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Errors and Complications during and After Endodontic Treatment

[1] Turayeva K. F; [2] Nasipkulov Javoxir Sirojjon o‘g‘li; [3] Urazov Bayramali Mamadali o‘g‘li
[1] Assistant of the Department of Therapeutic Dentistry, Samarkand State Medical University
[2'3] 3rd year students of Samarkand State Medical University

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Annotation: Errors, even unintentional ones, interfere with the impartial and objective clinical judgment of the dentist. On the other hand, the choice of adequate approaches to resolve certain clinical situations depends on the errors made in the past and how well the doctor was able to understand the reasons for their occurrence. If we analyze the last patient who came to you with the problem of unsuccessful endodontic treatment and successfully installed a dental implant, the idea would arise that implantation is a more predictable intervention than endodontics. And this would also be a mistake. Current trends in endodontics include the use of a microscope to perform iatrogenic interventions.

Keywords: anatomy of canals; instruments for their processing; predictability of interventions, errors in endodontic treatment.

Introduction: Considering this fact, in this article we will try to analyze the most common problems that arise during endodontic appointments and suggest the most optimal ways to solve them. In this regard, our analysis will focus on the following three aspects:

These aspects are logically interconnected: after all, anatomy determines the possibility of adequate treatment, and the choice of the necessary tools determines the feasibility of the manipulation as a whole.

All dentists should clearly understand the role and prospects of continuing clinical education, emphasizing the improvement of knowledge of dental anatomy. Endodontic, occlusal, periodontal and even aesthetic problems often arise due to anatomical reasons that no one pays attention to. Overly simplified educational materials form a misunderstanding of the endodontic details of tooth structure in the doctor, thereby increasing the risk of developing a number of possible

complications.

Methods and materials: A typical radiograph of the first maxillary molar is shown. After extraction, the structural features of this tooth were studied under a microscope. This is one of the recommendations that all doctors should take into account: after extraction, teeth should be examined under a microscope or magnifying glass. Two-dimensional radiographs can show only three root canals, while up to 80% of all first and third molars may have four roots and one or more canals. The MB and MP (MB-2) canals usually merge, but their morphology remains unique. For diagnostic, access and treatment purposes, it is safer for the clinician to consider these canals as independent of each other. Wisdom teeth often differ in their anatomy from the first and second molars, as they are more complex, so the classical rules of root canal treatment may not be suitable, and the structure of these teeth in most cases requires four canals. The radiographic apex of a tooth should not be considered as a reference point for assessing the adequacy of root canal filling, as the radiographic apex and the actual apical opening are often quite different. Such a simple anatomy of the apical opening, as depicted in advertising brochures for endodontic instruments, can only be found in incisors; in other teeth it is much more complex.

A photograph of an extracted molar shows that the actual position of the apical opening is more than 1 mm below the radiographic apex of the tooth. If the tooth is only 0.75 mm underfilled at the narrowing point, direct radiography shows that there is still more than 2 mm left to the radiographic apex. Therefore, the main thing in such cases is not to overdo it.

Results: The narrowing of the root canal is located approximately 3 mm from the root apex. Thus, even if the canal is filled to the point of narrowing, a direct radiograph shows an unfilled space of almost 4 mm. Using an apex locator, you can avoid problems and "misunderstandings" with the depth of filling. Today, many apex locators allow you to determine the position of the root apex very accurately. At the same time, the author of this article found that when testing the latest designs of apex locators, they sometimes provide slightly "shortened" indicators of the position of the root apex due to the closure of the electrical loop of the device in the area of root compression. However, on the other hand, when performing primary endodontic intervention, the filling of root canals is histologically justified, since the remaining part is filled with the so-called "biological plug". In the past, the removal of root canal filling material beyond the apex in the treatment of vital teeth is a biologically unsound approach, although it cannot be considered a critical error. This is reminiscent of the debate between Europeans and Americans: at many conferences, the former ask the latter why they extend the material beyond the apex rather than filling it? It should be noted that this trend has indeed been observed in North America, but over the past 50 years the concept of the endodontic filling margin has changed to be more coronal than apical.

Discussion: If a tooth is completely calcified on radiographs, then the pulp is considered to be completely absent and, therefore, there is no reason for endodontic treatment. However, studies have shown that even in cases of radiographic obliteration of the canals, clinically they may have a pulp extending from the crown to the apex, which is somewhat smaller. Consequently, endodontic manipulations in such teeth are no longer justified.

The goal of endodontic treatment of vital teeth (in primary endodontic interventions) is to fill the roots of the teeth to the level of anatomical narrowing, not to the level of the radiographic apex. In primary endodontic interventions, the extension of the root filling material beyond the apex is an unacceptable clinical outcome of the treatment. A number of factors should be taken into account that affect the quality of diagnostic manipulations performed to determine the location of the apex opening. In the case of secondary endodontic interventions, it is better to fill the canals to the level of the tooth apex, in which case its location should be clearly defined in advance. In some cases, if adequate cleaning and treatment of the root canals is ensured, removal of the root filling material beyond the apex of the tooth may be unavoidable. Clinically, the anatomy of the root canals can be much more complicated than the doctor perceives from radiographic data, since the number of roots and canals of the teeth often exceeds what can be recorded on two-dimensional radiographs.

Vertucci classified eight different types of canals in the ovoid root, with the root canals running independently of each other or intersecting in various combinations along their course. Gulabivala added five more canal patterns to the eight canals suggested by Vertucci, including the possibility of having four separate canals in a single root.

Round burs have long been the tool of choice for creating access to root canals. Due to their spherical shape, they seem safer than other analogues, and they are also convenient for performing pulpotomy in the coronal section and treating calcified pulp chambers. There is a common misconception that round burs provide safe and slow preparation, but this is not true. An X-ray image is shown, which shows how dangerous the uncontrolled use of a round bur is. As a result of its use, a tunnel with parallel walls was formed in the coronal section of the canal, while endodontic considerations would have made it more expedient to form a cone. An experienced clinician can create the desired cone shape using round burs of different working diameters. However, it is much easier to achieve the same result with conical burs. In addition, it may be necessary to use 5-7 instruments to form a conical entrance to the canal with a round bur, while the same result can be achieved with only 2 conical instruments.

In fact, round burs are characterized by the presence of three main disadvantages. The first is the size. The working part of the round bur is too large. The second disadvantage is the shape. After preparation with a round bur, recesses are formed in the structure of the bur, which makes it difficult to insert working files. In such conditions, the file is simply placed in the wrong direction. Without understanding the true cause of the problem, the doctor tries to insert the file as deep as possible, making the wall of the spherical depression thinner and thinner, until eventually a perforation is formed. The third disadvantage of round burs is the impossibility of cutting the entire roof of the pulp chamber in full volume. Khademiy found that the use of a round bur to create access to the dental canals does not allow, due to the shape of the bur, to completely cut all the walls of the pulp chamber, and in some places the dentin "roof" of the pulp remains. What does this lead to? Yes, because in such areas there are residual zones of pulp or plaque that are formed during preparation and are not cleaned later. In other areas, on the contrary, the walls of the pulp chamber are prepared more than necessary. There is little logic behind this approach.

Thus, round burs can be used for endodontic purposes, but such interventions require planning. New instrument systems take into account the aforementioned disadvantages of round burs and are modified in such a way that they provide the most biologically reliable approach to creating access to the root canal. When preparing the pulp chamber using a carbide conical bur, the doctor is able to feel the difference between even dense dentin and pulp remains (Fig. 12). On the other hand, the lack of visualization during preparation in the pulp area can be compensated for by using 8x or 24x magnification. Thus, the doctor has the opportunity to identify all areas that require additional preparation. In any case, the use of conical carbide burs and magnifying optics contributes to the most rational preservation of cervical dentin tissue, which is very important for ensuring the functional stability of the tooth. The cervical dentin, also called the "neck of the tooth," occupies a height of approximately 8 mm, of which 4 mm is coronal to the level of the bone crest and 4 mm is apical.

In this article, we also analyze a clinical case that shows that a comprehensive approach to endodontic radiation is the key to success. A 42-year-old woman was scheduled for endodontic treatment of a calcified central incisor with the aim of subsequent intracanal bleaching (Fig. 13). On the pre-intervention radiograph, the canal was completely obliterated, except for the area in the center of the tooth root. In such clinical cases, it is recommended to use a microscope to visually enlarge the working area to ensure a successful treatment outcome. In clinical practice, general practitioners cope with partially sclerotic root canals without any magnification, spending a little more effort and nerves than those who use a microscope or magnifying glasses for such cases. Isolating individual teeth during endodontic treatment can be somewhat confusing for the dentist, since it is sometimes difficult to visualize the three-dimensional structure of the tooth root system under the rubber dam. In addition, the rubber dam hides some anatomical landmarks that the doctor

can use when creating an access. Also, the rubber dam clamp makes it difficult to use X-rays immediately, as it leads to a change in the position of the sensor during the diagnostic imaging process. Some doctors suggest not using rubber dams at all in the endodontic treatment of sclerotic root canals. According to the author of the article, the disadvantages of isolating a single tooth can be avoided by isolating the rubber dam sheets of all teeth in the quadrant of interest at the same time: in this way, all anatomical landmarks can be visualized without disturbing the dryness of the working area in any way. The first step in endodontic treatment of calcified central incisors is to plan the access cavity from the palatal side of the tooth. After the doctor reaches the pulp chamber area, it is advisable to take a control radiograph. To create the appropriate access, it is necessary to use adapted burs. First, they make a small depression in the enamel and dentin structure of the tooth, and then continue it in the apical direction.

This approach reduces the risk of the drill slipping during preparation. In addition, it also ensures the correct inclination of the drill along the entire depth until it reaches the pulp chamber. Having organized the access in this way, we have a very narrow and directed access to the incisal pulp. By expanding this access, the doctor can visualize all the necessary map of the lower part of the pulp chamber.

The author of this article suggests taking a series of targeted radiographs with a conical bur in the tooth structure, in order to visually understand how its position depends on the position of the pulp chamber and the canal openings. Previously, this approach was used with endodontic files in the root canal, but the conical burs that the dentist uses to perform pulpotomy and create an access to the hole are also ideal for this purpose. By using the approach described above, the doctor also manages to minimize the amount of tissue prepared compared to the tissue that must be removed when creating a classic horizontal access in the center of the crown. The latter also involves changing the direction of the preparation from horizontal to vertical at an angle of 90 degrees, which also led to the emergence of a number of iatrogenic complications.

Thus, the proposed modified approach allows solving a number of problems associated with the implementation of classical algorithms for preparing teeth for endodontic treatment, in particular:

Instead of isolating a single tooth, it is recommended to isolate the entire sextant or quadrant to ensure visualization of all anatomical landmarks;

Instead of a horizontal entry at an angle of 45 to 90 degrees, which is then shifted vertically, it is recommended to enter the pulp chamber with a conical drill from the palatal side below the incisal edge of the tooth;

Instead of the classic marking with a drill for primary preparation of the access point on the enamel at a 90-degree angle, it is recommended to form the primary cavity at a 45-degree angle using a round, diamond or conical carbide drill;

Instead of creating a deep entry with a long round bur, it is recommended to deepen into the pulp chamber cavity with conical carbide burs;

Instead of deep tunneling to find the pulp using different instruments, it is recommended to perform treatment according to the concept of "from the incisal edge to the apical end", adhering to one direction of the instruments.

Conclusion: In restorative dentistry, fissurotomy, air-abrasive treatment, laser cutting of hard tissues and other modifications of the approaches to the preparation of occlusal caries sites provide for the preservation of a much larger volume of hard tooth tissue than classical cutting of enamel and dentin. Thus, the paradigm of minimally invasive interventions, in which new instruments and materials have been developed, is becoming increasingly popular. In contrast, aggressive treatment methods, involving the cutting of a large volume of hard tooth tissue, are becoming increasingly popular in endodontics. This only indicates that the change in the treatment paradigm in endodontics is developing much more slowly than in restorative dentistry. However, sooner or

later all fields come to the conclusion that a conservative approach is the most effective, since it eliminates the development of secondary complications.

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