Correlation between Clinical and Histologic Pulp Diagnoses

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Abstract

Introduction: Clinicians routinely face conditions in which they have to decide whether the dental pulp can be saved or not. This study evaluated how reliable the clinical diagnosis of normal pulp/reversible pulpitis (savable pulp) or irreversible pulpitis (nonsavable pulp) is when compared with the histologic diagnosis. **Methods:** The study material consisted of 95 teeth collected consecutively in a general practice over a 5-year period and extracted for reasons not related to this study. Based on clinical criteria, teeth were categorized as having normal pulps, reversible pulpitis, or irreversible pulpitis. The former 2 were grouped together because they represent similar conditions in terms of prognosis. Teeth were processed for histologic and histobacteriologic analyses, and pulps were categorized as healthy, reversibly inflamed, or irreversibly inflamed according to defined criteria. The number of matching clinical/histologic diagnosis was recorded. **Results:** The clinical diagnosis of normal pulp/reversible pulpitis matched the histologic diagnosis in 57 of 59 (96.6%) teeth. Correspondence of the clinical and histologic diagnosis of irreversible pulpitis occurred in 27 of 32 (84.4%) cases. Infection advancing to the pulp tissue was a common finding in teeth with irreversible pulpitis but was never observed in normal/reversibly inflamed pulps. **Conclusions:** Findings using defined criteria for clinical and histologic classification of pulp conditions revealed a good agreement, especially for cases with no disease or reversible disease. This means that the classification of pulp conditions as normal pulps, reversible pulpitis, and irreversible pulpitis has high chances of guiding the correct therapy in the large majority of cases. However, there is still a need for refined and improved means for reliable pulp diagnosis. (*J Endod* 2014;40:1932–1939)

Key Words

Clinical diagnosis, histologic, irreversible pulpitis, reversible pulpitis

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Pulpitis consists of pulp inflammation in response to irritants of microbial, chemical, or physical (mechanical and thermal) origin. Early attempts to classify pulpitis for clinical diagnosis were based on the type and severity of inflammation (eg, acute serous pulpitis, acute suppurative pulpitis, and chronic ulcerative pulpitis) [1], but studies showed that this classification is not accurate and has poor correlation with the histologic conditions of the pulp tissue [2–5].

The most currently used and generally accepted classification of pulpitis is based on the prognosis of treatment [6, 7]. Accordingly, pulpitis is deemed as reversible when the pulp can predictably return to normal conditions after the removal of the irritant stimulus. In teeth with irreversible pulpitis, pulp conditions have little chance to be reverted to normal only by the removal of the irritants; most cases require partial or total excision of the affected pulp tissue. Knowledge of the pulp response to advancing caries lesions permits one to assume that pulp exposure by caries is a good indicator of irreversible inflammation. As caries destroys dentin and approaches the pulp, the inflammatory response becomes intense and increased in magnitude [8]. However, inflammation does not usually become severe to the point of being considered irreversible until the caries lesion reaches the point of near exposure or the pulp is frankly exposed. In these conditions, the pulp tissue enters in direct contact with bacteria from the caries biofilm and almost invariably undergoes severe inflammation followed by necrosis and then infection [9]. These processes occur by tissue compartments and gradually migrate in the apical direction [10, 11].

In many clinical situations, it is not possible for the clinician to ascertain whether the pulp is exposed, especially in the presence of large restorations or when the therapeutic decision is for stepwise excavation and indirect pulp capping. Thus, diagnosis is mostly based on other features including depth of the caries or restoration as evidenced by radiographs and clinical examination; presence, duration, type, and severity of symptoms; and pulp response to sensibility tests. It remains a matter of debate whether or not the diagnosis based on these features matches the pulp histologic diagnosis.

For instance, symptoms have been widely accepted as indicators of the inflammatory status of the pulp. It is by and large accepted that the presence of relatively mild symptoms relates to reversible pulpitis, whereas more severe symptoms are associated with irreversible pulpitis [12]. However, a systematic review [13] concluded that there is insufficient evidence to determine whether the presence, nature, and duration of symptoms offer accurate information about the extent of pulp inflammation.

Clinicians often have to decide whether the pulp can be saved or not. Consequently, it is important to determine how reliable the clinical diagnosis is in distinguishing cases with savable pulps from those with nonsavable pulps. The purpose of this study was to correlate the clinical diagnosis of normal pulps, reversible pulpitis, and irreversible pulpitis with the histologic diagnosis in a series of teeth extracted consecutively in a dental practice over a certain period of time.

Materials and Methods

The material for this study consisted of 95 human teeth collected consecutively in a general practice operated by a single dentist over a period of 5 years. These were obtained from 79 patients (50 women and 29 men) aged 18–75 years (mean = 37.9 years). The teeth were extracted for prosthetic, periodontal, or orthodontic reasons; treatment plan needs; or the patient's desire of not having the tooth treated. The study was approved by the institutional review board, and all patients gave consent for histologic analysis. From this pool, 58 teeth had untreated caries lesions, 33 teeth had amalgam or composite restorations, and 4 teeth were intact. The teeth were clinically

categorized as having "normal pulp," "reversible pulpitis," or "irreversible pulpitis" on the basis of the following clinical criteria.

Normal Pulps/Reversible Pulpitis

Teeth with the clinical diagnosis of normal pulp or reversible pulpitis were grouped together because they represent clinical conditions in which the pulp can be usually maintained. Teeth included in this group had no history of spontaneous pain and presented only mild sensitivity to cold or sweet stimuli. Pulp sensibility tests yielded responses within normal limits or slightly exaggerated (thermal tests). Pain elicited with the application of the stimulus ceased within a few seconds or immediately upon removal of the stimulus. All teeth were negative to percussion and palpation. Radiographs showed normal periradicular conditions.

A total of 59 teeth were included in this group. Of these, 35 were unrestored teeth with caries lesions of varying extent, which were arbitrarily classified as shallow, medium, or deep. Shallow caries were those penetrating the enamel and involving less than one quarter of dentin thickness, medium caries were those involving approximately one quarter to three quarters of dentin thickness, and deep caries were those involving more than three quarters of dentin thickness (Supplemental Table S1) (14). The other 24 teeth exhibited amalgam or composite restorations (Supplemental Table S1 is available online at www.jendodon.com).

Irreversible Pulpitis

This group consisted of teeth with a clinical diagnosis of irreversible pulpitis. These teeth were associated with severe pain that prompted the patient to seek professional aid or teeth with a history of repeated pain episodes, and often led to self-medication with analgesics. All patients reported that pain was either provoked (by temperature changes, posture changes, or chewing) or spontaneous and had become continuous. In some cases, the patient woke up in the night or pain caused the interruption of normal activities. Pain was defined as throbbing, dull, or sharp. In all cases, it was graded as severe. All patients had difficulty locating the precise tooth that was the source of the pain, and in some instances the patient confused the maxillary and mandibular arches. Sometimes the patient declared that pain was radiating to the ear, the temporal or orbital regions, or the neck. Sensibility tests (heat and cold) gave exaggerated responses. Pain did not cease upon removal of the causative stimulus. The percussion test was negative or slightly positive for some cases. A periapical radiograph was taken for each tooth, and no evident periradicular changes were present, except for widening of the periodontal ligament space in a few cases. A total of 32 teeth were included in this group; 23 of these were teeth with untreated deep caries lesions, whereas 9 were teeth exhibiting amalgam or composite restorations of varying extents (Supplemental Table S2). All cases with a clear indication of pulp necrosis (no response to sensibility tests) associated or not with clinical and radiographic evidence of apical periodontitis were excluded from the study (Supplemental Table S2 is available online at www.jendodon.com).

Control Group

The control group consisted of 4 caries-free maxillary molars whose pulp responded normally to all tests (Supplemental Table S3) (Supplemental Table S3 is available online at www.jendodon.com).

Histologic Processing

Immediately after extraction, the following approaches were undertaken in order to allow proper fixation of the pulp tissue and correct orientation of the specimen in the paraffin block. The teeth were ground under magnification with high-speed diamond burs under water spray on a mesiodistal or buccolingual plane until 1 or 2 pulp horns were encountered. In some teeth, the roots were separated 2–3 mm apically to the root canal orifices before grinding the crowns. Subsequently, they were immersed in a 10% neutral buffered formalin solution for at least 48 hours. Demineralization was performed in an aqueous solution consisting of a mixture of 22.5% (v/v) formic acid and 10% (w/v) sodium citrate for 3–4 weeks with the end point being determined radiographically. All specimens were then washed in running tap water for 48 hours, dehydrated in ascending grades of ethanol, cleared in xylene, infiltrated, and embedded in paraffin (melting point 56°C) according to standard procedures. With the microtome set at 4–5 μm/L, meticulous longitudinal serial sections were taken until the pulp was exhausted. This implied that 500–600 sections were cut for molar teeth. Every fifth section was stained with hematoxylin-eosin for screening purposes and the assessment of inflammation. These sections were used to locate the areas with the most severe inflammatory reaction. Based on this initial evaluation, all slides adjacent to the location with the most severe reaction were stained. In addition, a modified Brown and Brenn technique for staining bacteria (15, 16) was used for selected slides. Coverslips were then placed on the slides, which were examined under a light microscope.

The worst histologic condition observed was recorded for each pulp. Slides were examined by 2 evaluators (D.R. and S.L.). Evaluations were performed separately, and whenever disagreement occurred, it was resolved by joint discussion.

Histologic Criteria

The teeth were histologically classified into 3 categories according to a slight modification of the criteria proposed by Anderson et al (14).

1. Reversible pulp disease: this group included specimens with uninflamed pulps and atrophic pulps. The atrophic pulp appears less cellular than the young healthy pulp with fewer fibroblasts but a greater amount of collagen bundles. The odontoblastic layer may be reduced and flattened. Islands of calcification may be seen throughout the pulp tissue, with thick layers of tertiary dentin reducing the volume of the pulp space. Specimens with evidence of moderate chronic inflammation confined to the coronal pulp were also included. In these cases, lymphocytes and plasma cells are seen gathered in moderate concentrations beneath the deepest areas of caries penetration but do not obscure the normal architecture. Areas of coagulation or liquefaction necrosis, as well as bacteria, are absent.

2. Irreversible pulp disease: either partial or total necrosis of the coronal pulp is present. At least 1 area, even if it is very small, of the pulp tissue has undergone liquefaction or coagulation surrounded by masses of live and dead polymorphonuclear neutrophils (PMNs). Peripherally, concentrations of chronic inflammatory cells (lymphocytes, plasma cells, and macrophages) form a dense halo around these central zones of abscess. Bacterial aggregations/biofilms are observed colonizing the necrotic pulp tissue or the adjacent dentin walls. The presence/absence of a direct communication between the caries cavity and the pulp chamber (ie, perforation) was recorded.

3. Healthy pulp: pulp with no changes in the dentin/predentin/odontoblast complex is present. Dentinal tubules running parallel to each other through dentin and predentin with no reduction in numbers are also observed. There is no reduction of the odontoblast layer or the odontoblast cell size. Tertiary dentin and other calcifications