

Long-term Prognosis of Pulpal Status of Traumatized Teeth Exhibiting Contradictory Results between Pulp Sensibility Test and Ultrasound Doppler Flowmetry: A Retrospective Study

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Abstract

Introduction: In this retrospective study, we investigated long-term (over 3 years) follow-up results of teeth that exhibited contradictory results between the pulp sensibility test (thermal or electric pulp test) and ultrasound Doppler flowmetry (UDF) until 1 year after trauma to inspect the prognosis of the pulp. **Methods:** Data were collected from the records of trauma patients in our hospital between February 2012 and May 2015. The teeth that had continuously shown contrasting results on the pulp sensibility test and UDF until 1 year after trauma were chosen for the study. Cases with follow-up records of more than 3 years after trauma were finally included, and a retrospective chart review was performed. **Results:** Data from 343 teeth in 147 patients who visited the hospital with traumatic dental injuries were examined. Among these, 13 teeth from 7 patients were included, and the record of each case was reviewed. All the subjects showed negative responses on the pulp sensibility test and positive responses on UDF until 1 year after trauma. Ultimately, 8 of the 13 teeth recovered pulp sensibility. Two teeth failed to recover pulp sensibility and became symptomatic; root canal treatment was performed on the teeth. The remaining 3 teeth belonged to patients suffering from nerve damage; therefore, the pulp sensibility test was not feasible. **Conclusions:** Based on this study, UDF can be effectively used for the evaluation of pulpal status in traumatized teeth. (*J Endod* 2017; ■:1–10)

Key Words

Dental trauma, pulp sensibility test, pulp vitality, ultrasound Doppler

For the assessment of the pulpal status of a tooth, pulp sensibility tests or pulp vitality tests can be used. Although the accurate assessment of pulpal status is an essential part of endodontics (1), a

completely reliable technique for determining the status of dental pulp has not been developed yet. Ambiguity in pulp diagnosis exists because the dental pulp is surrounded by hard tissues, which makes it difficult to gain access to the pulp, and thus, it is hard to directly examine the pulp (2). Pulp sensibility tests, which are commonly used to examine pulp status in dental clinics, include the thermal test (heat or cold), the electric pulp test (EPT), and cavity testing (3). They are all indirect methods that determine the state of pulp by examining the responsiveness of nerve fibers in the dental pulp. Therefore, false-positive or false-negative responses are often elicited, especially in young patients with immature teeth (4), traumatized teeth (5), or teeth that are in close proximity with regions where surgery was performed (6, 7).

Unlike pulp sensibility tests, pulp vitality tests directly detect and assess pulpal blood flow to determine pulpal status. Pulp vitality tests include laser Doppler flowmetry, pulse oximetry, and ultrasound Doppler flowmetry (UDF) (3). Studies have shown that laser Doppler flowmetry and pulse oximetry are effective methods for the assessment of pulpal status in normal teeth as well as traumatized teeth (8, 9). More recently, the application of UDF in evaluating pulpal blood flow has been reported, and UDF has been successfully used for the measurement of pulpal blood flow in both experimental (10) and clinical studies (11–13). Cho and Park (14) reported cases in which UDF was used for monitoring the vitality of teeth showing coronal discoloration after traumatic dental injuries.

According to the International Association of Dental Traumatology and the American Association of Endodontists guidelines for traumatic dental injuries, false-negative results in pulp sensibility tests may occur for up to 3 months after trauma (14, 15). This can cause difficulties in deciding when endodontic treatment should be provided to such patients. Some authors recommend the use of a “wait and see” strategy, which advocates that root canal treatment should be abandoned until at least 1 additional

Significance

Within the limitation of this study, UDF can be used effectively in determining the pulpal status of traumatized teeth. When UDF is used along with conventional pulp sensibility tests, unnecessary root canal treatments can be avoided.

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sign of pulp necrosis, such as sinus tract, coronal discoloration, or periapical radiolucency develops (5, 7).

The efficacy of UDF in assessing pulpal status of traumatized teeth was verified in our previous research (16). The pulp survival rate 1 year after trauma was 90% when UDF was used along with the conventional pulp sensibility test (EPT); this value was significantly higher than the pulp survival rate observed in the group in which only the EPT was performed for determining pulpal status (74%). Although the higher percentage of pulp survival in the group using UDF may be because of the better sensitivity of UDF in detecting pulp vitality, the possibility of false-positive or false-negative results in UDF should not be excluded because definite diagnosis of pulp status is only possible through histologic evaluation. Hence, to confirm the vitality of the traumatized teeth, longer clinical follow-ups were performed instead of histologic evaluation.

Subsequent to the previous study (16), we investigated long-term (over 3 years) follow-up results of the pulpal status of traumatized teeth that gave conflicting results between the pulp sensibility test (EPT) and the pulp vitality test (UDF) until 1 year after trauma. Thus, the present study aims to inspect the prognosis of the pulp in traumatized teeth.

Materials and Methods

Data Sources and Inclusion/Exclusion Criteria

The flowchart of data collection is presented in Figure 1. A clinical database was searched for trauma patients who visited the Department of Conservative Dentistry, Yonsei University Dental Hospital, Seoul, Korea, between February 2012 and May 2015. Teeth that met the inclusion criteria were selected for the study. The inclusion criteria are as follows:

1. Teeth on which both the pulp sensibility test (thermal test or EPT) and pulp vitality test (UDF) were used to assess pulpal status
2. Teeth with complete pulp test records performed at 2 weeks, 1 month, 3 months, 6 months, and 1 year after trauma
3. Avulsed teeth or teeth with pulp exposure that needed immediate root canal treatment were excluded from the study

Among the cases that met the inclusion criteria, the teeth that continuously showed contrasting results between pulp sensibility tests and UDF on every visit until 1 year after trauma were finally chosen for the study. For example, teeth showing negative responses on the pulp sensibility test but positive responses on UDF were included in the study. Cases having records of follow-ups performed for over 3 years after trauma were selected, and a retrospective chart review was conducted.

Because of the retrospective nature of the present study, it was reviewed and deemed exempt from the regulations of the institutional review board of the hospital.

Management of Traumatized Teeth and Assessment of Pulp Vitality

For pulp sensibility tests, the ice test and EPT were performed. During the ice test, an ice stick was applied to the middle third of the tooth crown on the labial surface, and the patient's response was recorded. A Parkell Pulp Vitality Tester (Parkell Electronics Division, Farmingdale, NY) was used for the EPT. After the tooth was dried and isolated using gauze and cotton rolls, the EPT tester probe was placed on the labial surface of the tooth. Toothpaste (2080 toothpaste; Aekyung, Seoul, Korea) was applied on the tip as a conducting medium. If the patient reported that he or she felt an electric current, the tooth was considered to show a positive response on the EPT.

For UDF, an MM-D-K (Minimax, St Petersburg, Russia) ultrasound Doppler imaging instrument with a 20-MHz continuous wave transducer was used to measure pulpal blood flow. Ultrasound gel (Pro-gel II; Dayo Medical, Seoul, Korea) was used as the coupling agent. After isolating the target tooth with gauze and cotton rolls, the ultrasound gel was applied, and the transducer tip was placed on the cervical one third of the crown at an approximately 60° angle. When a steady pulsatile waveform and sound were detected, the tooth was considered to have a positive response on the UDF (12). When the pulsatile sound was

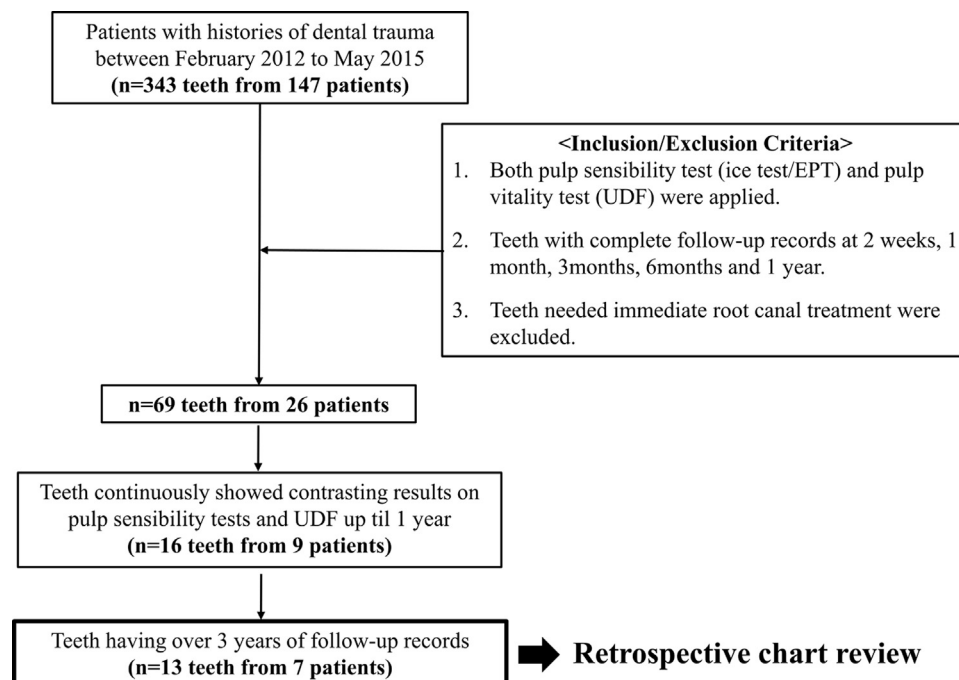


Figure 1. The flowchart for case selection.

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