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Review Article

Most Frequent Complications in Endodontic Treatment

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Abstract

Endodontics has become an essential part of the daily work of dentists, through different procedures to preserve teeth in the oral cavity. A thorough bibliographic review was carried out on the main risks and complications of endodontic treatments.

Keywords: Endodontics; Root Canal Treatment; Endodontic Risk

Introduction

Anesthesia is the first important step during endodontic treatment; it gains the patient's trust and cooperation, while influencing their desire to retain the affected tooth. Deep pulp anesthesia is an indispensable requirement for removing vital pulp tissue in the absence of pain, and in the vast majority of situations, when treating a tooth with necrotic pulp, anesthesia should also be used to provide psychological comfort to the patient and to prevent the discomfort caused by the staple when isolating the tooth.

Most common causes of failure of deep anesthesia in endodontics

- Anatomical limitations
- Hot tooth.
- Apical periodontitis

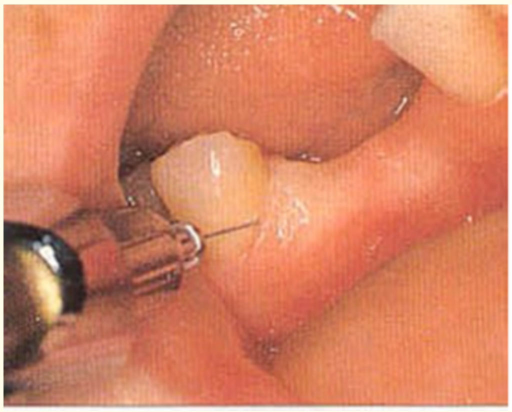

Figure 1: Supplementary intraligamentary injection.

Conventional anesthetic techniques sometimes do not allow obtaining deep anesthesia to perform endodontic procedures; among the possible causes of this situation, anatomical limitations must be considered: a dense bone cortex, aberrant distribution of nerve fibers or accessory innervation, especially in the mandible. In these cases, intraligamentous injection can be effective in helping to obtain the required nerve block, and, if there is a small communication with the pulp chamber, we can try intrapulpal injection. Another cause that very frequently makes it difficult to achieve deep anesthesia is those patients who come with severe pulpitis (a condition that is sometimes called hot tooth). This pulp stage can reduce the pain threshold in these teeth, for which some possible alternative solutions are proposed

- Upper Teeth: Difficulties with anesthesia are often encountered in the premolar and molar regions. After buccal infiltration, a palatal injection should be administered on the root tip of the painful tooth. Routine use of a topical anesthetic can reduce the patient's discomfort caused by the injection, provided that the paste or liquid is allowed to act for at least 30 seconds prior to injection. Even so, palatal injection can cause pain, so the dentist should press firmly with the finger on the injection point for several seconds, remove the finger, insert the needle to the bone and continue applying pressure on the tip of the needle [1,2].
- **Lower Teeth:** The second premolar and lower molars are where it is most difficult to achieve adequate anesthesia. A mandibular block is initially administered. When the desired

symptoms on the lip and tongue are present, an intraligamentous or periodontal injection will be administered slowly, on the mesial and distal surfaces of the affected tooth, with the bevel of the needle facing away from the tooth. In this way, the operator can begin his procedure, although the patient may feel pain when drilling close to the pulp. A small fraction of the pulp is exposed and an intrapulpal needle is placed, introducing a short, fine needle into the exposed hole [1,3].

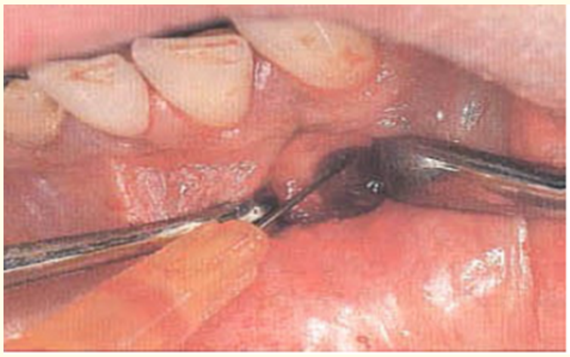

Figure 2: Jaw Intraosseous Alternative Anesthetic Tec.

The injection must be rapid to achieve a sudden increase in pulp pressure. This is what accounts for the deep analgesia achieved in this procedure. The tooth is then unroofed, the chamber is accessed, the canals are located and denervated as quickly as possible, since pulp analgesia lasts only a few minutes. Another method, which is not part of our usual practices or included in our clinical practice guidelines, but which we learned about in our theoretical research, is the one recommended by (Christopher-Walker-Goodman) that can be successful and consists of injecting the anesthetic directly into the intraosseous medullary space around the roots of the affected tooth. A limited cutting drill is used to remove the bone cortex between the roots through minimal access in order to avoid injuries. The anesthetic is then introduced into the medullary space with a short needle and deep analgesia is achieved by infiltration.

Dumsha and Gutmann (1998) attribute the difficulty in achieving the necessary deep anesthesia to particular conditions such as acute pulpal or periradicular pain (apical periodontitis), and acute alveolar abscess or cellulitis, which represents a major obstacle in the management of these situations. The main anatomical difficulties for the maxilla occur in the area of the zygomaticoalveolar crest where the penetration of the anesthetic solution may be restricted, especially in children; the prominence of the anterior nasal spine may make it difficult to approach the root apices of the incisors; and at the level of the premolars and molars, the inclination of their palatal root towards that area may make palatal infiltration anesthesia necessary; even the lateral incisors and canines may present a marked inclination towards the palate. In the mandible, difficulties arise due to the variability of the anatomical position of the mandibular foramen and the presence of accessory innervation.

To achieve deep anesthesia in the lower teeth, these authors suggest first anesthetizing by trying to achieve mandibular blockage, evidenced by the labial signs that indicate deep anesthesia, infiltrating one third of the carpule of anesthetic solution around the affected tooth; use the mental block and/or mylohyoid infiltration in the molars, and finally, do not start the endodontic treatment until it is confirmed, by applying various stimuli, such as percussion or cold, that deep anesthesia has been achieved. If after adequately following these basic principles deep anesthesia is not achieved, Dumsha and Gutmann (1998) consider intraligamentary injection, which should be placed near each root in multi-rooted teeth. If the previous techniques fail, intrapulpal injection can be used, explaining to the patient that he will feel intense pain when entering the chamber, but that deep pulpal anesthesia will be achieved immediately.

The use of intraligamentous injection has been proposed as a primary anesthetic technique. Given this consideration, Walton (1990) conducted an extensive review and concluded that although periodontal injury is minimal, and the anesthetic effect achieved through it is rapid and local, it is unpredictable, so he suggests not using it in teeth with deep caries or aggressive surgical procedures, since it would add a damaging effect to the irritated pulp tissue; however, this phenomenon has not been demonstrated experimentally.

In addition, among other disadvantages of this anesthetic technique, it is mentioned that although in the posterior teeth the discomfort caused by the injection is minimal, in the anterior area it is extremely painful and tends to cause discomfort that persists for hours, and even up to 2 days. Intraligamentous injection to obtain preoperative anesthesia in vital teeth with symptoms of reversible pulpitis is not convenient, so it must be achieved through regional blockade. In cases of acute alveolar abscess where there is an edematous area in the soft tissues adjacent to the affected tooth, nerve trunk block is recommended (mandibular, infraorbital, nasopalatine, etc.). When an incision and drainage is indicated, the anesthetic effect is increased by infiltrating the periphery of the swelling, but never directly into it, because it is very painful, the infection can spread to other planes and the desired anesthetic effect is not achieved [1,2].

All procedures performed during endodontic therapy must be done with prudence and care; however, accidents and complications do occur. The general stomatologist and particularly the specialist must have a high level of knowledge and clinical experience to be able to successfully manage all the accidents that may occur during endodontic therapy and that can foreseeably be solved when the basic biological concepts for endodontic therapy are taken into account and later the technology is integrated into conventional endodontic treatment. Likewise, the factors that contribute to the prevention, treatment and prognosis of accidents deserve great attention. These include the quality of the radiographic recording and interpretation, the anatomical conditions of the tooth to be treated, the conditions of the instruments and finally the experience of the operator. Although there are different treatment modalities in endodontic therapy and various techniques that can be used to deal with difficulties in endodontic diagnosis and treatment, it must be emphasized that an important factor in resolving accidents and complications in endodontic therapy is not just another technique, a new material or instrument, but rather a greater knowledge of the biological basis and a preventive approach to diagnosis and treatment.

These are the essential success factors in providing a high level of patient care. The objective of this section is to describe the accidents that can occur during endodontic therapy and to analyze the prevention and treatment of accidents that occur during the approach, biomechanical preparation and obturation of the root canal system. Accidents in Endodontics The treatment of endodontic procedures, like other disciplines of dentistry, is sometimes related to unforeseen and undesirable circumstances. Accidents during endodontic therapy can be defined as those unfortunate events that occur during treatment, some of them due to lack of proper attention to detail and others because they are totally unpredictable. Knowledge of the causes of endodontic therapy accidents is essential to prevent them, and it is also necessary to learn the methods of recognition, treatment, and their effects on prognosis. Almost all procedural difficulties can be avoided by adhering to the basic principles of diagnosis, treatment planning, opening preparation, cleaning, instrumentation, and obturation. Therefore, four essential components must be considered in the treatment of accidents during endodontic therapy: prevention, detection, treatment, and prognosis. Related to the Approach The main objective of an access cavity is to provide the operator with a direct and unobstructed route to the apical constriction, thus facilitating biomechanical preparation and obturation of the root canal system [1-4].

Objective

To describe the main complications and risks of endodontic treatments.

Literature search methods

The scientific information was collected through a search using the following descriptors in English: The Medical Subject Headings (MeSH): "dental endodontics, root canal treatment, complications and risk in endodontics

Analysis strategy

The search was based solely on the main complications and risks of root canal treatments.

Development.

Despite the anatomical variations present in the configurations of the pulp chambers, the pulp system is generally located on the longitudinal axis of the tooth. Deviation from this path and lack of attention to the degree of axial inclination of a tooth, in relation to neighboring teeth and the alveolar bone, causes excessive removal of tooth structure resulting in undermining or perforation of the crown or root at various levels. Consequently, as patients become more careful about the care of their teeth, there is an increased demand for root canal treatment of teeth that may have previously been extracted.

Often these preserved teeth are extensively restored and calcified and present a challenge when locating the canals. Also, as the years pass or in response to irritating agents, the chamber can change its dimensions, making it difficult to visualize radiographically. Complications such as failure to locate the pulp chamber or root canal, root perforation in the cervical area or furcation, wear of the pulp floor or walls or both, and excessive destruction of tooth tissue due to unnecessarily wide opening may result in tooth tissue loss or may require major restorative procedures and sometimes corrective surgery.

For this reason, a complete evaluation of the tooth to be treated is essential before the start of treatment and access must be made in a careful manner. Gutmann and Castellucci point out certain general considerations when performing the chamber opening; in anterior teeth, removal of the lingual and incisal bridge is essential to obtain a direct line to the root canal system and also to allow the location of additional canals in lower incisors, canines, and premolars. In posterior teeth, failure to completely remove the roof of the pulp chamber is a common problem that prevents the location of the root canal system. Once performed, it is essential to recognize the anatomical relationships in the pulp floor to determine the location of the canal orifices, avoiding perforations. Likewise, cervical bridges must be removed to allow direct access to the canals. Another general consideration of great importance is referred to by Moreinis, Skidmore and Gutmann, who recommend performing the preoperative evaluation with two x-rays for diagnosis, one in an orthoradial direction and another with a 15º mesio or distoradial angle; additionally, a coronal x-ray for the posterior teeth provides more information on the vertical dimension of the pulp chamber. In endodontics, there is no doubt that the x-ray is the most important diagnostic aid and that it allows seeing many details about the tooth that cannot be seen clinically. He adds that the more parallel the x-ray is taken, the more precise the information will be, which will help prevent accidents during endodontic therapy. Among the most important points we have

Relevant information provided by Endodontic Radiography.

Approximate working length 2. Mesiodistal width of the root canal 3. Position of the canal orifice 4. Mesial or distal curvature of the root 5. Presence of radiolucent areas 6. Periodontal defects 7. Number of roots 8. Number of canals 9. Presence of curvatures in the canal.

A good radiograph will show the degree of cervical constriction, coronal asymmetry, differences between the longitudinal axis of the root and the crown, the presence of additional roots and/or canals, and dental malpositions [4-6].

Of course, to reach the canals the tooth must be perforated, that is, according to Alvarez Valls, trepanned, but since it is a conceptual surgical procedure, it should not be carried out indiscriminately, but rather requires a precise and accurate technique. Apart from knowing exactly the location of the coronary surface to be treated and the area of access to the chamber and the canals, they vary according to the particular anatomical characteristics of each tooth, as we studied previously. We must never lose sight of the fact that there are operating times and precautionary rules that are essential for the execution of a good technique. Considerations to avoid errors in chamber Access

Know the anatomy of the tooth to be treated perfectly, remove all existing caries and seal with a sealing agent as airtight as possible. 1. Approach the pulp chamber gradually and without haste, through a wide dentine cover, to have access to the chamber itself in its entirety. 2. Never modify the floor of the pulp cavity in premolars and molars or work on it and if for some reason of force majeure this were necessary, it will be essential to explore this area with probes and paraclinical techniques (e.g. acid etching techniques and revealing substances, eosin, iodine, etc.). 3. Eliminate the dihedral and trihedral angles formed by the pulp horns, which are found especially in young teeth with very high cusps. This operation is sometimes made very difficult by the presence of adventitious dentine pulp calcifications. Pulp remains, nodules and dentine calcifications must be excluded from the chamber, leaving the chamber perfectly smooth and clean. 4. All chamber access must guarantee a clear, wide and straight access to the major axis of the tooth. This implies that indirect access or, in other words, access from the proximal surfaces must always be systematically excluded.

Sometimes it happens that the operation of chamber access becomes more complex due to certain identification processes in the vicinity of the pulp chambers, forcing us to search deeper into the canal. In these cases, if the fundamental references mentioned above are not taken accurately (of searching for access to the canal in a straight line with the major axis of the tooth), there is a potential risk of traumatic perforation on any of the surfaces and at different levels depending on the inclination we give to the drill.

This risk can be explained by the forward projection that the upper incisors generally have, leading the clinician to make mistakes when determining the possible root trajectory. It is not uncommon for beginners to find bleeding points (vital pulp) during initial chamber access or primary trepanation, and to mistake them for the actual openings of the respective canals in each case, immediately beginning to introduce the first files. It is clear that even though from this point of view, the filing at this time may be technically correct, resulting in an apparently successful final result, the rest of the roof corresponding to the pulp chamber of premolars and molars will almost always be left untreated, resulting in incomplete cleaning of said chamber, leaving pulp remains, blood and/or solid and liquid debris, a not infrequent cause of dental dyschromia, spoiling the final results of the treatment in this case affecting the aesthetic function, and even without losing sight of the fact that these remains could decompose, ruining the endodontic therapy and also interfering with drug therapy.

For these reasons, the ceiling of the pulp chambers must always be considered within the cavity design for chamber access, even when the circumstances of the case allow us to access the canals through the pulp horns. In this section, we would like to insist on the care that must always be taken regarding the floor of the chamber, for which the use of the drill inside the chamber must always be oriented from gingival to occlusal and the drills chosen for this purpose must be blunt or inactive to guarantee the safety of this area of the tissue. Most common errors made when performing chamber access [4-6].

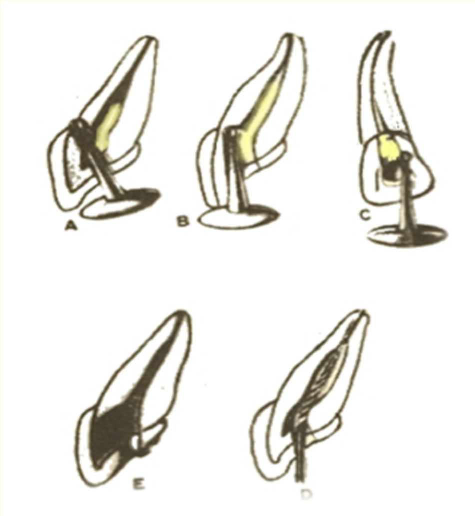

Figure 3

A - Vestibular perforation. B - Vestibular step C - Lateral step D - Incorrect chamber access that prevents the instruments from entering straight E - Incorrect removal of the chamber roof that causes tooth dyschromia. In the case of caries in the angle of the incisors, the access cavity should be extended towards the palatal or lingual surface, getting as close as possible to the shape described for the incisors, trying to remove the least amount of dental tissue, as long as the good instrumentation is not put at risk.

In cases of extensive interproximal caries, we recommend provisional reconstruction of the cavity with caries or extending it towards the palatal or buccal surface, always depending on the amount of dental tissue (dentin and enamel) that may remain between the cavity and the surgical access point, as well as the future work planned for this tooth, especially for the upper and lower anterior sector. Perforations Endodontic perforations are artificial openings in the root of a tooth that result in communication between the root canal and the periodontium. They generally occur due to a lack of knowledge of the internal anatomy, excessive and improper milling of the pulp chamber, and the use of instruments in the canals. Success in endodontic therapy depends in part on accurate diagnosis and an appropriate treatment plan. Because the prognosis of a tooth worsens when a perforation occurs, they must be identified and prevented as part of a process in the treatment plan. Kvinnsland., *et al*. suggest that the procedures most related to perforations are the location of calcified canals, their permeabilization and the biomechanical preparation of the canal system; as for distribution, he pointed out that they occur in all teeth, but are more common in the upper jaw than in the lower jaw. Likewise, the vestibular and lingual surfaces as well as the middle areas of the canal are the areas with the highest number of perforations. Rules to avoid perforations, according to Lasala

Know the pulp anatomy of the tooth to be treated, the correct access to the chamber and the guidelines for the use of instruments. 2. Have positional and three-dimensional criteria and perfect visibility 3. Be careful in narrow canals during the instrumental step from 25 to 30, the opportune moment for perforation 4. Do not use rotary instruments except in indicated cases and wide canals.

Guidelines for preventing perforations during access preparation, according to Moreinis: 1. Direct the drill perpendicular to the vestibular surface of the tooth 2. In cases of cervical constrictions, rotated teeth, or absence of a large part of the crown, it is very useful to determine the position of the tooth. 3. In cases of dental malposition or teeth with difficult access, access can be performed without a rubber dam until reaching the pulp space to maximize orientation. Observing the bony eminences may indicate the position of the root. 4. When space permits, long-shank drills should be used to avoid tilting the contra-angle and to improve visibility 5. Only low-speed drills should be used. 6. Radiographs should be taken at various angles as the opening progresses [4-6].

Seltzer, Sinai., *et al*. base the prognosis of a perforation on: location, size, time between location and repair of the perforation, biocompatibility of the filling material and accessibility to the main canal, they also establish the importance of prevention or treatment of bacterial infection.

Fuss., *et al*. report that a small perforation is usually associated with less tissue destruction and inflammation and is easier to seal;

therefore, healing is more predictable, and the prognosis is better. Small perforations are those that occur with endodontic instruments of size #15 or #20. Authors such as Seltzer and Fuss consider that the factor that most significantly influences the prognosis is the location of the perforation; the proximity of the perforation to the gingival sulcus can favor contamination of the same with bacteria from the oral cavity through the gingival sulcus. Therefore, a critical area is at the level of the bone crest and the junctional epithelium; Fuss., *et al*. classified the perforations according to the proximity to this area, in such a way that furcation perforations are included in those that are at the level of the bone crest and are those with the worst prognosis. Perforations located coronally to this area have a good prognosis and those located below usually have a good prognosis when an adequate root canal treatment is performed. On the other hand, the treatment of a perforation is based on the position of the perforation with respect to the alveolar crest and the junctional epithelium, therefore, it is essential to locate it. The diagnosis of a root perforation requires a combination of symptomatic findings, clinical observation and diagnostic means. Lasala and Torabinejad report that an immediate and typical sign is abundant bleeding emanating from the perforation site or radiographic extrusion of a file towards the periodontal ligament or bone and that when the patient is not anesthetized, severe periodontal pain occurs [6-8].

Kaufman., *et al*. point out some disadvantages that occur with radiographs to locate perforations; Among them, the superposition of anatomical structures and implants on the image of the root, the fact that the procedure takes a lot of time, patients with gag reflex do not allow x-rays to be taken, the precision or accuracy is limited; and due to biological risks, x-rays should be minimized. Therefore, an aid in the diagnosis of perforations is the electronic apex locator, considered a reliable instrument by Kauffman., *et al*.

They point out it as an essential factor for the success of the treatment; however, they establish the importance of taking x-rays after locating the perforation with it, to determine the location in relation to the bone crest.

They also report that with an orthograde access, overinstrumentation and consequently overfilling is prevented, which can affect the tissues near the root. It should be emphasized that the location and establishment of an adequate measurement of the distance from the coronal orifice to the periodontium are important determinants that must be established for a successful filling of a root perforation. It is also important to evaluate the thickness of the perforated dentin wall.

The use of magnification (magnifying glasses or microscope) contributes to the location of the perforation; a paper point can be used to evaluate the depth and a radiopaque agent can be used to reveal the perforation site. Regarding treatment, Torabinejad and Fuss report that coronal perforations can be sealed externally and the material selected will depend on aesthetic considerations; resins or glass ionomers for anterior teeth and amalgam for posterior teeth. At the time of treatment, the perforation must be disinfected, the material to be used must provide an adequate seal against bacterial penetration and must not be irritating to the supporting tissues. On the other hand, Kvinnsland reports that there is a slight tendency for success in treatment when perforations are located in the apical portion of the root, compared to those located coronally. Perforations located in the middle and apical third must be sealed in the endodontic act with gutta-percha and sealing cement.

It is advisable to use calcium hydroxide as an antibacterial medication until a second appointment where the root canal system will be sealed. Kaufman., *et al*. establish a method of immediate sealing after detection, which uses an electronic apex locator and thermal compaction of gutta-percha to seal the root canal system and the perforation. Authors such as Bogaerts, Goon., *et al*. recommend surgical and non-surgical treatments. Surgical access depends on the location of the perforation. As bone loss occurs, the repair process may result in the formation of a permanent periodontal defect. Therefore, in cases of large perforations, instead of repairing the perforation, the possibility of root amputation, hemisection or extraction with or without replantation should be considered. The decision depends on the level of the bone crest and its relationship to the furcation, the degree of root convergence and the length of the roots [6-8].

Authors such as Bogaerts and Kvinnsland agree that the internal matrix concept using calcium hydroxide can be used in perforation repair. The exact mode of action of calcium hydroxide remains a point of debate, but there is no doubt that the continuous changes in this material can create the formation of a hard tissue barrier. However, calcium hydroxide can be kept in place for two weeks before sealing the perforation. The internal matrix concept with calcium hydroxide can be used in conjunction with SuperEBA cement, (Harry J Bosworth Co, Skokie, IL). Other authors such as Dazey., *et al*. report that amalgam, glass ionomer and calcium hydroxide are used in various restorative and endodontic procedures; each has therapeutic potential to treat both known and undetected perforations [6-8].

The success of perforation repair depends on the combination of conditions and circumstances that will determine the achievement of an acceptable biological result. One of these conditions is the sealing capacity of the restorative materials. Gutta-percha, cavit and zinc oxide-eugenol have also been used. Perforations at the crest level are the most difficult to manage due to the proximity to the junctional epithelium and the possible communication with the gingival sulcus.

They can be treated with surgical procedures to seal externally or forced extrusion to subsequently seal the perforation; in any case, any biocompatible material with a short hardening time can be used. In a histological investigation carried out by Balla., *et al*. on experimental furcation perforations sealed with tricalcium phosphate, hydroxyapatite and amalgam, complete healing was not observed with any of the materials. Likewise, the authors report that the degree of tissue response depends on a) the initial damage to the periodontal tissue; b) the size and location of the perforation; c) the sealing capacity and toxicity of the repair materials and d) bacterial contamination. Sinai., *et al*. agree with the results obtained with tricalcium phosphate and point out that it is not the ideal material for sealing furcation perforations. Goon., *et al*. report that a long-standing lesion associated with an undetected furcation perforation can be successfully managed with a multidisciplinary treatment, involving the repetition of conventional endodontic treatment and an orthograde sealing of the perforation, guided tissue regeneration and subsequently an orthograde resealing of the perforation with glass ionomer and an intermediate restorative material. Torabinejad., *et al*. recommend the use of ProRoot, MTA (Loma Linda University, Loma Linda, CA) for the repair of root perforations, since it has been shown to prevent microleakage, is biocompatible and promotes tissue regeneration when it comes into contact with the pulp or periapical tissues. On the other hand, the results of the research carried out by Sluyk., *et al*. conclude that the presence of moisture in the perforation favors the adaptation of the material to the walls of the same, which increases the marginal seal. The results of a research carried out by Kvinnsland., *et al*. suggest that teeth with perforations, when treated appropriately, can have a good evolution in 50% of the cases. A successful result seems to be related mainly to the method used in the treatment of the perforation and the degree to which this does not create additional problems, such as the loss of the junctional epithelium [6-8].

One of the goals of endodontic treatment is to restore the biology of the affected tooth; this means that the affected tooth should be functional, without presenting symptoms or pathosis. To achieve this purpose, an important step in endodontic therapy is the biomechanical preparation of the root canal system. During biomechanical preparation, different instruments are used within the canal system, which can fracture and become trapped in the canal walls. The canal system can also be blocked by filling materials, such as gutta-percha cones, silver points, amalgam and cements. Excessive widening can cause lateral perforations. Steps and deformations in the canal anatomy are created mostly in curved canals, when the apical size of the final canal preparation is too large. There are many accidents that can occur in endodontic treatment, but in all cases, they all arise from incorrect performance of the operative treatment technique.

If the operator follows the instructions carefully, it is very difficult for a complication to occur, although sometimes they are not exempt from them. These complications or accidents can be grouped into those that occur during the biomechanical preparation of the tooth and those produced when filling the root canal system. Accidents or complications during the biomechanical preparation of the tooth: 1. Pain. 2. Fracture of the tooth being treated. 3. Crown perforation. 4. Perforation of the floor of the pulp chamber. 5. False pathways in the root canals. 6. Formation of steps in the canals. 7. Fracture of instruments in the root canal. 8. Blockage of the apical zone. 9. Decrease in the working length (see section 1.2). 10. Overinstrumentation [6-8].

Complications when filling the root canal system

- Underfilling.
- Empty spaces (poor preparation of the canal).
- Overfilling.
- Internal resorption.
- External resorption.

Pain: The first complication described is the absence of analgesia; this is frequently present, where despite the

tooth being anesthetized there is pain, especially and frequently in acute inflammatory processes of irreversible nature. In these cases, intrapulpal anesthesia is recommended as the most direct way to solve the problem, when, of course, the classic and elective infiltrative and trunk techniques have failed for the reasons stated above, since the intraparadontal and intraosseous techniques are not recommended in this particular case, since using any of these would seriously injure the periodontal ligament, which is largely responsible for the future success of the endodontic treatment, since it is through the health of these tissues that stability, nutrition and protection will be *provided to the new endodontically treated tooth. Pain at the apical end of the root is also frequent in cases between appointments due to the capillarity of the root canals among other factors, such as cases where they present asymptomatic chronic periapical pathologies, states of pulp necrosis etc.*

Painful manifestations can also occur when between consultations the temporary or transitory restoration has been left with leaks due to a defect in the manipulation of the material because the time of its effectiveness has been prolonged (for example, a seal with Zinc oxide and Eugenol for more than four days). Other causes described may be traumatic occlusion due to overfilling, insufficient or excessive instrumentation and/or irrigation (e.g. over instrumentation) and fissures or fractures caused by the instrumentation that were not diagnosed in a timely manner, therefore it is advisable to go to the anesthetic to make the visit more pleasant for the patient and to facilitate the operating maneuvers for the professional.

Prevention, Prognosis and Treatment of Accidents Related to Fracture of the Tooth Being Treated: Proper cleaning and preparation are the key to preventing problems when filling the root canal system. During filling, some accidents occur due to inappropriate biomechanical preparation. In general, the quality of the filling reflects the preparation of the root canal system. Regardless of the technique selected for filling the root canal system, there are basic principles that must be taken into account to achieve success. Frequently, the application or attention to these principles during filling procedures prevents the need to resolve an accident. On the other hand, excessive widening in the preparation of the root canal system weakens the tooth to the point of being a predisposing factor to the occurrence of vertical root fractures during forced root canal filling procedures [9,10].

Vertical fractures Vertical root fractures occur during different phases of treatment: instrumentation, filling, due to the effects of occlusion and placement of pins. In both lateral and vertical condensation, the risk of fracture is high when too much force is exerted during compaction. Lateral condensation, for example, is the standard technique that is still most widely used in our endodontic practices nationwide, which often carries the risk of causing root fractures. The perception of the cracking noise during lateral condensation may indicate the existence of an accident if it is accompanied by the sudden cessation of the spacer giving way, and from that moment on it can be spaced much more, as much as possible in this case we are in the presence of a vertical root fracture, which is also a more predisposing factor in those teeth that due to some periodontal injury for example have suffered a frank weakening in one of their cortices, generally the vestibular one.

For this case the use of an electronic spacer is recommended, which helps to carry out a more controlled and tangible condensation, since the truth is that almost always this accident goes unnoticed at the time of the canal obturation, causing a failure in the total treatment in the medium term. Lasala refers as predisposing causes the curvature or thinness of the canals, the exaggerated biomechanical preparation of the canals and as a triggering cause, the intense or inadequate pressure at the time of compaction. Likewise, Lindauer., *et al*. suggest that there are several factors that may predispose a tooth to suffer a vertical fracture, such as tooth morphology, the biomechanical preparation technique used, trauma and resorptions. Regarding tooth morphology, Tamse., *et al*. report that vertical fractures frequently occur in teeth or roots that have thin mesiodistal dimensions such as upper premolars [9,10].

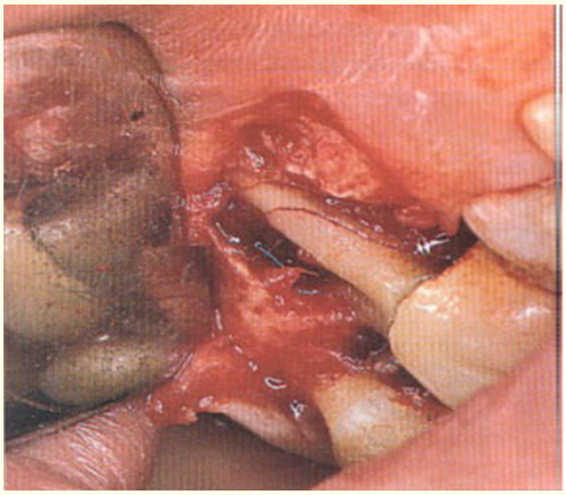

Figure 4: Fracture during treatment.

Holcomb., *et al*. in an investigation of the forces necessary for lateral compaction to produce a vertical fracture, concluded that there is a statistically significant correlation between the force and the root width, the diameter of the canal, the conicity of the canal and the number of accessory cones placed. Telli., *et al*. investigated the distribution of forces in two- and three-dimensional models of a lower canine during vertical and lateral compaction of gutta-percha, and concluded that fracture due to compaction forces does not occur in teeth with straight canals, although they excluded from the study certain conditions such as undetected dental irregularities, severe root curvatures and poor application of the techniques. Frank and Meister report that the detection of a vertical fracture is usually unmistakable, since at the time of its occurrence a sudden cracking sound may occur along with a painful reaction [9,10].

Torabinejad reports that another sign is a sudden decrease in the resistance to pressure of a spacer or condenser during obturation, with the appearance of blood in the root canal. Meister., *et al*. establish that the time that elapses between the obturation of the root canal system and the presence of symptoms can vary between 3 days to 14 years. Diagnosis can be difficult but there are determining characteristics, among them, radiographically a suggestive radiolucent halo, possible bone defect, minor symptoms of discomfort in the tooth, periodontal abscess, fistulous tract and depth in the probing at the level of the fracture. Regarding treatment, unfortunately, the only feasible one in most cases is tooth extraction; the most important thing is to recognize the causes and modify the techniques that cause them; on the contrary, Holcomb., *et al*. report that possibly in cases of multi-rooted teeth only the resection of the involved root is necessary. Lasala also recommends root resection and hemisection to resolve the most benign cases. Crown and root fractures Fractures of teeth that undergo endodontic therapy are complications that can be avoided in many cases.

These fractures can occur during the performance of root canal treatment or during chewing. When the crown of the tooth fractures, three problems arise: a) the intra-canal medication is exposed; b) the impossibility of placing the staple and rubber dam, which will be placed on neighboring teeth; c) the possibility of final restoration. Tooth extraction will only be used when it is practically impossible to retain the future restoration.

Crown and root fractures should generally be treated by extraction, unless they are chisel-type fractures, in which only the cusp or part of the crown is affected; in this case, the loose segment can be removed and treatment completed. If the fracture is more extensive, the tooth may not be restorable and may need to be extracted. Lovdahl., *et al*. recommend establishing a diagnosis and treatment plan integrating periodontics, orthodontics, and surgery in cases of endodontically compromised teeth with deep caries or fractures in the crown or margins of the tooth. In cases where the tooth structure is below the gingival margin but on the bone crest, periodontal surgery can be performed; in cases of fractures below the bone crest, a combination of orthodontics (forced extrusion) and periodontal surgery is indicated; and finally, in cases of multi-rooted teeth with margins below the bone crest, amputation or hemisection can be performed. Coronary perforation: Coronary perforation when making chamber access is caused by an improper technique when making chamber access. As long as this occurs at the level of the clinical crown, the complication is not as serious. In the case that it is below the clinical crown, the treatment would be the same as for a false pathway with the same chances of success or failure as the latter. Perforation of the floor of the pulp chamber: Perforation of the floor of the chamber also occurs as a result of an incorrect chamber access technique. The consequences are identical to those of false pathways. And their treatment and prognosis are also identical [9,10].

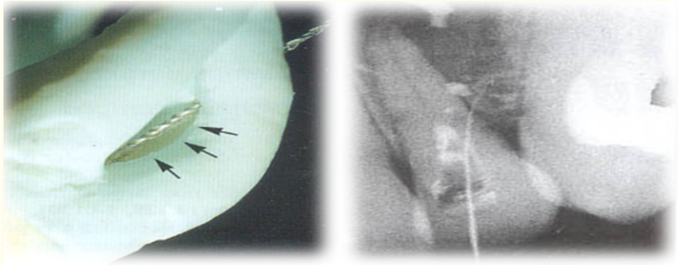

Figure 5, 6: Floor and false track perforations.

False pathways in root canals: (lateral perforation) This complication is observed mainly in the mechanical preparation of root canals when rigid reamers or rotary drills are used. The appearance of these is a serious problem, the solution of which is not easy. Various techniques have been described to resolve this situation, but none of them have provided satisfactory long-term solutions. The best solution is to prevent it from occurring.

Figure 7: Formation of steps.

Step formation in the canals: This is one of the most frequent problems that occurs in the mechanical preparation of root canals. It is due to poor instrumentation technique or the use of rigid expanders. As with all complications, the best solution is to prevent it from occurring. Once it has occurred, the canal must be reinstrumented to try to eliminate it. It occurs most frequently in the preparation of curved and narrow canals. The best way to avoid its appearance is not to begin instrumentation until the actual working length is reached and then use the correct technique. Fracture of instruments in the root canal: (instrument breakages) [9,10].

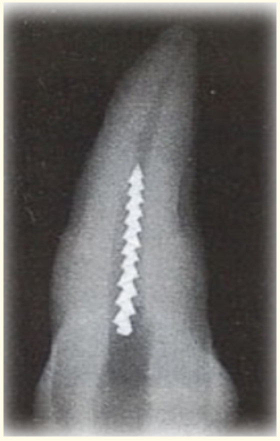

Figure 8: File fracture.

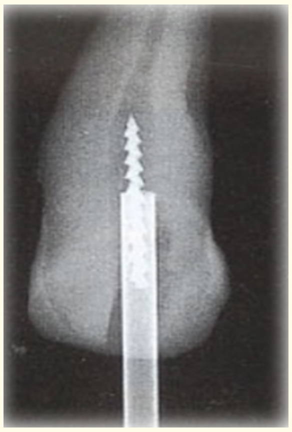

Figure 9: Maceran trepanning drill.

Given the frequent situation of a file breaking inside the canal system during biomechanical preparation, it is worth asking the question: why did the instrument break? One cause is excessive use, that is, instrument fatigue. It should be noted that the physical properties of a file or reamer deteriorate, both with use and with the different curvatures to which they are subjected and the continuous and abrupt changes in temperature when sterilizing them. This is probably one of the complications that causes us the most problems. This is due to forcing the instruments into the canal, to the use of fatigued instruments or those that have previously been bent. In both cases, the situation is not easy to resolve and its prognosis is not very favorable. Drills have been designed to unclog the fractured fragment, such as the Maceran trepanning drill and its corresponding extractor.

Dr. Manuel A. Gonzalez Longoria designed a similar instrument from a hypodermic needle, which he rotated counterclockwise in the canal, showing favorable results in the removal of fractured instruments. It must always be remembered that the best solution to this complication is to prevent it from occurring. Grossman established a guideline for the prevention of fracture of instruments used in root canals and noted that when one accepts the challenge of treating curved, thin, and tortuous canals, one also assumes the risk of fracturing an instrument; Among its recommendations, it cites the following: Guide for the prevention of fracture of intracanal instruments, according to Grossman: 1. Stainless steel files can twist or bend, therefore, excessive torque forces should not be applied 2. Instruments should be examined before and after use to assess that the grooves are regularly aligned 3. Small diameter instruments such as files (#10 to #25) should not be used more than twice 4. Worn files, instead of cutting, get caught in the dentin walls, favoring their fracture 5. Files should be used following the sequence by size, without skipping a gauge 6. Dentinal remains should be removed from the files during the surgical moment, since its accumulation slows down the cutting process and predisposes to fracture. 7. All instruments should be used in moist canals, to facilitate cutting; sodium hypochlorite or another chemical agent can be used [9-12].

Another way to prevent instrument fracture is referred to by Glickman by establishing certain conditions, in which the instruments must be discarded and replaced with new ones, among which he points out: Other ways to prevent instrument fracture, according to Glickman: 1. Defects such as shiny or unthreaded areas can be detected in the instrument's grooves 2. Excessive use can cause twisting or bending of the instrument (very common in small diameter instruments). Greater care must be taken with nickel-titanium instruments since they fracture without warning, therefore they must be constantly evaluated 3. Instruments that have been excessively pre-curved, bent or twisted. 4. Accidental bending during use of the instrument. 5. When corrosion of the instrument is observed 6. When compaction instruments have defective tips or have been heated too much Instrument fracture in the root canal system is a potential risk that can occur during endodontic therapy. The possibility of instrument fracture increases when the instrument is used incorrectly. Hand instruments including stainless steel, nickel-titanium, and Hedström files; rotary instruments such as Gates-Glidden burs, nickel-titanium files, lentulos, and compactors are commonly misused during endodontic therapy.

The instruments that commonly fracture are K-files and Hedström files, and this accident is also currently occurring with rotary instruments. The fracture of an instrument inside the canal can occur during biomechanical preparation by the operator himself, or in cases of repeat treatment of a tooth that already has a fractured instrument. When an instrument fractures during biomechanical preparation inside the canal system, the question arises: what to do? Authors such as Lasala and Ruíz report that various solutions have been proposed depending on the moment in which it was fractured, the level at which the instrument is located within the canal system and the type of fractured instrument. Regarding the moment in which the fracture occurred, the fracture of an instrument at the end of the biomechanical preparation is not the same as one that has fractured at the beginning of the preparation, where the canal still contains pulp tissue. Glickman., *et al*. They report that the real problem with instrument fracture is that they block the possibility of adequate cleaning, preparation and obturation of the canal. Although some of the instruments can be removed, others cannot be removed due to the presence of curvatures or the total blockage of the canal lumen, avoiding going beyond the fractured segment. The therapeutic possibilities regarding the level of the canal where the instrument was fractured can be summarized in four: extracting it, going beyond it, including it in the filling material and alternative treatments such as periapical surgery [9-12].

Hulsmann reports that success in removing fractured instruments depends on factors such as the length and location of the fragment, the diameter and shape of the root canal and the friction of the fragment and its impaction in the dentin. Recently, Hulsmann., *et al*. evaluated the influence of several factors on the success or failure when removing fractured instruments and concluded that success was greater; a) in upper teeth (73%), than in lower teeth (64%); b) when the fragment was in the coronal third of the root; c) when the instrument was fractured before the root curvature; d) when the fragments are larger than 5 mm and e) when the instrument is a reamer or a lentulo rather than a Hedström file. On the other hand, they established that anatomical factors favourable to straight canals and single-rooted teeth. If the fracture occurs in the coronal third of the canal, an attempt is made to laterally instrument the fractured instrument with small files and chelating agents, in order to widen the canal to facilitate its removal. If its removal is not possible, after carrying out the biomechanical preparation of the canal system, it will be sealed by leaving the instrument inside the canal.

Authors such as Ruiz and Walvekar establish that a file can be extracted if it is passed over with another and pulled outwards by rubbing on it; Special care must be taken when overriding it, since a sudden movement can displace it in an apical direction, complicating the situation. Likewise, the fragment can be extracted using two Hedström files on different sides of the fractured instrument, to drag the fragment outwards, after having overridden it with fine K-type files. In contrast, other authors such as Lovdahl., *et al*. report that Hedström files cannot engage steel instruments and therefore do not work in the removal of fractured instruments, lentulos or Gates Glidden burs. Regarding the use of special forceps such as the Steiglitz forceps (Moyco, Union Broach, York, Penn) for the removal of fractured instruments, Lovdahl., *et al*. report that although they work on rare occasions, they do not recommend them, since the instrument must be very long to be able to grasp it and the serrations of the forceps are not designed to catch the fragment. As for the Masserann equipment (Micromega SA, Bensacon, France), it is recommended mainly for the removal of silver tips and pins, although it can be used in certain cases of fractured instruments. In contrast, Hulsmann34 reports that this equipment removes a large amount of dentin and cannot be used in thin and curved canals, nor in the apical third of the root. Genttleman., *et al*. recommend the use of the Endo Extractor (Braseler USA, Inc., Savannah, GA) for the extraction of fractured instruments. This is a device consisting of a trephine that prepares a space around the instrument, then a hollow extractor tube with adhesive is placed inside it to then be extracted; in the same way Spriggs., *et al*. recommend its use as long as the fractured fragment is located near the entrance orifice of the canal [9-12].

Hulsmann recommends bypassing or removing the fractured instrument using the Canal Finder system (Fa. Societe Endo Tecnique, Marseille France) and claims that this can be achieved in 50% of cases where manual removal has failed. Contradictorily, the author reports a certain risk of producing perforations when using the system at high speed. He also describes a technique combining the use of the Canal Finder system to bypass the instrument and the use of ultrasound to release and extract the fractured instrument. Ultrasonic devices have been widely used in the removal of fractured instruments and have various devices that can facilitate their removal. Suter recommends a technique where he uses ultrasonic tips to release the coronal portion of the instrument and a disposable needle and Hedström files to remove them from the canal.

Nehme presents a new technique for the removal of instruments that cannot be bypassed by conventional means, using an ultrasonic condenser (SO4, Satellec, France) which modifies the conicity and diameter, allowing deep penetration into the canal without excessively wearing down the tooth structure and leaving enough space for the removal of the instrument. He also says that it is very helpful, especially when the operating microscope is not available. If the fracture occurs in the apical third, it must be taken into account at what stage of the biomechanical preparation of the canal system the instrument fracture occurred. Fractures at this level usually occur with instruments of a larger diameter, so it is possible to assume that the complete biomechanical preparation had already been carried out. If this were the case, the filling will be done with gutta-percha and cement, trying to achieve an adequate seal of the apical portion. In general, in these cases, healing and evolution are good, and subsequent radiographic controls are necessary. If the evolution is not good, with symptoms or poor healing of the periapical tissue, periapical surgery should be performed. Regarding the prognosis, Crump., *et al*. based on the results of their study, concluded that, although instrument fracture may increase the risk of failure, it is not a determining factor towards failure; therefore, generally, the fracture of an instrument does not have an adverse effect on the prognosis. For his part, Torabinejad states that the prognosis depends on the magnitude of the canal that is not debrided or obturated in the apical direction. The prognosis improves when a larger diameter instrument is fractured in the final phase of cleaning and preparing the canal system near the working length and is unfavorable in canals that have not been prepared and the instrument is fractured far from the apex or outside the apical foramen. Likewise, accessibility is of vital importance for the possible performance of a surgical procedure. Fracture of Burs Lasala says that when rectifying the opening of the chamber and access to the canals, the fracture of the burs can occur; this possibly occurs due to the depth of the tissue, the shape of the bur and the activation of the same when it is already placed in position, instead of taking it activated to the work point. Regarding the prognosis, he says that this accident does not have a negative influence, since the fragment can be removed without leaving consequences [9-12].

Walvekar., *et al*. reported a case where a bur was fractured when opening the chamber and became trapped in the canal. After the attempt to remove it, it completely blocked the canal. As Lasala says, the removal of the fractured fragment depends on certain factors such as the severity of the upper teeth and the presence of vital pulp, which acts as an obstacle to the progress of the fragment towards the interior of the canal. Regarding the treatment, Walvekar., *et al*.

They recommend going over the fragment with a #8 file and continuing with #10 and #15 files until a Hedström file can be placed to hook the fragment. Lasala prefers to first try to remove the fragment with the explorer; if this is not possible, he recommends using reamers to detach it from the walls and try to drag it with one or more barbed probes. Lovdahl and Hulsmann point out that the use of ultrasonic devices facilitates the removal of fractured objects and instruments within the root canal. Deviations from the anatomy of the root canal When carrying out the biomechanical preparation, the anatomical characteristics of the root canal system must be taken into account in order to avoid deviations in it. The main cause of deviations in the anatomy of the root canal is generally due to excessive preparation, caused by the use of instruments.

Overly large instruments or overuse of smaller instruments in the curved apical portion of the canal. These alterations in the canal anatomy can be divided into: step formation, displacement in the apical region, obliteration of the canal and perforations due to wear. A step is an artificial irregularity in the surface of the root canal wall, which prevents the placement of instruments along the working length. The instrument straightens itself and begins to penetrate the dentin, which can cause a perforation. Apical zone blockage.

Blockage of the apical zone is a not infrequent cause of complications during endodontic instrumentation. It is partly conditioned by the incorrect selection and combination of irrigants and intracanal medications, and on the other hand it is subject to the change of a file, generally of smaller diameter, to one of larger diameter, without irrigation as an intermediate condition, creating a block of debris that becomes compacted and tends to totally or partially obliterate the apical constriction. The displacement in the apical region is the formation of a funnel at the apical end, it is created just like the step since the file straightens itself and its tip goes through the dentin wall, which when trying to straighten it results in a long or grooved perforation, also called "zip" or "drop foramen"; complicating the adequate control of the filling materials to obtain an appropriate seal.

Accidental obliteration sometimes occurs due to the entry of particles of the provisional or definitive materials and the compaction of dentin chips from the instrumentation. In these cases, an attempt will be made to eliminate all remains with the help of chemomechanical irrigants and low-caliber instruments. Another deformation of the anatomy of the root canal is perforations due to wear. These occur when the upper portion of the instrument straightens the molar canal, thinning its walls, causing a potential communication with the furca.

As we know, this region corresponds to the danger zone, which mainly affects the mesial root of lower molars. Regarding the formation of steps, authors such as Frank, Glickman, Lasala and Torabinejad agree that the main causes of this deviation include the lack of straight-line access, the loss of working length, the inability to overcome a curvature of the canal, over-preparation of curved canals and the compaction of debris in the apical portion of the canal. To prevent the formation of steps, an accurate interpretation of diagnostic radiographs must be made before placing instruments into the root canal system, pre-curving them before use and not forcing them into the root canal system. Glickman and Lasala recommend following the progressive increase in standardized numbering strictly, that is, moving from a given caliber to the next higher one and in very curved canals not using rotation as an active movement but rather impulse and traction movements, in addition to not preparing more than one #25 or #30 instrument. Glickman., *et al*. recommend certain steps to prevent the formation of steps in thin, curved or calcified canals, where it was not possible to determine the working length at the beginning of the treatment Prevention of step formation in narrow canals, according to Glickman: 1. Take the length of the tooth on the initial x-ray and subtract 1 mm, to determine the working length 2. Fill the pulp chamber with sodium hypochlorite 3. Use a #6, #8 or #10 file to the working length. Do not apply apical force, just advance with a torque movement 4. Instrument the canal circumferentially until the instrument feels free within the canal, using the same file that established the working length. Do not remove the file until it is free of obstructions 5. Irrigate the canal between one instrument and another. 6. Proceed until a #15 file reaches the working length 7. Obtain an x-ray and adjust the working length if necessary [9-12].

Frank says that the formation of a step should be suspected when the instrument cannot be placed to the working length. There may be a loss of the normal tactile sensation with the tip of the instrument passing through the lumen, which is replaced by the tip of the instrument hitting a solid wall. Radiographically, it is evident that the tip of the instrument seems to deviate from the lumen of the canal, therefore, during the remainder of the preparation, an attempt should be made to clear the step formed. To correct the step, Frank, Glickman and Lasala recommend going back to the lower gauges, restarting the widening and trying to gently remove it. A #10 or #15 file will be used, pre-curving the tip, to explore the canal to the apex, directing the curved tip towards the wall opposite the step, with back-and-forth movements or as if winding a watch to help the instrument advance.

Once the working length is reached, a larger instrument with a pre-curved tip is changed, an x-ray is taken, and a file is filed using lubricants and irrigation solutions, using short vertical pulses; the tip should always be kept against the inner wall and pressure should be applied with the grooves on the step. The use of chelating agents when crossing the step is not recommended due to the possibility of producing a perforation instead of overcoming the step. Early detection of a step will facilitate the management of this error. A step created with a #25 or #30 file is more difficult to overcome than one created with a file of smaller diameter. Herrero., *et al*. conducted a study where they compared different types of flexible files with K-type files, in terms of displacement in the anatomy of the apical third in moderately curved canals, and also evaluated the relationship between the diameter and the number of uses of the instruments with this deformation. The authors concluded based on the experimental results that: a) flexible files produce less displacement than K-type files and b) the displacement is directly related to the diameter of the instrument, since the lower the flexibility of the instrument, the greater the diameter. Svec., *et al*. demonstrated that the degree to which a stainless steel file is pre-curved influences the displacement of the anatomy at the apex.

They also confirmed that nickel-titanium files can be pre-curved; that the degree of root curvature influences the degree of deviation of the anatomy and that with nickel-titanium files less deviation was observed in gradual curves; unlike stainless steel files, where there was less deviation in sharp curves. When evaluating the balanced force technique with or without coronal widening, it was observed that with prior crown preparation, instrumentation was easier, but when comparing the degree of deviation at the apex with the group without prior preparation, no significant differences were found. Regarding prognosis, Torabinejad reports that failure of root canal treatment where steps have occurred varies according to the amount of debris present in the uninstrumented and unfilled portion of the canal [11-13].

The patient should be informed about the situation and the importance of establishing clinical and radiographic controls. Lateral perforations or strip perforations are problems that frequently occur in thin and concave roots; the treatment and prognosis differ from that of other perforations, due to their size, oval shape and thin margins of wear. Gutmann., *et al*. report that strip perforations frequently occur in the distal wall of the mesiobuccal roots of upper molars and in the mesial roots of lower molars near the furcation area. The elongated size and irregular margins of the perforation or wear lead to bone destruction, therefore, sealing the lateral perforation is extremely important. On the other hand, a communication through the gingival sulcus could complicate the prognosis.

Because most lateral perforations occur in the coronal third of the root surface near the furcation area, special attention must be paid to the development of any periodontal defects in that region. It has been reported that the repair of the periodontal lesion resulting from a perforation is related to the location and the time elapsed between the moment the perforation occurred and its subsequent sealing. Allam proposes a two-stage treatment technique: an endodontic phase in which the canal system is sealed with gutta-percha that flows through the lateral perforation and a surgical phase that will allow the removal of excess gutta-percha. Likewise, Dazey and Kaufmann point out the importance of the removal of excess gutta-percha, because it can become a constant irritant that delays or prevents complete healing. In previous years and sometimes due to difficult access, extraction or amputation were the only possible solutions for lateral perforation or perforation due to wear.

Nowadays, by carrying out the treatment in two phases, the success of the surgical treatment could be positive, allowing a complete bone repair. Overinstrumentation: According to Frank, when the initial phases of the instrumentation of the canal have been concluded without incident, a problem can quickly arise if excessive overpreparation (overinstrumentation) is carried out. This is a frequent complication due to, among other reasons, the lack of experience of an operator, especially when carrying out the instrumentation using standard techniques with manual instrumentation, also the age of the teeth, directly linked to the maturation of the same, which brings with it anatomical variants at the level of the apical foramen, etc. [11-13].

Torabinejad reports that root canal instrumentation outside the anatomic apical foramen results in foramen perforation, and that incorrect working length or failure to maintain the working length causes foramen perforation. Bleeding in the canal or on the instruments used in the canal, pain during canal cleaning in a previously asymptomatic patient, and sudden loss of the apical limit indicate foramen perforation. Penetration of the last file beyond the radiographic apex is evidence of such a procedural accident. Treatment includes determination of a new working length, creation of an apical seat, and canal obturation along its length. Lasala recommends placing a drug so that at the next appointment, after irrigation and aspiration removing retained clots, no further bleeding occurs. The prognosis depends on the size and shape of the defect; It is difficult to seal an inverted funnel-shaped apex that facilitates extrusion of the filling material towards the periapex, therefore clinical and radiographic controls are recommended. Subfilling

Figure 10: Subfilling.

Both underfilling and empty spaces in the root canal are easily solved by unfilling the canal, correcting the instrumentation and proceeding to refill using an appropriate technique that guarantees the success of the treatment.

Overfilling and overextension

For a proper understanding of the nature of overfilling and overextension problems, a distinction must be made between them. Overfilling implies that the canal system has been filled in three dimensions and a surplus of material is extruded through the apical foramen; overextension is limited exclusively to the extrusion of the vertical dimension of the filling material; it does not imply three-dimensional filling, but is only the displacement of the filling material out of the apical constriction. Frank points out that filling material can sometimes be inadvertently pushed beyond the apical limit, ending up in the periradicular bone, the paranasal sinus, the mandibular canal, or even protruding through the cortical plate. Gutmann., *et al*. Frank establishes some causes that can produce overextension and overfilling when vertical or lateral compaction is used, among them: Causes of overextension and overfilling when vertical or lateral compaction is used, according to Gutmann: 1. Overinstrumentation of the apical constriction, resulting in the absence of an apical dentin matrix 2. Errors during biomechanical preparation such as displacement in the apical zone (zip), perforations, wear 3. Excessive forces in compaction 4. Excessive amount of sealant 5. Use of small or poorly adapted main cones. 6. Excessive penetration of the compaction instrument 7. Any combination of the above To prevent overfilling, Frank says that special attention must be paid to details; the exact working lengths and care to maintain them. Modifying the filling technique is also preventive, especially in young patients with larger root canal systems or in teeth with apical resorption. Limiting compaction forces and appropriate adaptation of the main cone are also recommended. Manisali., *et al*. reported a case of overfilling with iodoform paste that was resorbed 4 days after the accident. The overfilling extended from the lower left second premolar to the angle of the mandible. A panoramic radiograph showed the lower dental canal intact, so it was suspected that the paste was located at the level of the bone trabeculae [11-13].

Gatot., *et al*. reported a case of overfilling with injected thermosoftened gutta-percha and concluded that with these new obturation techniques, less time is required to perform the procedure, the material adapts to the canal and its irregularities and very little manual condensation is needed, but failures to determine the working length and create an apical stop in dentin can lead to overextension of the gutta-percha in the periradicular tissues. Authors such as Gutmann., *et al*. point out that in cases of overextension with the lateral compaction technique, the filling material can be removed from the foramen as long as the cement has not hardened; if it has hardened, it can be removed using solvents and Hedström files. Frank, on the other hand, says that it is very difficult to remove the overextended material; many times when trying to remove it, it will break and the fragment will be left loose in the periapical tissue; Likewise, in attempts to remove an overextension with Hedström files and solvents, the material may be pushed towards the periapex. Metzger., *et al*. propose a technique for removing overextended gutta-percha, in which the gutta-percha is initially softened with xylene and removed up to 2 to 3 mm from the apex. Subsequently, the remaining solid gutta-percha is hooked and slowly removed with a Hedström file placed between 0.5 and 1 mm outside the apical foramen. Lasala and Frank report that even though it is known that an overfilling means a delay in periapical healing, in cases of good clinical tolerance it is advisable to observe the clinical and radiographic evolution for up to 24 months. If the overfilled material is very voluminous or causes discomfort, periapical surgery may be used. Torabinejad reports that the prognosis depends on the degree of sealing achieved, the amount and biocompatibility of the extruded materials, and the host reaction. Incorporating two simple steps into the root canal treatment procedure significantly decreases the possibility of abnormal fillings; first, confirming and maintaining the working length of the canal throughout the instrumentation procedure, and second, obtaining radiographs during the initial stages of filling to allow corrective measures if indicated. Void spaces.

Although the sub-obturation can be conditioned by a bad measurement of the working length, an internal calcification, a bad probing of the main canal and the persistence of a lateral canal that interferes, an elderly or bruxopathic patient where the main canal can be presumed to be quite diminished in its light, and other causes that threaten before and during the filing, conformation and endodontic obturation, since the empty spaces are that variety in which the range of possible causes is reduced and generally point to the bad technique used by the operator.

It is generally an accident that happens more linked to the cold lateral condensation technique rather than in the presence of heat, although in the rest of the obturation techniques one is not exempt from incurring in this accident that will eventually ruin the final treatment, it is worth noting that during filing, especially in the standard technique, the appearance of an undetected step can also predispose the appearance of this complication in which the treatment or conduct will be the same as in the cases of sub-obturation. Internal reabsorption [11-13].

Tooth resorption is a physiological or pathological process that involves a loss of cementum or dentin and cementum. Various types of tooth resorption are known today, but they are not distinguishable at a histological level. Thus, resorption is considered to be external when it affects or starts in the periodontal ligament and internal when it starts in the pulp tissue. The etiology of tooth resorption is unknown, however it is understood that internal resorption is the consequence of chronic pulpitis, although it is unknown why it affects some teeth much more than others. Trauma and infections are important etiological factors. Generally, regular enlargements are observed in the lumens of the dental canals, in exceptional cases when the resorption is close to the most coronal portion of the canal with the thinning of the dental walls, as a pink stain is seen due to the gradual increase in pulp tissue. Although the highest incidence is found in the incisors, the advance of internal resorptions can be very aggressive and fast-moving or prolonged over time and progress very slowly. In any case, the pulp maintains its vitality until it is perforated, at which time it may become necrotic. In all cases, as soon as the diagnosis is made, endodontic treatment must be carried out immediately. Internal resorption stops as soon as the affected pulp is appropriately removed. External resorption. The most frequently found external resorption will be that related to the normal physiological processes of primary or temporary teeth during the eruption of permanent teeth [11-13].

Pathological resorption of the root surface after damage to the cementum can be due to numerous causes: • Tooth impaction. • Luxation lesions. • Periapical inflammation secondary to pulp necrosis. • Periodontal disease. • Excessive mechanical or occlusal forces. • Whitening of endodontically treated teeth. • Tumors and cysts. • Certain systemic disorders. • Radiotherapy. External resorption can be classified into five groups: 1. Inflammatory resorption. 2. Superficial resorption. 3. Cervical resorption. 4. Replacement resorption. 5. Idiopathic resorption. Inflammatory resorption.

Inflammatory resorption is thought to be due to the presence of infected or necrotic pulp tissue in the root canal. This affects the dentin surrounding the apical foramen or lateral canal of any tooth, so the pulp infection perpetuates the resorption that can advance rapidly. In cases of inflammatory resorption, endodontic treatment carries a fairly good prognosis, the only problem that may arise is the difficulty in achieving an apical stop due to the lack of apical constriction. However, with time, a stop can be achieved with calcium hydroxide or the chloroform immersion technique can be used to obtain a good fit in the apical 2-3 mm of the canal (which would help prevent the extrusion of filling material into the periapical tissues).

Superficial resorption.

Suele ser una reabsorción leve secundaria a una lesión del ligamento periodontal o del cemento. Este trastorno cura sin necesidad de tratamiento, reparándose de forma espontanea. No suele visualizarse en las radiografías.

There is, however, a more destructive form of superficial resorption that may be due to acute or chronic compression, such as that produced by an erupting or impacted tooth, by orthodontic treatment or by a tumor or cyst. Various systemic disorders can also induce resorption, such as hypoparathyroidism, hyperparathyroidism, calcitosis, Gaucher's disease, Turner's syndrome or Paget's disease. Treatment consists of eliminating the cause: in the case of a systemic disease, the patient should be referred to a specialist. This disorder should be monitored periodically.

Cervical resorption.

Cervical resorption is the result of inflammation within the periodontal ligament, possibly following trauma to the same. It is located in the cervical area of the tooth and can present two different clinical forms: a wide and shallow crater or a perforating resorption. It usually affects a single tooth and progresses slowly. Cervical resorption is usually asymptomatic and is diagnosed during a routine radiological examination. It does not affect the pulp until the process is very advanced.

This resorption can also be related to the whitening treatment of a tooth that has undergone endodontic treatment. Resorption Replacement. It consists of a slow replacement of the root by the surrounding bone, which leads to ankylosis. It is due to an injury to the cells that cover the cementum as a result of a dislocation. According to Andreasen, replacement resorption after avulsion, to which this type of resorption is closely related, has an avulsion rate of 80-96%. This alteration may be temporary if the lesion is limited, but in more extensive cases it progresses progressively. If the pulp becomes necrotic, inflammatory resorption may be added to the process. In this case, bone repair can be encouraged by applying calcium hydroxide to the canal. Idiopathic resorption.

Some cases of external resorption affect more than one tooth but are not accompanied by systemic alterations and do not fit well into any of the previous categories and we consider them idiopathic, where the prognosis will be reserved and the treatment plan less conventional, depending on the magnitude of the condition and the speed of its progression.

Tissue or Subcutaneous Emphysema. Tissue or subcutaneous emphysema is defined as the abnormal presence of air pressure along or between facial planes. Facial planes are tissue-bound areas that in non-pathologic conditions are only potential spaces. Emphysema may be complicated by tissue destruction due to movement of irrigants/medications from the root canal system into periapical tissues or secondary infection. It can be seen radiographically and is almost always indicative of serious conditions such as tracheal or esophageal rupture and bronchial rupture or pneumothorax. Etiologic categories of subcutaneous emphysema: 1. Emphysema during or after extraction 2. Emphysema during the course of root canal treatment 3. Emphysema after soft tissue lacerations during dental procedures. Subcutaneous emphysema during root canal treatment is caused by a combination of several factors: Most common causes of emphysema: 1. Procedural accidents that cause perforations of the apex or root of a tooth; allowing air to pass into potential spaces 2. Inadvertent irrigation of subcutaneous tissues with oxygen-producing irrigants under pressure. 3. Use of high-speed handpieces without exhaustive protection to prevent air from passing into the surgical area. 4. Prolonged or excessive use of air syringes to improve visibility. In endodontic procedures, the complication occurs as a result of copious irrigation with hydrogen peroxide, which can create the abnormal presence of trapped air in the tissues; the oxygen released by the hydrogen peroxide can carry debris or gases into the adjacent bone through the apical foramen or through an inadvertent perforation in the canal wall. However, it can also be absorbed into the circulatory system and form emboli in various parts of the body, including the coronal and cerebral circulation. When drying the root canal system with compressed air, the use of the syringe may introduce high air pressures into the periapical tissues and in some cases into the facial planes [11-13].

Compressed air should be used with great care when it is used to remove debris and dry the tooth. It should be avoided when the root canal system has been made patent. The first portal of entry of air into the anatomic spaces appears to be the root canal, but the movement of air through soft tissue lacerations, such as those created by the use of the rubber dam and the staple, must also be taken into account. The main clinical sign of subcutaneous emphysema is rapid swelling of the face and sometimes the neck. The extension of the edema almost always crosses the midline. In addition, erythema, numbness of the area and, in most cases, crepitus triggered by palpation may be observed. Pain is variable and usually short-lived; sometimes only a slight discomfort or pressure sensation is felt. When the neck is involved, there is general malaise with difficulty swallowing.

Subcutaneous emphysema caused by endodontic treatment can last from days to weeks, disappearing from the facial regions before the neck region. Soft tissue distension is observed on soft tissue radiographs. Later signs of subcutaneous emphysema that may appear 1 to 2 hours after the accident are: diffuse edema, erythema, pyrexia and sometimes chronic pain. A differential diagnosis must be established with an allergic reaction, hematoma and angioneurotic edema. The allergic reaction is faster and the skin manifestations precede the cardiorespiratory manifestations. The hematoma forms rapidly without the presence of an initial discoloration. In angioedema, areas of circumscribed edema preceding a burning sensation may be present in the skin and mucous membranes. Crepitus is pathognomonic of emphysema, therefore it is easy to distinguish from angioedema.

Measures to Prevent Subcutaneous Emphysema: 1. Always use a rubber dam 2. Place irrigation needles without pressure into the root canal system. 3. Release the contents of the syringe gently. 4. Avoid using hydrogen peroxide while irrigating teeth with open apices. 5. Avoid using hydrogen peroxide in root canals with hemorrhagic pulps. 6. Use high suction or absorbent paper points to dry or remove fluids from the root canal system 7. Avoid using compressed air directly in the access chambers during endodontic treatments. 8. Judiciously apply vasoconstrictors before the surgical procedure. 9. Apply copious irrigation with saline solution during surgical access. 10. Use ultrasound or sonic instruments in apical surgeries If subcutaneous emphysema occurs, there are some treatment options, although none have been scientifically proven.

Course of action in the event of an emphysema episode.

Stop root canal treatment. 2. Reassure the patient. 3. Determine the cause of the accident, for example: perforation, passage of air into the tissues, passage of hydrogen peroxide. 4. If hydrogen peroxide has passed, gently irrigate the area with distilled water through the entrance. 5. If the patient is in pain, administer local anesthetics to the appropriate areas. 6. If the inflammation does not appear to be related to subcutaneous emphysema, consider an allergic reaction and treat it appropriately. 7. Consider prescribing antibiotics, because the introduction of air may include microorganisms. 8. Consider prescribing analgesics, because there may be tissue distension a few days later. 9. If there is difficulty breathing or swallowing, and this does not appear to be related to anxiety states, consider medical advice.

Infection is a potential problem, so the patient should be given antibiotics prophylactically; in some cases, antibiotics are not always effective, so drainage of the localized infection should be established. During endodontic treatment, many factors could contribute to the development of subcutaneous emphysema, and the best treatment is prevention during conventional and surgical procedures. The complication is not dangerous, and the general dentist and endodontist should be aware of the different treatment possibilities for the resolution of this type of accident. Irrigation frequency and irrigant volume are important factors in the removal of debris. Irrigation frequency should increase as the preparation approaches the apical constriction.

An appropriate volume of irrigant is at least 2 ml each time the canal is irrigated, and it is recommended to irrigate the canal each time it is finished working with a file thickness. Regarding the needles, the most important thing is the caliber, which should be small, a 27-gauge needle is preferred, which has the potential to penetrate more deeply into the canal. It should also not be tight within the canal walls; a pumping motion should be applied, minimizing the risk of propelling the irrigant into the periapical tissues. The needle should penetrate to the apical third of the canal and then be withdrawn 2 mm, in order to achieve good irrigation towards the coronal third and thus avoid over-irrigation or periapical emphysema. Ideally, during canal preparation, it should be done in the presence of moisture, this prevents improper operation of the instrument and the risk of creating an apical dentinal stop. It is important to highlight the fact that although the irrigation needle should be inserted up to the apical third, the conservative criteria of the working length should be reviewed because at no time should the spaces be exceeded beyond the apical constriction.

Likewise, for the collection of the irrigant, several techniques have been used, among them we find: collection with cotton, gauze, ejectors and paper points. However, today with the technological advances of imaging and endodontics as a particular specialty within stomatology, techniques have been achieved that significantly reduce the risks of causing periapical emphysema. In this sense, graduated diameter cannulas have been designed whose most distal end is blunt and closed, having the opening approximately 1.5 mm from the most distal edge.

This guarantees, first, avoiding the potential risk of apical injection of debris and/or irrigants that cause emphysema, second, it creates a spiral circulation system that mechanically sweeps the debris by dragging it more effectively, expelling it from the canal towards the coronal, and third, it enables the evacuation of the debris dissolved in the irrigant in an assisted manner through the aspiration cannulas. An alternative to manual irrigation is ultrasound-assisted irrigation, which prevents the files from contacting the walls, since the rotation of the files can be blocked and reduce the effectiveness of irrigation. Therefore, the effectiveness of irrigation with ultrasound increases as irrigation time increases. Other studies do not show a significant difference between the effectiveness of cleaning using hypochlorite and ultrasound, and hypochlorite alone, mainly in the apical third [12,13].

This is supported by the presence of different factors, such as: degree of curvature, type of tooth used for the study, anatomy of the root canal, amount of irrigant used and evaluation criteria. It is very important to follow the steps correctly during a preparation and irrigation process, to obtain the best performance of the irrigant substance. It is very important to know the characteristics and properties of each of the irrigants that are most frequently used during endodontic therapy, in order to choose the most appropriate one: one that has antimicrobial action, lubricant, organic and inorganic tissue solvent. Among the irrigants that most closely match these characteristics is sodium hypochlorite, which together with chelating substances offers thorough cleaning of the root canal.

The effectiveness of an irrigating agent depends directly on various factors such as handling, dilution, pH, temperature, etc., therefore it is essential to know its proper handling, storage, and characteristics, in order to obtain the best result from it. The most recommended solutions are the chemically active ones, since the inactive ones only have a washing benefit, which is not sufficient for an adequate cleaning of a root canal. Tissue edema Various irrigation solutions have been used in the chemomechanical preparation of the root canal system; among them, saline solution, hydrogen peroxide, alcohol and sodium hypochlorite; regardless of their toxicity, any of them can cause problems when extruded into the periapical tissues. Sodium hypochlorite (NaOCL) is one of the most common irrigating agents used in the biomechanical preparation of the root canal system, but it is well known that it is irritating to vital tissues; The solution is usually applied during and after biomechanical preparation using syringes with well-adapted needles.

A recognized potential complication is the passage of the irrigant through the apex into the periapical tissues. According to Becking, Gluskin and Sabala, the signs and symptoms that occur when NaOCl is extruded into the periapical tissues are severe pain, rapid development of edema, hematomas, necrosis and abscesses. Complications are caused by the oxidative effect of NaOCl on the vital tissues surrounding the tooth being treated; followed by an inflammatory response of the organism [13].

This type of accident can be prevented by a group of clinical and preclinical measures to be taken: Prevention of tissue edema 1. Careful review of the patient's medical history, regarding allergies to cleaning products containing chlorine; and subsequent referral to specialists for the performance of some sensitivity tests. 2. Bend the irrigating needle in the center to limit the tip of the needle to the upper levels of the canal and facilitate access to the posterior teeth 3. Use a rubber dam. 4. Avoid excessive pressure inside the canal when applying the solution. 5. Swing the needle in and out of the canal orifice to ensure that it is free 6. Avoid embolizing the needle from the syringe during placement of the irrigant into the root canal system. 7. Make sure that the needle is well adapted to the syringe to prevent accidental separation and accidental irrigation of the patient's eyes. Regarding the injuries to the patient's eyes, Ingram reported a case where immediate pain, abundant tearing, intense burning and erythema were observed, loss of corneal epithelial cells may occur and recommends irrigating the eye immediately with saline solution and referring the patient to an ophthalmologist for evaluation and treatment. If the above-mentioned complications occur, appropriate treatment should be applied and prophylactic measures taken.

Course of action in the event of an episode of edema: 1. Recognize that an irrigation accident has occurred. 2. Remain calm, stop treatment, and explain to the patient. Remain calm, stop treatment, and explain to the patient. 3. Immediate pain control with local anesthesia. 4. Monitor the tooth for half an hour; there will be a hemorrhagic exudate through it; if drainage persists, consider leaving the tooth open for 24 hours. 5.

Apply appropriate analgesics. 6. Administer prophylactic or therapeutic antibiotics in case of a second infection. 7. Cold compresses for the first 6 hours; followed by warm compresses and mouthwashes. 8. Consider referring the patient to an Oral Surgeon or Endodontist if the patient remains apprehensive or develops complications. Consider referring the patient to an Oral Surgeon or Endodontist if the patient remains apprehensive or develops complications. Mehra., *et al*. reported a case where a facial hematoma formed after inadvertent injection of sodium hypochlorite into the periapical tissues.

This case required hospitalization of the patient, administration of intravenous antibiotics, multiple surgical incisions under general anesthesia to facilitate decompression of the hematoma, and placement of a drain for 2 days. Gluskin., *et al*. report that even though NaOCl is known as an irrigant of the root canal system, it could be left in the pulp chamber and, through instrumentation, passively carried to the deepest levels of the root canal system, fulfilling the objectives of dissolving organic debris, disinfection, and lubrication. Chapter 2: Most frequent complications in endodontic treatment. 1.4. Penetration of instruments into respiratory and digestive tracts. Allergies. Prevention and treatment. Prevention, Prognosis and Treatment of Other Endodontic Accidents Aspiration and swallowing of instruments Isolating the tooth to be treated with a rubber dam is a precaution that all operators must take. Since the 1960s, until today, it has been established that isolation serves to ensure and maintain disinfection during treatment; improve visibility of the operating field; provide safety to the patient, dentist and assistant, avoiding the ingestion or aspiration of endodontic instruments and materials during treatment and provide a perfect seal in the cervical area, to avoid contamination with saliva or filtration of chemicals during endodontic therapy. In general, the use of a rubber dam is mandatory during the various phases of endodontic treatment. However, when difficulties are anticipated in locating the pulp chambers, it is necessary to begin the approach without placing a rubber dam; although instruments such as files, expanders or barbed probes should not be used inside the canals. Aspiration or swallowing of foreign bodies is an accident that can occur during any dental procedure [11-13].

The patient is usually placed in a supine or semi-supine position, which increases the risk that instruments may fall into the oropharynx, with subsequent aspiration or swallowing. Zitzmann., *et al*. report that there is a certain predisposition in some patients to swallow instruments, including: prisoners, psychotics, alcoholics, senile, retarded, nervous and patients with excessive gag reflex; also patients with total prostheses due to reduced sensitivity in the palatal mucosa; patients with limited mouth openings, low palates, macroglossia, long necks and obese patients. Pregnant and overweight patients have increased abdominal pressure and impaired swallowing coordination, in these cases the patient should be treated in a more upright position. There are many respiratory complications due to aspiration of objects; among them; infection, lung abscesses, pneumonia and atelectasis; gastrointestinal complications also occur due to the passage of objects into the digestive tract; among them; blockages, abscesses, perforations and peritonitis.

There have been several publications on aspiration and swallowing of instruments, such as files and expanders; Mejia., *et al*. report that instruments can take several routes, they can go through the patient's digestive tract over a period of days to months, or the instrument can remain in the stomach, duodenum, colon, or appendix; in which a surgical procedure has been necessary for its removal, due to the possibility of infection [10,13].

If the object reaches the stomach, it is prudent to wait until it passes through the gastrointestinal tract, where its location can be verified by X-ray. If the object does not have prominent surfaces, it can be evacuated in 2 to 5 days. When the instrument is sharp (such as files, burs, staples), it can become lodged in the duodenum or colon, causing peritonitis; if it lodges in the appendix, it causes acute appendicitis. Barkmeier and Zitzmann recommend that if the staple is to be placed first, it is best to tie it with a piece of dental floss to facilitate retrieval if it becomes loose. Another option is to place a physical barrier (such as a piece of gauze) in the throat to prevent swallowing foreign bodies during endodontic practice. Conduct to follow in case of swallowing a foreign body in consultation (tooth, files, staples, etc.), the stomatologist must: 1. Avoid sitting the patient quickly, but rather place him face down so that he can release the object or in other cases, tell the patient to place his head below the thorax to induce the object to come out 2. Remove objects that are accessible in the throat. High suction, if a pharyngeal tip is available, is useful to recover lost objects; the use of hemostatic forceps and cotton tweezers 3. Refer the patient directly to medical care that includes x-rays, to determine if the object is lodged in the bronchi or in the stomach, so that the necessary measures can be taken for its removal. It is very useful to provide a sample file to the doctor so that he has a better idea of the size and shape of the object [13].

The aspiration or swallowing of dental instruments or materials can present a serious threat to the patient's health. The rubber dam or gauze pack should be used to provide protection for the patient. Each dentist should examine his or her techniques to determine if he or she is using all available methods to prevent these accidents. In humans, the stomatognathic system is made up of the mouth, nose, pharynx, larynx, trachea, lungs, and diaphragm. The organs that comprise it are also part of the respiratory system and some of the digestive system. When breathing without speaking, the respiratory cycle is made up of two phases that last more or less the same: inspiration and expiration. But while speaking, the respiratory cycle changes. The inspiration phase shortens and accelerates while the expiration phase slows down, extending in time between five and ten seconds, a duration that can even be longer.

The throat, in the human body, is the area of the neck located in front of the spine where the digestive and respiratory systems converge. It houses the larynx, pharynx and the upper portions of the esophagus and trachea. Some of the large arteries and veins also pass through the throat. The throat allows food to pass from the mouth to the esophagus, and air to pass from the nose and mouth to the trachea. It also intervenes in the process of voice formation. These anatomical-functional issues constitute parameters that must always be present during the planning of endodontic treatment by the specialist, since the reality is that we are never exempt from potential risks in which the respiratory and/or digestive tracts could be injured with real compromise for the life of the patient to be treated, so some of the most frequent conditions are: 1. Asphyxia. 2. Dysphagia. 3. Pharyngitis. 4. Hemorrhage. 5. Peritonitis.

Suffocation

In asphyxia, air cannot enter the lungs and oxygen does not reach the circulating blood. Causes of asphyxia include drowning, due to obstruction of the airways by foreign bodies. To prevent irreparable brain damage due to tissue oxygenation being stopped, some form of artificial respiration must be started immediately. Most people die four to six minutes after respiratory arrest if they are not artificially ventilated. Many forms of artificial respiration have been devised. The most practical for emergency resuscitation is the mouth-to-mouth procedure: the rescuer blows pressurized air into the victim's mouth to fill the lungs. Before doing so, any foreign body obstructing the airways must be removed. The victim's head must be tilted back to prevent the tongue from falling and obstructing the larynx; to do this, the chin is pulled up with one hand while the forehead is pushed back with the other. The rescuer closes the nostrils by pinching them with his fingers, takes a deep breath, puts his mouth to the victim's mouth, and blows hard until he sees the chest fill; then he removes his mouth and watches the victim exhale. This process should be repeated 12 times per minute in an adult and 20 times per minute in a child. If the airway is not clear, the position of the victim's head should be checked. If there is still no patency, the body is rotated to the side and hit between the shoulder blades to clear the bronchi. Then mouth-to-mouth resuscitation is resumed. If there is still no patency, the Heimlich maneuver is performed. This is a technique that has been developed in recent years to treat patients with airways obstructed by a foreign body. Invented by the American doctor Henry Jay Heimlich, it is called the Heimlich maneuver or "bear hug" and consists of the sudden application of pressure on the victim's abdomen. The increase in abdominal pressure compresses the diaphragm, which compresses the lungs, which expel air at high speed and pressure, clearing the airways. The maneuver is performed by standing behind the patient, surrounding his waist with your arms and interlacing your hands, placing them between the navel and the rib cage, and pressing hard and abruptly backwards and upwards. If the victim is in a horizontal position, press on the abdomen with your hand. Avoid pressing on the ribs, as they can break, especially in children and the elderly. Once started, artificial respiration should not be stopped until the patient begins to breathe on their own. When the patient begins to breathe spontaneously, they should not be left unattended: breathing may suddenly stop again or respiratory irregularities may occur. In cases of drowning, artificial respiration should always be attempted, even if the patient has shown signs of death for several minutes. Several cases have been described of patients submerged for more than half an hour, cyanotic and with no possibility of resuscitation, who responded to the first attempts of the rescuer. Dysphagia. Mechanical dysphagia can be caused by obstruction of the swallowing duct (foreign body), by narrowing of the duct or by compression from the outside. In this case, where the instrument has blunt edges and a generally sinuous shape like a guide ring, for example, we should not be confident, thinking that the movements proper to swallowing will satisfactorily resolve the accident, since on many occasions they advance the object to a position of true drowning, so immediate referral should be carried out with the indication of a corresponding cervical-thoracic x-ray seeking to obtain the most exact position of the foreign body in question. Pharyngitis Narrowing may be due to inflammation (pharyngitis), chemical irritation or friction. Sometimes the instrument may be small and underestimated in importance, for example a wooden wedge with which we hold a staple during absolute isolation. In these cases, when we realize this, we mistakenly assume that everything will be fine. However, the patient may not give the fact due importance and not tell us about it, thinking that a certain discomfort will be temporary and, apart from this, it becomes a local irritant that leads to established pharyngitis [13].

Hemorrhage. Hemorrhage, understood as the extravasation of blood fluid outside the body, is an unavoidable consequence of most clinical-surgical treatments. Therefore, it is important to know before carrying out said treatment the type of bleeding that we are going to encounter, as well as to assess any circumstance that affects it, evaluating it and establishing the necessary protocols so that it remains at controlled levels and not dangerous for the patient's life. On the other hand, the professional must be prepared to deal with any complication that may appear during the course of surgical treatment in relation to hemorrhage, as well as to make the appropriate decisions at the appropriate times to minimize the effects of said complication.

Finally, the appearance of hemorrhagic complications may not only appear during the surgical intervention itself, but also in the postoperative period. The stomatologist must be able to establish measures that minimize the risk of their appearance and treat them correctly if they occur. Of all the instruments that could cause obstructive accidents in the respiratory and/or digestive tract, files and rotary instruments are by far the ones with the most harmful results, and can cause tears in the esophagus and throughout the digestive tract, which would cause multiple areas of bleeding, which would invariably lead to emergency surgical treatment.

Hemostasis is the spontaneous or artificial stopping of blood flow or hemorrhage. It is the set of mechanisms that cause the interruption of hemorrhage from an injured vessel through vascular, platelet and plasma factors, etc. There are two phases in hemostasis: • Primary hemostasis or parietal phase. • Coagulation or plasma phase. In conclusion, hemostasis is the stopping of hemorrhage by the physiological properties of vasoconstriction and coagulation, as well as surgical methods. Peritonitis. Peritonitis, inflammation of the membrane that lines the abdominal cavity and the organs contained in it.

Peritonitis is usually an acute condition caused by a perforation of the intestine, such as a ruptured diverticulum. It may also be caused by irritating substances, such as gastric acid from a tear in the stomach wall, or bile from a ruptured gallbladder or a lacerated liver. Localized peritonitis is most often seen in the pelvis from an infection caused by an instrument lodged in this region. Peritonitis sometimes results from the leakage of pus into the abdominal cavity from a ruptured abscess. This sometimes occurs after intestinal surgery with suppuration from the surgical wound. The main symptom is acute abdominal pain that worsens with movement. The patient often has nausea and vomiting, and is feverish. Severe cases of acute peritonitis without treatment are often fatal. Treatment is directed at the underlying cause. Intravenous fluids and antibiotics must also be administered [13].

We can say in general that the greatest success in preventing accidents during endodontic treatment will be aimed at ensuring the use of absolute isolation in each case, which is the only truly effective way to prevent any event of this nature. Allergies Klassen refers to a chemical allergy as an adverse reaction that arises from prior sensitization to a particular chemical substance or another with a structural similarity. Reactions of this nature are mediated by the immune system.

The terms hypersensitivity and drug allergy also apply to the allergic state. Allergic reactions are divided into four major categories, based on the mechanism of immunological participation: Type I, or ANAPHYLACTIC: Where vasodilation, edema, and an inflammatory reaction occur. The sites where this type of reaction most frequently occurs are the gastrointestinal tract (food allergies); the skin (urticaria and atopic dermatitis); the respiratory tract (rhinitis and asthma) and blood vessels (anaphylactic shock). Such reactions arise rapidly and are called immediate hypersensitivity reactions. Type II, or CYTOLYTIC. They occur mainly in the cells present in the circulatory system, such as: hemolytic anemia, thrombocytopenic purpura, lupus erythematosus, etc. Type III, or ARTHUS. It occurs mainly in the vascular endothelium, triggering a destructive inflammation called serum sickness; the clinical symptoms are urticarial rashes, arthritis, lymphadenopathy and fever. Type IV, or Delayed Hypersensitivity Such as contact dermatitis.

Latex hypersensitivity is one of the most common allergies; regular contact with products containing latex, especially gloves, can cause adverse reactions in certain people. Health care workers, people allergic to certain foods such as bananas, avocados, chestnuts and kiwi; Patients who have undergone multiple surgeries during childhood, such as patients with spina bifida and certain disorders requiring repeated urinary catheterizations, are potentially sensitive to latex. According to Knowles., *et al*. patients may present with the symptoms of a normal allergic reaction, such as dermatitis, pruritus, urticaria, bronchospasm, and anaphylaxis. On the other hand, Sadafi and Field report that in a sensitized individual, a delayed hypersensitivity (Type IV) develops 6 to 72 hours after exposure, causing contact dermatitis. Immediate hypersensitivity reactions (Type I) in the form of urticaria and erythema occur within minutes at the site of contact. Immediate systemic reactions and diffuse rash may also occur; conjunctivitis and rhinitis and bronchospasms that cause hypotension, anaphylaxis, and may endanger the patient's life. The oral mucosa of patients is exposed to latex from gloves or other dental instruments containing latex. During endodontic treatment in hypersensitive patients, certain precautions must be followed. The office must have materials that do not contain latex. For patients who are hypersensitive to latex, direct contact with it is not necessary, since the powder used to prevent the glove from adhering to the skin (phosphated corn starch) is enough to create an allergic reaction when it comes into contact with the mucous membranes.

However, in patients with latex sensitivity, Patterson in 1989 established a feasible alternative for isolation. This procedure consisted of using a polyethylene bag, cut and washed, which provided adequate protection for the nasopharynx, but did not create an adequate seal at the level of the neck of the tooth, due to its lack of elasticity; therefore, its use was not a practical procedure.

The guidelines to follow for the care of patients allergic to latex were published by the Office of Safety and Asepsis Procedures; which recommends that these patients should be the first of the day, and that there should be no instruments or materials containing latex in the office; the entrance to the office should remain closed, and there should also be an emergency team in case of an anaphylactic reaction. The only treatment available is prevention. Premedication with antihistamines or corticosteroids does not protect a sensitized person from having a reaction to latex products. Regarding endodontics, Knowles and Field refer that the main problem lies in the gloves and the rubber dam; although rubber stops, the obturator plunger in anesthesia syringes, latex devices on some instruments, mouth covers, ejectors and gutta-percha should also be taken into account.

En 1994, Boxer y col. reportaron un caso clínico donde se realizó un tratamiento de conducto a una higienista dental, alérgica al látex; se tomaron todas las medidas preventivas pertinentes al caso; pero al momento de la obturación, se pasaron inadvertidamente algunos conos de gutapercha a través del ápice a los tejidos periapicales. El paciente reportó al instante, malestar, inflamación gingival y labial, sensación pulsátil alrededor del diente y urticaria difusa. Aunque se administró 4 mg de dexametasona alrededor del diente; el malestar y la inflamación persistieron por 4 semanas, hasta que la gutapercha fue removida e inmediatamente el paciente experimento alivio. Químicamente se estableció que la gutapercha y el látex aparecen como isómeros, pareciera ser posible que los pacientes hipersensibles al látex, pudieran ser alérgicos a la gutapercha.

Sodium hypochlorite has become the most popular irrigating solution in endodontic treatment, although not many cases of hypersensitivity have been reported, it should be noted that allergic reactions may occur. Caliskan., *et al*. report that in patients hypersensitive to hypochlorite, in addition to severe pain, burning sensation, inflammation, ecchymosis and bleeding through the canal; difficulty breathing, hypotension and erythema are observed, for which medical attention should be received immediately in a health service. In these cases, it is recommended to irrigate the root canal system alternating hydrogen peroxide and physiological solution.

As a measure to prevent accidents due to hypersensitivity to sodium hypochlorite, the medical history must be meticulously performed; if there is any suspicion of allergies to cleaning products, the patient should be referred to perform specialized hypersensitivity tests. 1. Prevention is the most important factor to avoid accidents during endodontic therapy. 2. The proper management of each accident determines the prognosis of the case. Final considerations. Neither the presence nor the absence of symptoms can by itself determine the failure of an endodontic treatment without the integration of other factors. The main cause of endodontic failure is the filtration of infected or necrotic material from a poorly filled portion of the canal. Non-surgical retreatment of root canals is indicated in cases of apparent success with a poor root filling and that are going to be included in a prosthetic-restorative treatment, as well as cases of failure that are or are not producing pathology. Decide between conservative and surgical retreatment, depending on the possibility of coronal access to the root canals. Always make a prior evaluation of the characteristics of the root canal treatment with x-rays in new projections [13].

Conclusion

There are many consequences and risks that can arise from root canal treatments. This paper describes several of the most frequently diagnosed ones.

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Bibliography

1. Álvarez Valls L. "Endodontics". Chapter XX. ICL. Havana (1977).
2. Clinical practical guides. Collective of authors. Ed. ECIMED (2003).
3. Endodontic Standards, Ministry of Public Health, National Directorate of Stomatology, Havana, Editorial DM (1983).
4. Comprehensive General Stomatology. Grisel González Naya and Mirta Elena Montero del Castillo, Havana. Ed. ECIMED (2013).
5. Álvarez J., *et al*. "Efficacy of oral OLEOZON® as an intracanal medication in endodontic treatment. Playa 2014". *REO* 7.1 (2014): 29-38.
6. Ministry of Public Health. Center for State Control of Medicines and Medical Devices. Oleozón® Oral. Cuba: CECMED (2017).
7. Nascimento GG., *et al*. "Comparison of the effectiveness of single- and multiple-sessions disinfection protocols against endotoxins in root canal infections: Systematic review and meta-analysis". *Scientific Reports* 11.1 (2021): 1226.
8. Chagas Carvalho Alves N., *et al*. "Influence of occlusal reduction on pain after endodontic treatment: A systematic review and meta-analysis". *Scientific Reports* 11.1 (2021): 14019.
9. Nosrat A., *et al*. "Postoperative pain: An analysis on evolution of research in half-century". *Journal of Endodontics* 47 (2021): 358-365.
10. Ather A., *et al*. "Outcome of pulpotomy in permanent teeth with irreversible pulpitis: A systematic review and meta-analysis". *Scientific Reports* 12.1 (2022): 19664.
11. Huang Q., *et al*. "Current applications and future directions of lasers in endodontics: A narrative review". *Bioengineering* 10 (2023): 296.

12. Elafifi-Ebeid H., *et al*. "Post-endodontic pain evaluation after different intracanal laser assisted disinfection techniques". *Systematic Review Journal of Clinical and Experimental Dentistry* 15.2 (2023): e149-e159.

13. Meire MA., *et al*. "Effectiveness of adjunct therapy for the treatment of apical periodontitis: A systematic review and meta-analysis". *International Endodontic Journal* 56.3 (2023): 455-474.