Impact of Cone-beam Computed Tomography on Treatment Planning for External Cervical Resorption and a Novel Axial Slice–based Classification System

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Abstract

Introduction: The aim of this study was to compare treatment plans for external cervical resorption (ECR) developed from periapical (PA) radiographs and cone-beam computed tomographic (CBCT) imaging. The secondary aim of this study was to test a new classification system for ECR based on CBCT axial slice analysis. **Methods:** ECR was identified in 56 teeth (47 patients) from a database of 928 CBCT images. Strict exclusion criteria resulted in a sample of 30 ECR teeth (25 patients) and 10 ECR-free control teeth. Six examiners evaluated CBCT and matched PA images in separate sessions. Examiners classified ECR according to the Heithersay classification system and the novel Rohde classification system and provided a treatment plan. **Results:** All 30 ECR cases were identified by CBCT imaging and 29 by PA radiography. Interrater agreement was uniformly higher with CBCT imaging, and treatment plans developed from CBCT scans differed from those developed with PA radiographs in 56.7% of the cases. Examiners recommended ECR repair in the majority of cases (59.8% of CBCT images and 56.7% of PA radiographs). The Heithersay classification was dependent on the method of imaging with a greater prevalence of class 4 reported with CBCT imaging ($P = .0016$). The Rohde classification system significantly predicted the recommended treatment plan ($P = .002$ for Rohde class 2 and $P = .043$ for Rohde class 3). All Heithersay classifications failed to statistically predict treatment plans. **Conclusions:** Treatment plans changed between PA and CBCT imaging in the majority of cases evaluated. If CBCT imaging is available, the Rohde classification system may help guide treatment planning for cases of ECR. *(J Endod 2017;■:1–6)*

Key Words

Cone-beam computed tomography, external cervical resorption, invasive cervical resorption, management, root resorption, treatment planning

Significance

A new CBCT classification system for external cervical resorption is presented.

External cervical resorption (ECR) is a substantial diagnostic and treatment planning challenge even for highly experienced clinicians. Although the exact etiology of ECR remains unknown, ECR has been associated with orthodontics, trauma, occlusal dysfunction, surgery, periodontal therapy, and internal bleaching (1–3). External cervical resorption is believed to occur in 3 general stages: an initiation stage, an active resorption stage, and a reparative stage. In all stages, the presence of a pericanalar resorption-resistant sheet (PRRS) prevents pulp space penetration. The PRRS and attempted calcific repair in the reparative stage of ECR results in the distinct radiographic features of ECR that clinicians often rely on to make a diagnosis (4). The timely diagnosis of ECR is difficult because these findings are often incidental and patients presenting with ECR are most commonly asymptomatic (1, 5).

Since the introduction of cone-beam computed tomographic (CBCT) imaging into endodontics, a great deal of literature has developed supporting the superior technical and diagnostic accuracy of CBCT imaging when compared with traditional periapical (PA) imaging (6). The ability to analyze slice images has greatly improved providers' capability to identify the location and extent of ECR lesions (7, 8). However, because of the increased radiation dose to patients, it is recommended that providers be judicial in their use of this technology. Only a few studies exist in the literature showing the effect of CBCT use on treatment planning or outcomes, including only 1 study that evaluated ECR cases (9–12).

The majority of the foundational work on ECR was conducted by Heithersay (3), who preferred the term invasive cervical resorption. Heithersay published an extended report on ECR that explored predisposing factors, characterized clinical and histologic features, provided a classification system, and promoted treatment strategies (13–15). The primary treatment strategy advocated by Heithersay was an external surgical approach without a flap in which he recommended the use of 90% aqueous trichloroacetic acid to inactivate the resorptive tissue followed by curettage, restoration with glass ionomer, and endodontic treatment when necessary. In consideration of this treatment strategy, the apical extent of ECR lesions affects a provider's ability to achieve the treatment goals. Accordingly, the 4-point classification system introduced by Heithersay combines the progression of the resorption toward the pulp and the furthest apical extent of the lesion to grade the severity of tooth structure loss caused by resorption. This classification system remains in common use and at present provides the only available prognostic guide to aid clinicians in treatment planning decisions for ECR (14).

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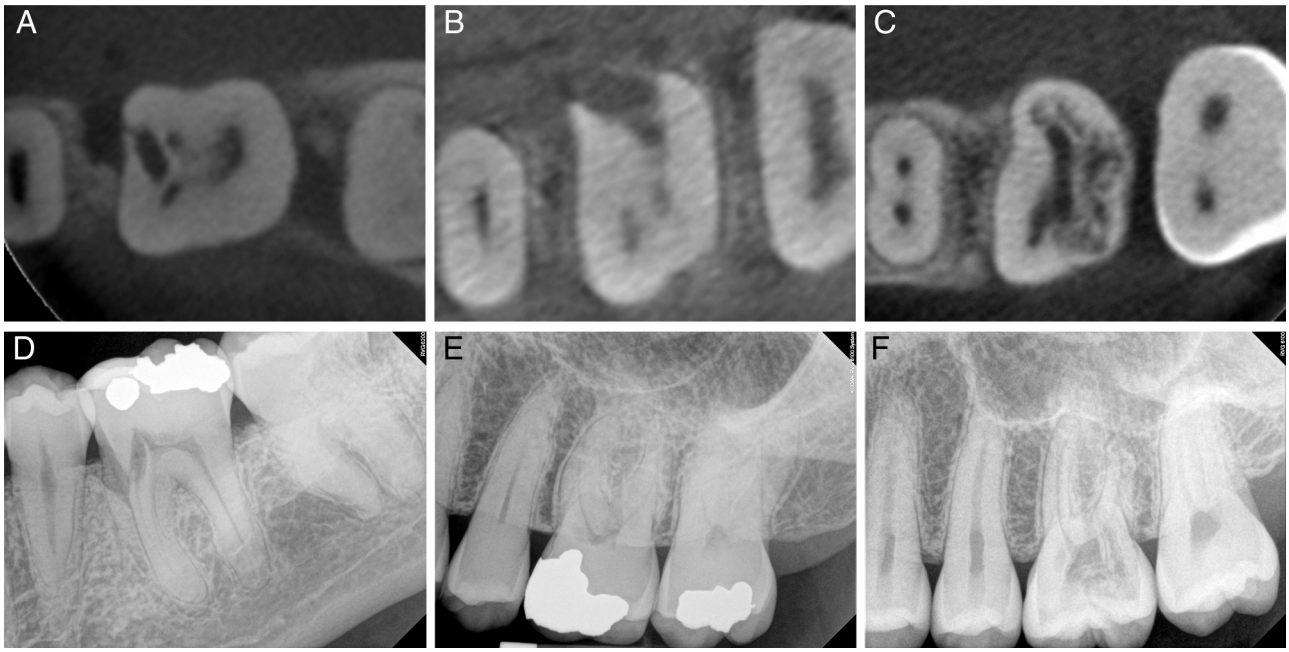

Figure 1. Rohde classification system. (*Top*) Example CBCT axial slices depicting (*A*) Rohde class 1, (*B*) Rohde class 2, and (*C*) Rohde class 3. (*Bottom*) Corresponding periapical images of the teeth depicted in the CBCT slices above them: (*D*) PA image of Rohde class 1, (*E*) PA image of Rohde class 2, and (*F*) PA of Rohde class 3.

Since the early work by Heithersay, dramatic changes have occurred within the field of endodontics such as the widespread implementation of new technology and techniques, including the dental operating microscope, ultrasonic instruments, calcium silicate–based materials, and small-volume CBCT imaging. A great deal of renewed interest in the treatment of ECR lesions using these new technologies has developed (16–19). Several recent case series have shown the successful treatment of class 4 ECR lesions using these modern techniques (16, 17). In one such case series, Salzano and Tirone (17) suggested the need for a new classification system based on the lateral extent of the lesion because they hypothesized that horizontal tooth structure loss in the critical cervical area would be more detrimental to prognosis than the apical extension.

With these observations in mind, we have proposed a new classification system based on the analysis of CBCT axial slices. This classification system, termed the Rohde classification system, is a 3-point classification system that applies to lesions in which the resorptive process has invaded dentin reaching the PRRS surrounding the dental pulp, as is seen in lesions classified as Heithersay classes 2 through 4 (Fig. 1*A–F*).

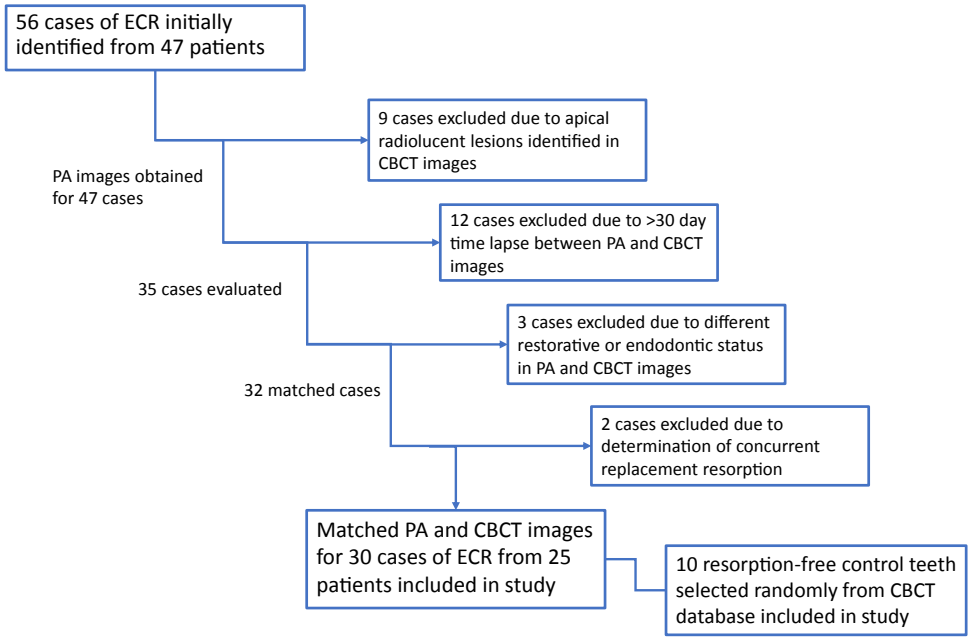

Figure 2. Exclusion criteria.