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Review article

PERIAPICAL SURGERY. EPIDEMIOLOGY, INDICATIONS AND CONTRAINDICATIONS. REVIEW.

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SUMMARY

Periapical endodontic surgery (apical osteotomy, apicoectomy, apicectomy, root resection), aims at the treatment of apical periodontitis, after exhaustion of the possibilities of orthograde endodontics.

Surgery is an essential part of endodontics and helps us retain natural teeth as long as possible. Not all periapical lesions are of true endodontic origin and can be treated nonsurgically.

With the development of new instruments and techniques, the indications for performing the procedure have changed. Clinicians should know all peculiarities when faced with patients with a different medical history or anatomical variations. They should be prepared to cope with intra/post operative pain and complications.

In this review are presented epidemiology, ways of treatment of periapical lesions, advantages and disadvantages, indications and contraindications of performing this procedure, peculiarities with different patients, as well as methods of conducting it, based on the current literature

Keywords: apical osteotomy, periapical lesions, treatment, orthodontic, retrograde,

INTRODUCTION

Periapical surgery is part of endodontic surgery. Its aim is the treatment of apical periodontitis after depleting the possibilities orthograde nonsurgical endodontics or due to failure or inability to perform such an approach. Removal of all irritants is the ultimate goal as well as an airtight root canal "hermetization", with subsequent periodontal repair and regeneration of tissues. Advantages, indications, contraindications medical and anatomical limitations have been presented this review.

Terminology

In literature, the term (apicoectomy, apicotomy, apicectomy, root resection) is still used, which, however, reflects only part of the volume of all manipulations which are performed. The term apicectomy was introduced by Farrar JN in 1880, and Partsch C (1896-1899) is credited with the methodological description of "root-end-resection" - "Wurzelspitzenresection". According to Lieblich SE (2013) in the 6-th edition of "Contemporary Oral and Maxillofacial Surgery", this is part of the endodontic surgery armamentarium, and the manipulation described by us in this review is called periapical surgery. In their review, Ma X et al. (2016) use the term periradicular surgery. Castelluci A (2005), terms it surgical endodontics or microsurgical endodontics. Thorabinejad (2017) considers that this is apical microsurgery, part of surgical endodontics or endodontic surgery. For him, contemporary endodontic surgery is microsurgical, and this is part of the endodontic treatment performed through a surgical flap, retrogradely. Most authors, share the same opinion and for them, peri/apical, periradicular surgery, is part of surgical endodontics or endodontic surgery. Some of them are Tsvetanov TZ (2015), Von ARX T (2011), Gutman JL (2014) [1]

Epidemiology of Periapical Lesions

Research shows that there are 6 main causes which lead to asymptomatic or chronic apical periodontitis: persistent intra-radicular infection; intraradicular infection (actinomycosis) [2]; foreign body reaction caused by a root-obturating material, accumulation of endogenous cholesterol crystals [3], true cystic lesions and tissue formed post treatment (scar). [4] Cholesterol crystals, according to Kim S and Kratchman S play a significant role in increasing the volume of lesions, their persistence or treatment failure [3].

Histological studies indicate that the frequency of lesions varies: periapical granulomas - 9%-83.8%; cysts - 6%-55%, periapical abscesses - 28%-35% [5]. In some studies, more periapical granulomas are found, while in others, cysts are equal to them ranging from 40% to 48%. A biopsy of 1659 lesions detects no sexual prevalence of a specific type of lesion, while other studies establish a higher percentage of cysts in men, Pechalova et al. [6] More lesions are detected in the frontal maxillary region and less in the distal, where mainly cysts prevail [6]. Others agree that granulomas and cysts are found more often in maxilla's front but state that granulomas predominate in the distal part. In the distal part of the mandible, mainly cysts are found, and in the front more granulomas. [5] Most authors agree that maxillary teeth have more lesions, but without specifying their true nature, due to radiographic diagnosis only, and no histological examination. Some histological studies find mainly granulomas -50%, within examined extracted teeth and a very small number of cysts - 15%, and even less true cysts. Others [7] find 2.3 times more lesions on the lower jaw, with distribution- dentigerous cysts (61, 8%), radicular (31, 6%), odontogenic (2,6%) or nonodontogenic (3,9%) lesions. A retrospective study of Koivisto et

al. for a period of 14 years on 9723 cases, detects apical granulomas in - 40.4%, cysts - 33.1%, keratocysts - 8.8%, central giant cell granulomas - 1.3%, ameloblastomas - 1.2% and 0.26% metastases [5]. Cysts, ameloblastomas, keratocysts and metastatic lesions occur more often in men, while in women central giant-cell granuloma is prevalent. Less common lesions are mainly diagnosed in the distal part of the mandible. Apical granulomas and cysts occur at the same frequency in males and females [5, 7].

Treatment of periapical lesions

Treatment of periapical lesions, according to Del Fabbro et al., must be undertaken based on clinical symptoms and radiographic changes. In most cases, this is done without any histopathological examination or another objective indicator, to provide evidence for treatment necessity, efficacy, prognosis or which approach would be more successful nonsurgical or surgical [8]. Besides periapical abscess, granuloma or cyst, other periapical pathologies or changes can mimic endodontic lesions and they do not succumb to treatment by endodontic methods only [2, 5]. Radiological studies, as well as vitality tests, may be informative, but not highly sensitive, which in turn requires a histological examination for final diagnosis [2]. Even studies with cone beam computed tomography (CBCT) are not sufficiently informative and show only 51%-76% match between radiographic and histological diagnosis. However, 3D CBCT has greater sensitivity than periapical and panoramic radiographs. [9]

Success rate of nonsurgical endodontics in the treatment of periapical lesions

The success of traditional nonsurgical treatment with the standard technique reaches 91% according to Yuan Ling Ng, V. Mann and K. Gulabivala. This rate ranges from 53-to 98% in cases when it is carried out in the course of initial treatment of pulpitis and the absence of periapical lesion [10]. In retreatment cases with the presence of an apical lesion, this percentage decreases to 72%. Retrospective studies show even lower scores – 44.2% [11]. For the treatment to be successful, the root canal system should be obturated a little shorter than the apex with a homogeneous root canal obturation [12, 13, 14, 15]. New NiTi tools and apical sealers increase the number of successful cases, offering better resistance to bacterial penetration. Epoxy resin sealers perform better compared to bioceramics based on MTA. Retreatment cases, followed for a period of 2 years, show that in teeth with unchanged root canal anatomy from the initial attempt, there is a greater probability of success. Debatable is the size of apical preparation, which some authors recommend to keep as small as possible, while others have the opposite view [16]. The Literary Review of Baugh D, Wallace J shows that the wider the apical zone is the smaller the number of bacteria that persist in it. Despite the use of various drugs for irrigation, techniques for activation, different types of preparation methods, still, a large number of bacteria can remain and negatively affect the periapical tissues [16]. Vladimirov S, Manchorova N and Shiyakov K believe that regardless of periapical lesion size, some can be treated nonsurgically[13, 14], as long as there is no permeable coronary restoration [12]. Nonsurgical treatment initially shows less success compared to the surgical, but after a 4-year follow-up period, it demonstrates a higher survival rate for teeth. Some authors find that periapical surgery has 28% less success compared to nonsurgical treatment.

Several factors affect the success of nonsurgical treatment: the presence of a periapical lesion, detectable radiographically; lesion size (volume); absence or presence of a sinus tract; root canal patency; dense, homogeneous obturation of the root canal system as close as possible to the apex; use of EDTA and subsequent final irrigation with NAOCL; use of chlorhexidine; absence of root perforation; absence of exacerbation between healing sessions; lack of extruded material outside the apex; adequate impervious coronal restoration [8, 12]. According to Setzer FC et àl. essential for the survival of treated teeth, is the volume of periodontal tissues or their absence [17].

The histological status of a periapical lesion is unclear for clinicians, which diagnose it radiographically [6]. The lesion may be a granuloma, cyst or a squamous cell carcinoma [1]. It is generally accepted that the granuloma can be cured and regresses after nonsurgical orthograde treatment [18]. It is believed that a one-year follow-up period is sufficient to give an accurate assessment of treatment success. A very small number of cases can worsen between the 6th and 12th months [8]. De Chevigny et al., Kruse C et al. consider that follow up should be for a longer period. They track their cases for 6 years or more [12, 19]. In the follow-up of 1000 cases, it was found that lesions that showed a complete radiographic cure in the first year were rarely aggravated later on. Based on a 15-year study, it was found that cases with uncertain recovery should be monitored for at least 4 years. According to Nair NP, not all granulomas and cysts are susceptible to orthograde therapy due to the presence of microorganisms inside the lesion, insufficient density and not an airtight root canal obturation, as well as partial removal of the cystic sac [18]. In practice, there is a dispute whether periapical cyst can be treated nonsurgically and whether they are affected at all, because extracellular polysaccharides-biofilms from (A. Israeli, P. propionicum) or other microorganisms can be formed onto the root surface, which protects bacteria from irrigating solutions, antibiotics, humoral and cellular immunity [4]. Some authors believe that the presence of actinomyces can be considered an indication for carrying out periapical surgery. Endodontists believe that cysts can regress when treated. This is based on the hypothesis of Bhasker [20], used by Vladimirov S, Manchorova N, Shiyakov K [13, 14], while oral surgeons have the opposite opinion and insist on performing radical treatment [1]. There is a method for biological treatment of large periapical cysts as well. Surgical fenestration is performed, without orthograde obturation of the root canal system, which shows success in 5 cases. The technique has previously been tried in 18 patients, and a patent has been filed.

The studies of Nair NP [4,18] show that 52% of lesions are epithelialized, and only 15% of them are true periapical cysts. Periapical cysts can be differentiated into two types: true and pocket-cysts [18]. The former is completely

isolated from the root canal system, while the latter communicates with it. It is believed that pocket cysts can regress after non-surgical therapy, while true ones do not respond. Only a radical surgical intervention leads to the healing of such lesions. Thus, the literature data and histopathology show that only 10%-15% of all apical lesions need surgical therapy in addition to nonsurgical [3]. Sometimes due to the complexity of the root canal system, even pocket cysts can not be treated nonsurgically. In some cases, even after an exactly performed endodontic treatment, there is no success. It is believed that waste products from the process of inflammation, such as cholesterol crystals, interfere with the regression of the lesion. This can be established cytologically by detecting large multinuclear cells or Rushton bodies. Some authors believe that the presence of those crystals is an indication for performing periapical surgery [3].

Nair NP found that apical granulomas and cysts may be the result of a foreign body reaction, and although these cases are very rare, they would not respond to orthograde treatment [4]. Some authors find that the success of apical surgery is much lower in granulomas than with cysts. Based on the above data, the reader would ask, why is it so rare that periapical endodontic surgery takes place?

The complex apical anatomy does not always achieve 100% success with nonsurgical orthograde therapy. According to Kim S, Kratchman S [3] nonsurgical therapy fails due to leaking root canal (29.41%), missed canal (15.55%), not fully obturated canal (15.55%), anatomic complexity (7.98%), apical fenestration (4.20%) and iatrogenic problem. Presence of symptomatic and increasing apical lesion does not cover all cases when surgical treatment is necessary. Failures of nonsurgical treatment, such as broken NiTi files that can not be removed; apical transportation or teeth, recovered with a post or pinlay and a crown/bridge, are treated much more successfully with periapical surgery [3].

Periapical endodontic surgery

Endodontic surgery is considered "the last attempt to rescue" an affected tooth [1, 21]. Modern endodontic surgery is predominantly microsurgical due to the introduction of the operating microscope, microinstruments and ultrasonic tips [1, 22]. In its classic version, it is more invasive and shows a lower percentage of success, but nowadays with the availability of new microinstruments, materials for root canal obturation and use of the dental microscope, ultrasound, piezosurgery, laser, it can be a less invasive, predictable and desirable procedure. An essential part of the endodontic arsenal, with an increased success rate-Gutman JL [1]. Single rooted teeth, without periapical lesions and the absence of intraoperative complications report a higher percentage of success [10]. The influence on success rate of different surgical techniques, orthograde and retrograde materials for obturation must be thoroughly evaluated through randomised controlled clinical trials.

In the past, classical endodontic surgery was performed predominantly with rotary instruments and required a larger operational field. More often, it ends with postoperative complications and a greater failure rate. Classical apicoectomy-periapical surgery relies on larger incisions and accesses to the lesion, in which blood vessels, nerves, the mental foramen or maxillary sinus can be affected. Because of its invasive character, Iriboz et al. consider that traditional endodontic surgery is accepted with mistrust from clinicians and patients [22] while modern one has 5 times higher success rate [23]. The purpose of periapical surgery is the removal of all necrotic tissues from and around the apical lesion/region (the root, soft tissues and bone). Treatment failure is due to the inability to obturate the root, seal it retrogradely, remove all pathological periapical tissue, disinfect and protect the operative field from further infection. With the help of the microscope, the endoscope and the ultrasonic tools, this problem is easier to solve and can be achieved with much greater precision. According to Setzer FC et al., more success is observed, especially when treating molars [17, 23]. Magnification, illumination and microinstruments allow much greater adequacy in planning, implementation, outcome and prognosis [1, 3, 17, 25].

The advantages of microsurgery include easier detection of roots and apices of affected teeth; smaller osteotomies; smaller angle of root resection. This allows the more cortical bone and root length to be preserved and the possibility of a coaxial retrograde preparation and obturation of the root tip, which fully satisfies the purpose of periapical surgery [3, 26, 27, 28].

Indications for periapical surgery

Indications, contraindications and factors associated with the success of endodontic surgery vary according to different authors, textbooks of oral surgery and institutions. They can be summarised in the following way.

1. Persistent periapical lesion after endodontic treatment, size more than 5 mm to 2cm. (Controversial due to the Bhasker's hypothesis).

2. Periapical pathology, which increases after endodontic treatment, detectable radiographically or by other imaging studies.

3. Significant extrusion of obturating material, which interferes with healing and leads to objective symptomatology.

4. Access for periradicular curettage, biopsy or access to additional root, if necessary.

5. Access for retrograde preparation or obturation, if necessary.

6. When the apical part of a tooth with periapical pathology can not be cleaned, shaped and obturated.

7. Anatomical abnormalities leading to the inability to perform the nonsurgical treatment:

- Highly curved root canals;
- Intracanal calcifications in teeth with periapical lesions interfering with shaping;
- External and internal root resorption;
- Apical perforations that interfere with healing and can not be filled nonsurgically from inside the canal;
- Teeth with underdeveloped roots, where apexfixation techniques have not been successful.

8. Periapical pathology:

- Chronic periapical osteitis;
- Chronic periapical periodontitis;
- Radicular cyst;
- Other cysts and tumours of the jaws;
- In the case of failure of the traditional technique of apicoectomy and when the tooth can be preserved after revision.

9. Traumatic radicular lesions:

- Radicular fractures of the apical third.

10. Failure of a particular type of treatment:

- Presence of intracanal post/pinlay in a tooth with periapical pathology, in which post removal will lead to fracture;
- Inability to remove the root canal obturation or a broken instrument in the apical third, which interferes with the healing process;
- Perforations of the pulp chamber, false radicular pathways or expansions and displacements of the apical foramen, which can not be repaired through the root canal;
- Incomplete endodontic obturation and depletion of the possibilities of nonsurgical treatment;
- Unsuccessful periapical surgery
- Other endodontic failures [3, 14, 20, 23, 25].

Contraindications for periapical surgery:

1. Apical lesion associated with a canal/s that can be shaped and cleaned;
2. A tooth which cannot be maintained or restored for mastication;
3. A non-cooperative patient;
4. Acute inflammation in the operative field;
5. An infected neighbouring tooth that has not been treated;
6. A connection between the apical lesion with the oral cavity and the periodontal pocket (Controversial due to the advancements in periodontal regenerative techniques);
7. Advanced bone loss, which will prevent tooth preservation after resection;
8. Involvement of the bi or trifurcation after periodontal disease (Controversial due to the advancements in periodontal regenerative techniques);
9. Conditions like (leukaemia, hemorrhagic diathesis, agranulocytosis, etc.) that need to be put under control first;
11. Lack of visibility and access;
12. Patients with systemic diseases in whom operations are contraindicated [21].

Factors associated with success in periapical surgery:

1. The general health state of the patient;
2. Type of the surgical procedure (classical-rotary, piezosurgical [27], laser); [29]
3. Level of clinical preparation (experience, knowledge, skills, dexterity);
4. Materials and methods for orthograde obturation;
5. Materials and methods for retrograde obturation; [30, 31]
6. Condition of the root canal obturation (infected, sterile, dense, unfilled);
7. Depth, volume and size of the apical lesion;
8. Absence or presence of bone cortex;
9. The humidity of the operative field and haemostasis [3].
10. Periodontal status- mobility, bone support, dehiscence, fenestration, crown to root ratio;
11. Defect in the apical 1/3;
12. Type of tooth- better with front teeth and MB root of maxillary molars**;**

Postoperative factors associated with success

1. Lack of symptomatic complaints;
2. Soft tissues healing;
3. No oroantral perforation or a sinus tract;
4. Radiographic evidence of periapical healing and formation of new periodontal ligament;
5. Presence of a weak shade that can be observed periapically, without the area being inflamed and with no available symptomatology;
6. Preserved function of the tooth and decreased mobility [3].

Factors associated with periapical surgery:

Psychological factors

Patients who experience fear of dental procedures may need additional preparation, clarification, explanation, reassurance and venous sedation [21].

Systemic factors

It is sometimes necessary to consult an internist before carrying out periapical surgery, especially when a local anaesthetic with adrenaline is used when performing sedation or complete anaesthesia [21]. The contemporary opinion is that elimination half-life is only 2 minutes, and its undesirable systemic effect is transitory. It should not be completely avoided during surgery unless the patient is allergic to bisulfites or is asthmatic.

Cardiac diseases

High blood pressure can increase the risk of operative complications, postoperative bleeding and haematomas. Beta-blockers and diuretics associated with potassium loss can intensify the undesirable effects of adrenaline in local anaesthetics, therefore the dose should be adjusted. Patients who have cardiac arrhythmia and those with cardiac transplants are susceptible to epinephrine. Those with unstable angina should be prepared, and their sedation is performed with special care. In patients who have had a heart attack, wait for at least 3 months, ideally 1 year. Those with a history of infective endocarditis, rheumatoid fever, heart valve diseases and cardiac surgery, should be provided with antibiotic prophylaxis. The same is necessary for patients with heart failure, aortic and mitral insufficiency, Marfan syndrome. The use of benzodiazepines is contraindicated for sedation of patients with myasthenia gravis due to their muscle relaxant effect [21].

Pulmonary diseases

Patients with chronic obstructive pulmonary disease, bronchitis and emphysema will have a difficulty being in the supine position for a long time. The use of rubber dam may require a low dose of oxygen to be fed through a nasal probe. In cases of severe asthma or emphysema, venous

sedation should be avoided because of the risk of respiratory depression. In COPD or asthma patients treated with theophylline, macrolide antibiotics should be avoided. Asthmatic patients should avoid NSAIDs pre or postoperatively and local anaesthetics with epinephrine or levonordefrine [21].

Haematological diseases

Patients with haematological diseases must be consulted with a haematologist. The operation in cases with leukaemia should be carried out in the periods of remission and between chemotherapy courses. Patients with haemophilia A, Christmas or Von Willebrand disease must be treated in a hospital setting. Conduction of anaesthesia is contraindicated in patients with à history of bleeding. If they are not prepared, a haematoma of the pharynx and obstruction of the respiratory tract can occur. Block anaesthesia is contraindicated [21].

Endocrine diseases

Diabetic patients should be treated in the morning and should eat before the procedure. Those taking oral hypoglycaemics should omit their morning dose and take it after surgery while monitoring for symptoms of hypoglycaemia. All diabetic patients are at increased risk of postoperative infections and should be prescribed antibiotics. Additional steroid therapy may be needed in diseases of the adrenal gland or those who had surgery for Pheochromocytoma. Whether anaesthetics containing adrenaline should be avoided is still controversial. A specialist should be consulted in patients with anaemia or receiving corticosteroids [21].

Radiotherapy

Radiotherapy of the head and neck leads to osteoradionecrosis, which can lead to delay in healing and an increased risk of infections. Surgical treatment should be carried out in a hospital setting under antibiotic coverage [21].

Patients on nonsteroidal anti-inflammatory drugs-NSAID

Patients taking aspirin may have an increased risk of bleeding. Local haemostatics can control bleeding and is not necessary to stop therapy. NSAIDs are contraindicated in patients taking warfarin due to amplification of their anticoagulant and nephrotoxic effect. They should be avoided in renal diseases and patients with a history of peptic ulcers. Toxicity of methotrexate, which is used to treat rheumatoid arthritis, is amplified by combining it with NSAIDs [21].

Warfarin

Patients on warfarin should measure their international normalised ratio- INR (prothrombin time index) 24 hours before surgery. Normal values are 2.0-3.0, except for patients with heart valves, where normal values are 2.5-4.0. It is believed that minimal surgical procedures can be performed at INR 3.0, so no change in the dose of Warfarin is needed. Block anaesthesia should be avoided. If values are higher, a doctor's consultation is necessary to adjust the therapy. There is evidence that stopping therapy can lead to thromboembolism more often than lead to uncontrolled bleeding after dose reduction. Drugs such as aspirin, piroxicam, amiodarone, clofibrate, cimetidine, omeprazole, propranolol, propafenone, sulfinpyrazone, diclofenac, diflunisal, ibuprofen and prolonged use of paracetamol, cotrimoxazole, fluconazole, erythromycin, isoniazid, miconazole and metronidazole amplify the effects of Warfarin [21]. Drugs such as griseofulvin, rifampin, nafcillin, barbiturates, carbamazepine, chlordiazepoxide, cholestyramine, sucralfate decrease its anticoagulant effect,Wells PS, et al. (1994).

Steroids

There is insufficient evidence that there is a need for steroid cover in surgical manipulations with general or local anaesthesia. In patients with prolonged corticosteroid therapy over 10 mg, it is necessary to increase the dose twice on the day of surgery [21].

Diseases of the liver and kidneys

Patients with chronic renal insufficiency have reduced resistance to infections. They may have elevated blood pressure and an increased risk of bleeding. They have prescribed corticosteroids often , and it may be necessary to increase the dose. Patients on dialysis are best treated the next day when the effect of heparin is still present, and the function of platelets will be optimal. Patients with arteriovenous fistula should be covered with antibiotics due to an increased risk of bacteraemia. Aminoglycosides should be avoided. A nephrologist should be consulted. Patients with a history and symptoms of liver disease should have their liver enzymes and clotting factors examined for potential liver disease. Patients with arthritis, regular alcohol users and those taking aspirin are potential candidates for complications because they may have decompensated liver disease. The liver is the place where anaesthesia is metabolized, and if it is damaged, their plasma concentration increases. This can lead to toxic effects in the CNS. Consultation with a specialist is necessary. Chloramphenicol, Erythromycin, Metronidazole, Tetracyclines, Azithromycin, Lincomycin, Clindamycin, Ketoconazole should be avoided. NSAIDs increase the risk of gastrointestinal bleeding and affect fluid balance. Paracetamol is hepatotoxic, and its dose should be reduced [21].

Gastrointestinal diseases

Patients with pancreatitis, pancreatic cancer and bile duct obstruction (in case of cancer or if there are metastases in the liver) may have an increased tendency for bleeding due to decreased absorption of Vit. K. If possible, the operation should be postponed or coagulation factors used. NSAIDs should be avoided in patients with peptic ulcer, esophagitis or gastritis, due to an increased risk of bleeding [21].

Pregnancy

During pregnancy, surgical procedures may be carried out, exceptionally, in the second trimester. It is best if you can avoid and postpone [20].

Anatomical factors

The quality of the tissues should be evaluated before surgery (colour, texture, thickness, height). When there is a presence of a sinus tract, care should be taken not to tear the mucosa, which is poorly attached. The tract should be carefully dissected from tissues. The attached gingiva

is much more firmly attached than the free one, and the boundary between the two tissues is the mucogingival line. Blood supply to the tissues comes from the vertical direction. To reduce bleeding, horizontal incisions in the mucosa should be avoided [21].

Access

The patient should be able to open the mouth wide enough, especially when operating on distal teeth. Sometimes trans-nasal access to the roots is necessary if they are high or in the sinus. The operative zone must have good visualization. In patients with bruxism or pronounced chin, there may be an increased thickness of the buccal cortex. The depth of the vestibule, as well as elasticity of the tissues, should be evaluated. In cases, with a narrow band of attached gingiva, the flap will enter alveolar mucosa, and it will be more difficult to reflect and retract. Access to the apical zone is limited, which will lead to an increased risk of bleeding, postoperative swelling and ecchymosis. When there is wide gingiva, the less connective tissue is affected, and it is easier to work due to better visibility and operational comfort [3, 20].

Muscles and Frenulums

Size, localization and volume of frenulums should be noted. This can affect flap design [3, 20, 21].

Palate

The high (gothic) palate gives much better vertical access if it is necessary to enter with the palatal approach. Flat palate hinders visual access and reflection of tissues due to proximity to large blood vessels. The palatine flap is thick and hard to apply back, and sometimes a stent is needed. It can be prone to necrosis due to vessel involvement from the trauma or vasoconstrictor in anaesthesia [3, 21].

Periodontal status

Periodontal status of the teeth should be evaluated before surgery with probing. The risk of marginal periodontitis or the presence of a sinus tract in the gingival sulcus should be assessed. Teeth need to be prepared, calculus removed and instructions for maintaining the oral hygiene should be given. A deep and narrow pocket may indicate a vertical fracture which will make operation unnecessary. Lack of a buccal or palatal bone is a risk factor that reduces treatment success. Chances of success are even less when both bone plates are absent. Marginal periodontitis is a negative factor that affects the healing period and prolongs periapical inflammation. Presence of bone dehiscence or fenestration influences flap design and root resection level [3, 21].

Tooth restoration

The tooth should be restorable and have enough "Ferrule", sufficient length and preserved periodontal support to be functional afterwards. It must be necessary for restoring occlusion and mastication [3, 20].

Buccal ridge

If the buccal rim of the jaw is combined with lingually located roots, access would be difficult and the healing plan will change. Tissues should be retracted a lot to ensure access and visibility, which will lead to postoperative swelling and pain. The problem can be solved by selecting another route for access [3, 21].

Bone exostoses

They increase difficulty and time in accessing bone. The oral mucosa on them is usually thin. This complicates incision, reflection, retraction, adaption and suturing as well as postoperative swelling and pain [3, 21].

Surgical complications

Many clinicians avoid surgery on distal teeth due to the possibility of affecting the inferior alveolar nerve and mandibular paraesthesia. They fear to enter the maxillary sinus because of the risk of infection or membrane perforation [3, 21].

Mental nerve, aperture and duct

The mental foramen is localized under the roots of the second premolar, and the mesial root of the first molar and is always larger than it looks on radiography. The vascular nerve bundle is located lingually and under the roots of teeth. A slight injury to the alveolar nerve can lead to anaesthesia. A series of periapical x-rays, combined with orthopantomography is a must, or best a CBCT should be made to determine the exact location. Anatomical topography dictates vertical incision positioning. The flap and vascular nerve bundle are kept from damage during the procedure, not to be severed. Patients with orthodontic lower premolar extraction may have the foramen more coronally.

It is important to have a sufficiently long vertical incision to expose the vascular nerve bundle after careful dissection. When it is found, a cut is made into the bone, and the retractor is placed there. Although rarely occurring, transient ipsilateral paraesthesia can happen due to tissue swelling and pinching of the nerve, even when the foramen is far from the surgical field. Normal sensitivity returns in a few weeks, therefore, monitoring is necessary [3, 21].

Palatal blood vessels

They extend from the large palatal opening in the middle, between the tip of the palate and the gingival edge. They are often found in bone ducts, but can also be damaged by palatal access. Vertical relief cuts should not be made in the molar area. During flap reflection, the vascular nerve bundle should be kept safe. Relief incision is allowed in the premolar zone [3, 21].

Sinus management

The sinus can be perforated when it is operated in the region of the distal maxillary teeth. This can be avoided with the careful operation, but this will not be avoided if roots enter the sinus. Sometimes, access to the palatal roots of the molars through the sinus is necessary to preserve the buccal cortex. When the sinus is perforated, it is most important to protect it from penetration of solid particles, such as cotton, obturating materials, etc. If perforation size is small, cotton can be sewn or a collagen membrane inserted to serve as a barrier. When it is large, you can put an iodized gauze or tape that will enter the sinus and then proceed with surgery. At the next stage, it is completely removed. A postoperative antibiotic should be prescribed, such as ciprofloxacin or amoxicillin for one week, decongestants as well. The patient should sleep with a slightly raised head. They should avoid efforts/when blowing the nose, coughing, sneezing/and should monitor for bleeding. Perforating the sinus does not show a large difference in

the healing process, compared to cases without [3, 21].

Postoperative reactions: swelling and pain

Pain and swelling are common reactions after endodontic surgery on the first day, as more often is swelling, especially in the anterior maxillary region. More often, these symptoms affect young patients and women. Some authors do not find a significant influence of age, gender, oral hygiene, and smoking on the postoperative period. Longer, larger, more invasive operations lead to greater swelling and pain [3]. The impression is that patients need analgesics one day after surgery and that 23% of patients are absent from work due to pain and swelling.

It is recommended that patients are prepared with 800 mg ibuprofen before and after surgery and continue it for another two days 4 times a day. Thus, pain and swelling are minimal. At least 400 mg is needed to cope with postoperative pain. Routine premedication with glucocorticosteroids, as well as taking painkillers is recommended before the onset of pain. Thus, the amount of analgesics is reduced, there are fewer side effects, and the patient returns to his daily activities. The combination of diclofenac and acetaminophen is effective in the treatment of acute pain, Adding codeine does not improve the formula, but only enhances side effects. Other researchers, however, in a controlled placebo randomized trial, found the combination of paracetamol and codeine, much more effective in correcting pain after wisdom tooth extraction than paracetamol alone. In a clinical study, it was found that ibuprofen was more effective for pain control than the acetaminophen. The combination of ibuprofen and acetaminophen was significantly more effective, applied 8 hours after pulpectomy. Results were obtained in a double-blind randomized trial, with a placebo control [3].

When using Dexamethasone 8 mg, divided into two equal doses-in the first and in the second day after surgery-64.7% of patients surveyed did not report swelling on the day after surgery, and nearly 80% of them had no pain. This can be due to premedication, as well as the use of a microsurgical approach, rather than a classic one [3]. The use of selective COX-2 inhibitors, such as Valdecoxib, Celecoxib and Rofecoxib, may reduce post-operative endodontic pain as well as lower the risk of gastric ulcer [3]. Low frequency laser therapy with 809nm GaAlAs-laser can also be used to reduce pain, but compared to placebo, the advantage is only in the first postoperative day [3]. Other authors did not find differences between laser and placebo treated groups. Low-frequency laser therapy is also used for decontamination, biostimulation and anti-inflammatory effect. More clinical studies on the effect and dose of NRT are needed. Patients after microsurgical periapical surgery need to be controlled for 2-3 days, which coincides with suture removal [3].

CONCLUSION

Many factors influence performing periapical surgery, and they should be taken into account to achieve predictable success. All indications and contraindications should be well known since nonsurgical treatment is not always possible or advisable. Differential diagnosis of periapical lesions should be well known since not all or of endodontic origin. Proximity to important anatomical areas requires careful preoperative planning and intraoperative state of awareness. The preservation of natural teeth should be our goal since they still can not be equally replaced by existing artificial materials and technologies.

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