

THE DOCTOR-PATIENT RELATIONSHIP FACING THE MUTUAL ASSUMED RISK CONCERNING VERTICAL ROOT FRACTURE. A NARRATIVE REVIEW – PART 1

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Abstract: *Background.* The vertical root fracture (VRF) is a longitudinal one starting and developing at dental root level. For a period of time diagnosis is presumptive, due to the nonspecific and moderate-intensity symptoms, confirmation requiring extraction of the tooth. Since loss of the tooth represents for both doctor and patient a treatment failure, the ensuing disappointment can be expressed in the form of claims with medico-legal issues.

Objective. To assess the doctor-patient relationship concerning the risks involved by vertical root fracture, starting from the etiology and diagnosis possibilities of such an occurrence.

Materials and methods. In order to analyze this subject, several biomedical databases were inquired - PubMed, Web of Science, Embase, Cochrane Library - using combinations of terms appropriate to the subject.

Results. Endodontic treatment engenders dentin root alterations affecting the structure of the tooth as a whole thus increasing the susceptibility and risks of VRF development. In such circumstances the doctor-patient partnership can be severely shaken if the patient has not fully understood the risks and consequently exclusively attributes the failure to the doctor. In this relationship, the doctor's communication skills are of paramount importance.

Conclusions. Awareness of the clinical and therapeutic factors that favor the occurrence of vertical root fractures by doctors and patients alike prevents the appearance of possible subsequent disagreements, informed consent playing the role of holding both the doctor and the patient accountable in order to prevent a possible accusation of malpractice.

Keywords: doctor-patient relationship, risk awareness, vertical root fracture, endodontic treatment.

INTRODUCTION

Vertical root fracture (VRF) is one of the most unfortunate events in endodontic practice. Diagnosis confirmation often requires consulting several specialists, soaring patient's disappointment who is most likely facing tooth loss.

Frustration is directly proportional to the time and financial effort and amplified by the expected complex restoration procedures. Dentist's decision to perform an endodontic treatment is definitely based on the appreciation of the degree of restorability of the respective tooth. Most patients are aware of progresses made in dentistry and possibilities of performing

high-performance endodontic treatments, the success rate being over 85%. Therefore, the patients have very high expectations both in terms of endodontic treatment quality and of further maintaining the tooth in complete functional conditions. Thoroughly explaining the treatment stages and risks involved is thus fundamental in establishing the doctor-patient partnership. It is essential that technical aspects that may seem cumbersome, boring and dull have to be fully understood by the patient from the very beginning of the endodontic treatment. Commonly we all - doctors and patients - have the unfortunate tendency of perceiving risk as only an immediate event and too little as a distant one. The occurrence

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of VRF is a most often unlikely event of which it is best for both doctor and patient to be aware of, as partners in carrying out a successful and sustainable endodontic treatment. The mandatory patient consent has to be fully understood and realized by the patient, especially for what would mean possible complications and generally accepted risks.

Being caused by occlusal loads and / or dental procedures, VRF may concern any tooth [1]. Decisive factors are generally considered to be stress developed during root canal filling using gutta-percha condensation techniques and endodontic post placement [2].

Multiple singular or cumulative factors compete in certain circumstances to the appearance of a VRF. The subject has received a lot of attention after relationship to microcracks occurring during shaping and filling root canals were stated [3].

Factors such as premature occlusive contacts, oral parafunctions involving large and repeated mastication forces and dental treatment procedures can aggravate these microcracks, which can eventually develop into vertical root fractures [4]. Direction and amount of occlusive loads are important generators of VRF when exceeding the elastic modulus of dentin at any tooth and all age groups [5]. The increase in life expectancy has also led to a larger number of teeth undergoing endodontic and restorative treatments and hence a higher rate of VRF.

Frustration felt by both dentist and patient is due to the late clinical manifestations of VRF: years after endodontic and prosthetic treatment. The diagnosis is difficult due to the absence of specific signs and symptoms and / or typical radiographic features, which further complicates the differential diagnosis compared to other pathologies. The prognosis is unfavourable extraction usually being the only treatment option [2].

MATERIAL AND METHOD

Several biomedical databases were inquired - PubMed, Web of Science, Embase, Cochrane Library - using combinations of terms appropriate to the subject. Boolean operators such as (vertical root fractures), (longitudinal root fractures), (vertical root fractures in endodontically treated teeth), (VRF), etc. were used. A number of 572 results have been found. Applying the inclusion and exclusion criteria resulted in 62 studies used the analysis we performed on the subject of VRF.

RESULTS

Prevalence of vertical root fractures

Rate of VRF in retrospective clinical trials targeting extracted endodontically treated was specified to be 10.9% [6], 13.4% [7] and even 31.7% [8]. These figures are obviously influenced by the number of study participants, the period of development and the analysis of the results, thus having a relative character. VRF originating from the apical region had a predilection for axial localization in the buccal-lingual direction (90.8%), as VRF originating from the cervical region showed a more diverse location: axial 57.4%, buccal-lingual 36.2%, mesio-distal 6.4% [10].

Pathogenicity of VRF

Vertical root fractures are initiated from the apical, middle or cervical third of the root and propagate longitudinally sometimes along its entire length. Axial extension can be complete, buccal-central, lingual-central, central or mesio-distal. The route of the fracture line can be straight, oblique, curved or in zig-zag (Fig. 1)[9].

When the fracture reaches the external root surface, the endodontic space directly communicates with the periodontal tissue. Tissue damage follows with a resulting destruction of the periodontium leading to decomposition of the periodontal ligament, alveolar bone loss and the formation of granulation tissue. Directed by the location and extent of the fracture line the bone defect usually fairly quickly spreads apically and interproximally [11].

VRF diagnosis

Most of the clinical signs and symptoms of vertical root fractures are non-specific. Most vertical root fractures are hence diagnosed following prosthetic rehabilitation, leading to the failure of the entire treatment. Comprehensive history, careful and systematic examination, accompanied by clinical tests and radiological examination can provide the diagnosis of VRF.

Symptoms are minimal, absence of pain or mild pain are most common in 66% of cases [9] and moderate or severe pain levels are rarely reached. The patient often detects a certain degree of tooth mobility but the tooth is usually stable. Symptoms caused by damage to the periapical region and showing mild pain in mastication and even mild mobility, have been reported [5]. Percussion and palpation response is of low intensity [11] and only occurs in 6,6% of cases [9].

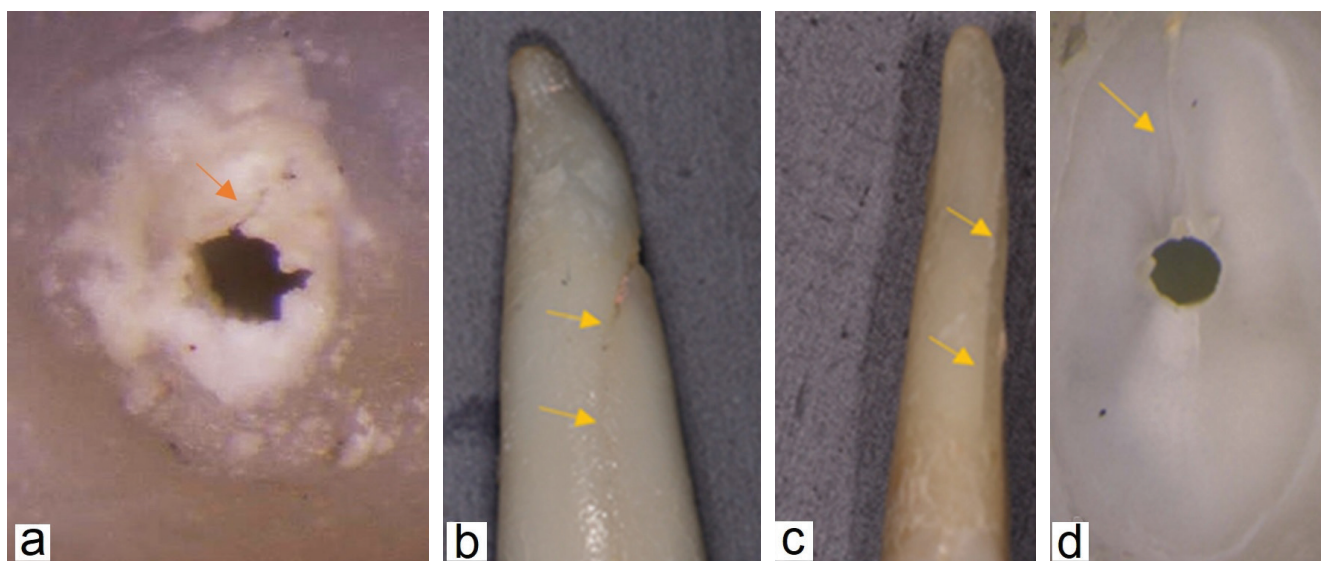


Figure 1. Initiation and propagation of vertical root fracture: a. Initiation of VRF in the apical region; b. VRF in the middle third; c. longitudinal propagation of VRF; d. incomplete fracture on the buccal-lingual direction.

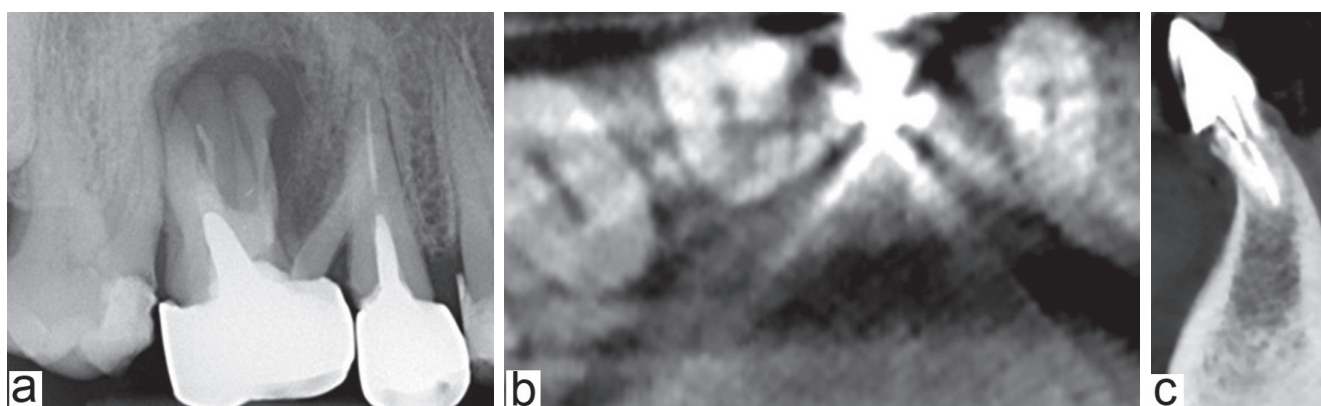


Figure 2. a. Radiological aspect of VRF at tooth 16; b. CBCT sagittal section of 41 - scattering due to the endodontic metallic post; c. CBCT cross section of 41 - VRF is detected.

The most common clinical sign of vertical root fracture is the presence of a deep periodontal pocket in less than 24% of cases [9, 11]. If buccal or lingual these pockets may be accompanied by sinus tracts in 13% to 42% [5] or even 46.6% of cases [9]. The VRF could thus perfectly mimic periodontal lesions [2, 5]. According to American Association of Endodontists (AAE) a narrow periodontal pocket associated to a sinus tract is frequently pathognomonic for VRF [12].

Radiographic examination is an important diagnostic adjunct, which can provide additional information when substantiated with clinical signs and symptoms. VRF can be overlooked if the X-ray beam does not pass along the fracture line. On conventional periapical radiography VRF is noticeable if separation of the root fragments takes place or the X-ray beam coincides with the fracture plane (Fig. 2a). Though it has been suggested that a radiolucent line separating

the root canal filling from the canal walls represents a fracture visualization, this may only be a radiological artifact, an incomplete filling or a bone structure overlap [1].

If bone resorption exists radiographic image may involve the cervical or apical third and extend along the root surface in a “J” - like pattern in 16.6% of the cases [9] or a “halo”. Computer tomography (CT) and cone beam computed tomography (CBCT) may better reveal a fracture line through multiplanar images reconstruction [13]. Clinical and *ex vivo* studies demonstrated a higher precision of CBCT for detection of VRF (Fig. 2c) and significantly more for complete fractures *versus* incomplete ones [14], though guttaperca and metallic posts may lead to radiological artifacts (Fig. 2b) and thus lower trust in using CBCT for VRF diagnosis [15]. The recommended resolution is in this cases 0.2 voxels [16]. CBCT is not currently

used in every dental office, conventional radiographic imaging still being the examination of choice [15].

Early clinical signs and symptoms suggesting a VRF showed 1 to 2 years later of a moment of overload exerted on an endodontically treated tooth [17]. The time interval elapsed between the completion of endodontic treatment and the diagnosis of a VRF is 1 to 5 years [6] or an average of 4,35 years [9]. One study reported 80% needed 2 years from first symptoms to diagnosis [8]. Even if invasive, if CBCT is inconclusive, direct surface root examination by surgical exposure may be the only way to avoid a diagnostic error.

Considering the studies taken into account the incidence of VRF show the highest rate for maxillary premolars 22.8% [10], mandibular premolars 51% [6], the mesial roots of mandibular molars 34% [10] up to 51.8% [6], the mesio-buccal root of the first maxillary molar 15% [18], mandibular and maxillary incisors 17.7% [19, 20]. The most frequent propagation direction is the buccal - lingual one [1, 2, 5, 6, 9].

DISCUSSION

The onset of VRF symptoms at about 5 years [8, 10, 11, 19, 21] after treatment endodontic ends justifies in the acceptance of some of the patients material demands from the doctors who performed the treatment of the concerned tooth [11, 21]. The difficulty of establishing a definitive diagnosis lasts on average over 2 years in 80% of cases [8] and until the tooth extraction decision is taken, the patient still needs on average another 2 years [11]. During this period of time bone resorption progresses and guided bone regeneration is required to compensate for the bone loss caused by VRF. Subsequent restoration by means of a dental implant is in many cases the only solution.

In some countries medical insurance systems provide for such unfortunate developments concerning the endodontic treatment. The prevalence of VRF in health systems that predict such events is 8.9% -10.9% [21].

The doctor-patient partnership can be severely shaken if the patient has not fully understood the risks and consequently attributes the failure exclusively to the doctor. In this relationship, the doctor's communication skills are of paramount importance.

Patients have different personalities and as a result the doctor-patient relationship can be of several types. Some patients are distrustful, suspicious and require multiple and detailed explanations, others have a total trust in the doctor and consider that they do not

need much explanation. The "pessimists", part of the first category, after understanding all the aspects, are well aware of the complexity of the treatment and assume it together with the doctor including the related risks. The second category - of "optimists" - minimizes and is less aware of the risk in the distant future of a VRF.

If, however, VRF occurs in the near future, patients find it harder to accept the difference between risk and error. The veracity of the information provided regarding the context of VRF occurrence is intentionally or not forgotten, in many cases the period of time elapsed until the onset of symptoms and diagnosis being too long to make possible correlation of the events.

In conclusion, endodontic treatment engenders dentin root alterations affecting the structure of the tooth as a whole thus increasing the susceptibility and risks of a VRF development.

All these aspects are well known and assumed by the endodontists after a proper information of the patients and with their consent. Lack of the informed consent may lead to legal complications, exposing the dentist to a possible malpractice indictment.

Conflict of interest

The authors declare that they have no conflict of interest.

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