agreement was estimated using Cohen's Kappa coefficient. Good agreement was set between 0.6 and 0.8 and almost perfect between 0.8 and 1.0.

### **Analysis statistical**

The information obtained was transcribed to a form that was specifically designed using Excel®. Data analysis was performed using SPSS Statistics v18.0 software.

Absolute and relative frequencies of pulpal disorders were established. Stratification by arch and area (anterior or posterior) was done. A bivariate analysis was performed to identify whether an association existed between gender and age with the presence of particular pulpal disorders.

## Results

There were 228 patients admitted to the Orthodontic Clinic during the evaluation period. 191 were excluded due to several causes: 129 were younger than 18 years old, 42 had a history of orthodontic

treatment, 14 were not reported, 5 did not show for the evaluation appointment, and 1 decided not to participate in the project. 37 patients (19 female, 18 male) comprising 981 teeth were analyzed. All the patients resided in urban areas. 48.6% showed pulpal or periodontal conditions in at least one tooth (39 teeth, Table 1).

**Table 1.** Patients baseline characteristics

VARIABLES		FREQUENCY	PERCENTAGE
<b>Sex</b>	Female	18	51.4%
	Male	19	48.6%
<b>Level of education</b>	Primary	1	2.7%
	Secondary	18	48.6%
	Professional	18	48.6%
	Total	37	100%
<b>Economic status</b>	2	5	13.5%
	3	21	56.8%
	4	8	21.6%
	5	3	8.1%
<b>Presence of pulpal or periapical conditions</b>		18	48%
<b>Healthy pulpal or periapical conditions</b>		19	52%
<b>Total</b>		37	100%

Among 19 patients with pulpal disorders, 79% of teeth were pulpless teeth that had received or were about to receive endodontic treatment, 15.8% presented pulpal necrosis, and 5.2% showed asymptomatic irreversible pulpitis. Out of the eight patients with altered periapical diagnosis, 87.5% showed asymptomatic apical periodontitis and 12.5% acute apical abscess (Table 2).

The first left maxillary molar followed by the right central maxillary incisor and the left lateral maxillary incisor was the tooth that showed the highest frequency of pulpal and periapical disorders (Figure 1).

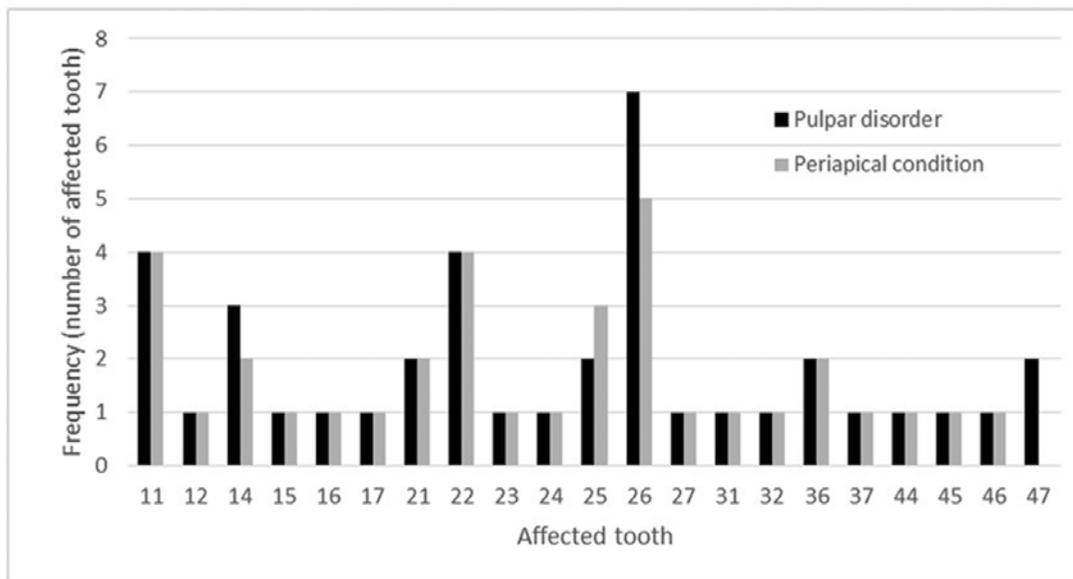
Out of the 34 teeth that exhibited endodontic treatment, 73.5% showed poor obturation (overextension or underextension) or condensation (underfilling) conditions.

Considering type of arch and distribution area, 74.3% of irregular conditions were found in the maxillary arch and 64.1% in the posterior area.

Previously treated teeth were found in patients of 41 years of age (S.D. 12 years) compared to teeth with normal pulps, which were found in patients of 26 years of age (S.D. 7 years) (Table 3).

**Table 2.** Distribution of teeth with pulpal disorders (19 patients) and periodontal conditions (8 patients)

	Diagnosis	Frequency	Percentage
Type of pulpal disorder	Previously treated teeth	15	51.7%
	Pulp necrosis teeth	13	44.8%
	Symptomatic and asymptomatic Irreversible pulpitis teeth	1	3.4%
Type of periapical condition	Asymptomatic apical periodontitis teeth	7	87.5%
	Acute apical abscess teeth	1	12.5%
	Total of teeth with periapical condition	8	100%



**Figure 1.** Frequency of disorder per tooth

**Table 3.** Frequency of pulpal and periapical disorders by age range

Age range	Frequency of pulpal disorders	Frequency of periapical disorders	Percentage
16 - 17	0	0	0 %
18 - 24	2	1	11.1 %
25 - 39	9	5	51.8 %
40 - 49	6	1	26 %
50 - 67	2	1	11.1 %
Total	19	8	100 %

When relating the number of restored surfaces and pulpal diagnosis, all previously treated teeth showed three or more restored surfaces.

## **Discussion**

According to the American Dental Association (ADA), 15 million endodontic treatments are performed in the United States every year. This procedure is generally executed as the treatment of choice after irreversible pulpitis or pulpal necrosis. A study carried out in Ecuador in 2010 reported a frequency of pulpal disorders of 17% (10). Rengifo in Cali, Colombia, reported a frequency of 7%, a low number compared to the 48.6% found in this study (11). No studies on the incidence of pulpal disorders during or after orthodontic treatment were found during literature search.

A previous study reported that the population between 21 and 30 years of age presented the highest frequency of endodontic treatment (31.2%), followed by the population between 31 and 40 years of age (25%) (6, 12). The present study found pulpal and periapical disorders in patients of 41 years of age and the highest percentage of healthy pulps was found in patients averaging 26 years of age.

Regarding tooth type, it has been reported that incisors were affected more (50.2%) than other teeth (49.8%) (13). According to Gulabivala in 2001 (14), this may be explained by the position and morphology of anterior teeth, which makes them more susceptible to caries and traumatic injury in patients under 30 years of age. Besides that posterior teeth require, more endodontic treatments because they remain longer in the mouth, their morphology facilitates dental plaque accumulation, and show large pulpal chambers (14). In the current study, posterior teeth showed the highest percentage of pulpal disorders (64.1%), specially the first molar.

It is important to take into consideration that orthodontic movement might cause inflammatory and degenerative pulpal responses, such as loss of vitality, apex remodeling, and reversible superficial resorption (6,15-17). In addition, the incidence and severity of such changes may vary due to previous pulpal conditions caused by trauma, dental caries, or periodontal disease (2,14, 15,16-26). Therefore, an exhaustive evaluation of the patient before initiating the orthodontic treatment is required.

On the other hand, traumatized teeth subjected to an inadequate orthodontic movement might cause necrosis, internal or external resorption, and pulpal calcifications that will complicate the orthodontic treatment (6). It has been found that a traumatized tooth might be moved orthodontically as long as the pulpal tissue is not severely compromised (infected or necrotic) (17,27). In the present study the history of trauma was not taken to account because its retrospective recollection could have induced bias.

The pulpal and periapical status of each tooth must be determined from a detailed clinical history and radiological and clinical evaluation. It is essential that all patients are questioned about previous experiences before the orthodontic treatment begins. By doing this, the orthodontic specialist will be able to anticipate any possible complications that may arise and monitor the affected tooth during the orthodontic treatment. An interdisciplinary communication with other specialists will assist in determining the long-term prognosis and the most adequate treatment plan for each patient (7,28,29). The orthodontic specialist must be aware of the importance of consulting with an endodontic specialist before starting the orthodontic treatment if questions about the pulpal status of a tooth emerge. This will assist in case of eventual legal complications that originate as a consequence of previously unnoticed pathologies that might be then classified as iatrogenic.

## Conclusions

Near half of the teeth evaluated before the start of orthodontic treatment showed pulpal or periapical disorders. Therefore, it is fundamental to perform a detailed clinical and radiological evaluation of the pulpal and periodontal status before the orthodontic movements begin to avoid exacerbation of existing pulpal conditions and to manage endodontically-treated teeth properly. The clinical examination

should be performed by the orthodontist and when in doubt send the patient to the endodontic specialist.

## Competing Interests

The authors declare that they have no competing interests

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