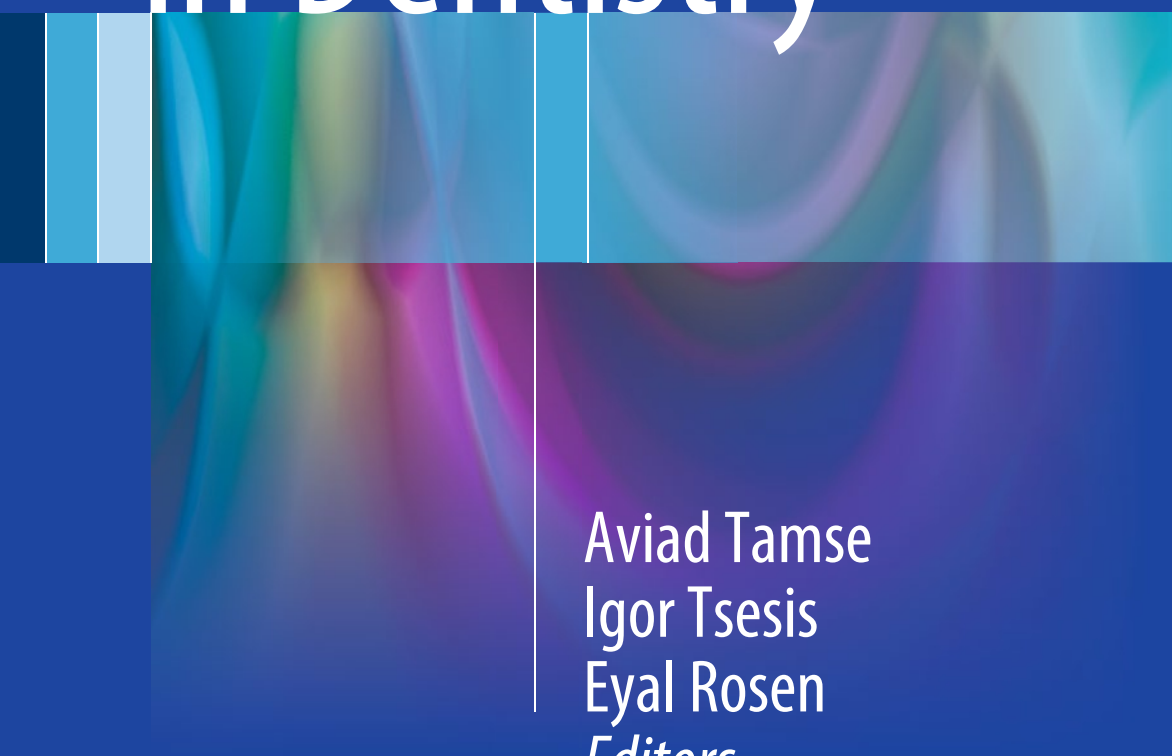
Vertical Root Fractures in Dentistry



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Contents

Introduction

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Aviad Tamse, Igor Tsesis, and Eyal Rosen

Abstract

Vertical root fractures (VRFs) are root-originated fractures in endodontically treated teeth and are considered as the third most common cause for tooth extraction after dental caries and periodontal diseases [1–3] (Fig. 1.1). They often present diagnostic problems that challenge the expertise of even skilled and most experienced clinicians [1, 2]. This clinical entity may be difficult to diagnose because often the clinical signs, symptoms, and radiographic features can mimic signs and symptoms of failed endodontic treatment or a periodontal disease [1, 4, 5]. In addition, there are many aspects and a variety of issues regarding the root fracture etiology and risk factors, and VRFs may develop also in teeth with good-quality endodontic treatment and well-prepared coronal restoration [1, 4, 5]. Therefore, prevention of these fractures is all together difficult and frustrating.

VRF is regarded as a clinical condition, in which several predisposing factors, such as the root anatomical structure, together with operative procedures, such as root canal treatment and dowel placement, contribute to the development of a fracture in the root [1, 4–12]. However, only after an unknown period of time, when the root canal and the fracture area becomes infected, an associated pathology may develop [1, 4–12].

Therefore, a VRF without infection, defined as a "*histological VRF*", is not clinically evident, until infection of the fracture occurs with ensuing emergence of clinical signs and symptoms [1, 4, 12]. At that stage, the VRF may be defined as a "*clinical VRF*". The prevalence of "clinical VRFs" as evaluated in extracted endodontically treated teeth was reported to range from 11 to 20 % [6, 7]. However, the prevalence of

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Fig. 1.1 A typical vertical root fracture in an endodontically treated, restored maxillary premolar

"histological VRFs" in endodontically treated teeth is yet unknown and is probably significantly larger than the prevalence of the clinically evident "clinical VRFs".

Imaging techniques, which are an essential landmark in the dental daily practice, may only be helpful sometimes for the definitive VRF diagnosis and are still incapable to demonstrate the incipient fracture [1, 4, 5].

It became acceptable and common to use cone beam computed tomography (CBCT) for the diagnosis of VRF [5], assuming that CBCT is clinically effective for this purpose and that it possesses superior efficacy over conventional periapical (PA) radiography. Nevertheless, recent published data raises a concern regarding the efficacy of CBCT and its alleged superiority over conventional PA radiography for the detection of VRF [13–15].

New reports suggest that actually there is no difference between the diagnostic accuracy of either imaging modalities and that both modalities have significant limitations [13, 15]. In addition, the presence of intracanal radiopaque materials adversely affects the diagnostic efficacy of CBCT; thus, CBCT is not beneficial for the diagnosis of VRF when metal dowels are present [14]. Therefore, there is a great

concern regarding CBCT potential benefit to the patient compared to its potential radiation risks [16–23] and regarding its clinical effectiveness for the diagnosis of VRFs [13–15, 24, 25].

Adding to the clinical complexity of this root-originated fracture is the fact that when a VRF is finally diagnosed, often years after the fracture was initiated and after the root and the tooth are fully treated and restored, it not only requires in some cases invasive diagnostic procedures such as exploratory flap procedure but is already late in most cases to save the tooth or root [1, 4, 5]. However, over the years, there had been attempts to save some of these teeth by either extracting the fractured root in a multirooted teeth or by attempts to treat the fractured root itself [26–32]. Although extraction of the fractured tooth or root is still usually the treatment of choice, modern endodontic techniques combined with an appropriate case selection seems to be able to allow the preservation of some VRF teeth [26–32].

When extraction of the root or the tooth following VRF diagnosis becomes inevitable, the dentist faces many times an additional dilemma, since the bony socket of the extracted tooth or root is infected and much of the tooth supporting bone was resorbed due to the infection facing the infected fracture [5, 31, 33–35]. This clinical challenge is especially evident when the buccal bony plate which is originally very thin is resorbed, and if not diagnosed and treated earlier, the interproximal bone resorbs as well [5, 31, 33–35]. The clinician is now facing a challenge of when and how to treat the infected socket, an issue that nowadays the profession has some new treatment modalities to treat [5, 31, 33–35].

VRFs are sometimes diagnosed years after endodontic and prosthetic procedures have been completed [36, 37], and many times, extraction of the VRF tooth or root becomes inevitable [37]. This late diagnosis may also contribute to significant supporting alveolar bone loss, thus complicating the postextraction socket management and the future restoration [37]. Endodontic medicolegal claims are common among malpractice claims in dentistry [38, 39], and this combined diagnostic and treatment challenge of VRFs may expose the practitioner also to potential medicolegal risks [37].

It is for the first time that a book is dedicated to this complex clinical condition, presenting the wasn't updated scientific information on VRF'S in dentistry. Many figures and illustrations accordingly this text to enables an efficient reading and learning of the various issues of VRFs. In this way the book will be beneficial to all dental beneficial to all dental professionals who want to learn more on the topic students, practicing dentist specialists and researches.

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Categorization of Dental Fractures

2

Leif K. Bakland and Aviad Tamse

Abstract

Categorization of dental fractures should take into account the origin, the location, and the direction of fracture progression. Identifying the fracture category will influence the selection of treatment options. The type of fracture category to be covered in this book will be that primarily occurring in endodontically treated teeth; the fracture is of a *chronic* nature and characterized as having a vertical direction over time and identified as vertical root fracture (VRF). The other two fracture types—crown-originating fractures (COFs) and trauma-related fractures—will be briefly described in this chapter to differentiate them from VRFs.

Introduction

Fractures of bones and teeth can be described as discontinuity in the integrity of these anatomic entities and usually result from either acute or chronic injury [1, 2]. In this chapter, we will categorize dental fractures for the purpose of identifying the various fracture entities involving teeth. To reduce confusion, the term *fracture* will be used when describing these clinical situations rather than the many other terms that have been used such as *cracks* and *infractions.* The term *crack* will be used as the initial minute fracture originating in the dentin and doesn't have clinical relevance (See Chap. 3).

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One of the reasons why dental fractures can be very confusing in their clinical presentation is that teeth consist of several tissues—enamel, dentin, cementum, pulp, and periodontal ligament. Adding to the anatomic complexity is the observation that symptoms alone cannot always be relied on to arrive at a definitive diagnosis and in addition clinical signs may often be difficult to interpret. It is generally recognized that for some dental fractures, pathognomonic signs and symptoms are few and frequently difficult to identify. These complexities have contributed to the difficulty in developing a universally acceptable classification. Efforts that have been made toward classification of dental fractures—such as that by the American Association of Endodontists [3], have not been adopted universally. Treatment of teeth with any type of fracture must be preceded by a accurate diagnosis. As mentioned above, the more complex the fracture situation is, the more difficult it may be to make the accurate diagnosis; such a situation can often be frustrating for both the patient and the dentist. Add to that the fact that treatment options vary considerably depending on the diagnosis, thus it is easy to understand why dental fractures can present some of the more difficult dental problems in the scope of dental practice. Since making an accurate and timely diagnosis is so important in terms of treatment planning and establishing a prognosis, we suggest that developing a practical categorization or classification of the various dental fractures may contribute to more predictable outcomes.

Supporting the value of a generally acceptable classification system is the observation by Andreasen [4] that "because of the increased incidence of medical and dental litigation (See Chap. 8) a necessary aspect of any classification system is the provision of an accurate description of the injury that can be easily understood by individuals with differing educational backgrounds."

Categorization of dental fractures should take into account the origin, the location, and the direction of fracture propagation. Identifying the category will influence the selection of treatment options. The focus in this book will be on the dental fractures that are of a *chronic* nature and characterized as generally having a vertical direction, corresponding to the long axis of the tooth, and having a time component that relates to the fracture line propagating over various time periods [5].

The clinical terms *craze lines*, *fractured cusp*, cracked tooth, and split tooth [3] describe fractures that are all longitudinal or variations thereof and can be categorized into one category. We suggest that category be referred to as *crown-originating fractures* (COFs). They are different from those resulting from *acute* traumatic injuries (trauma-related fractures) and those that are the focus of this book—vertical root fractures (VRFs) (See Table 2.1). The terms *crack* or *root crack* will be used to describe the initial minute fractures originating in dentin as explained previously.

Dental Fractures

The following is a scheme of categorization based on what can be observed with respect to the various dental fracture situations.

Table 2.1 Dental fractures

Categories	Characteristics
Crown-originating fracture (COF)	Spontaneous fracture originating in the crown and may progress into the root in an apical direction
Vertical root fracture (VRF)	A root-originating fracture that may originate anywhere in the root and occur primarily in endodontically treated teeth
Trauma-related fractures	Tooth fractures of acute nature may involve the crown or the root or both

Crown-Originating Fractures (COFs)

These types of fractures typically originate in the tooth crown and are not related to root canal treatment. The fractures progress toward the root; after reaching the coronal area of the root, the fracture lines continue in an apical direction. If not treated, teeth with such fractures will eventually split vertically, or if the fracture line progresses diagonally below a cusp, that cusp may fracture off the tooth. If the cusp fracture does not create a serious periodontal problem, usually this entity can be treated with good prognosis.

Craze lines are fractures limited to the enamel only and may extend over the marginal ridges (Fig. 2.1) in molars and occur in the anterior segments as well (Fig. 2.2) [3]. They are considered benign and require no treatment except occasionally for esthetic reasons.

Some crown-originating fractures (COFs) have been identified as *cracked teeth* [1]; they are found in maxillary and mandibular molars and maxillary premolars. These fractures occur mostly in teeth with vital pulps and have a mesiodistal pattern. They can be observed in intact crowns or may be seen next to a carious lesion or adjacent to a small restoration. The fracture in the crown can at times extend apically to eventually separate the tooth into two parts (*split tooth*) [3] (Figs. 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, and 2.9).

Crown-originating fractures typically extend to either or both of the marginal ridges through to the proximal surfaces [3]. Very few of these crown fractures have a bucolingual direction. The fractures progress from the marginal ridges through the pulp chambers and eventually may result in a split tooth.

Fractures may be visualized in the tooth crown with transillumination or with the use of dyes absorbed into the fracture lines. The patient's history and symptomatology may include pain in the tooth or pain referred to other oral regions increasing the diagnostic difficulty [6]. Many patients experience a vague discomfort during mastication, often with elevated sensitivity to cold.

Contributing to the diagnostic difficulty may be lack of notable caries or other reasons for pulpal disease. The patient's symptoms may also resemble those in patients with ear aches, TMJ dysfunction, sinusitis and neurological problems [7]. The longer the symptoms are present, the more diffuse they become, and the more difficult the diagnosis becomes [6]. It may be prudent to consider the presence of COF whenever the usual suspects (caries, etc.) are absent. Correct diagnosis and identification of the actual type of fracture involved will help in developing treatment options.