STUDY ON THE FAILURES OF APICAL RESECTION IN PERIODONTAL PATHOLOGY

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Abstract

The scope of the investigation was to identify the possible causes of failure after endodontic surgery in patients with or without periodontal problems.

Materials and method: the experimental group was formed of 89 cases considered as failures of apical resection. The study was developed along a period of 4 years, in the Oral Surgery Polyclinics and in the Clinics of Periodontology. Evaluation involved clinical and radiographic investigations, a number of 9 cases also requiring a morpho-pathological examination.

Results and discussion: The cases followed up long after the surgery may show complications in no way related to the endodontic surgical therapy. The success of the intervention is first depending on the observance of its indications and counterindications, as well as on the precision of its technical realization. The possible failure causes may involve non-observance of the counter indications of apical resection, against the background of the coexistence of periodontal pathology or of some general diseases which may provoke complications or prevent bone restructuring and morphofunctional reconstruction of the tooth.

Conclusions: Apical resection remains a valuable technique for the preservation, on the arch, of certain odonto-periodontal units otherwise morphologically and functionally compromised. The success or failure of apical resection depends on the correct evaluation of the condition of the marginal periodontium and also on the elaboration of a theoretical model capable of anticipating the post-surgery evolution of the alveolar bone.

Keywords: periodontitis, apical resection, surgery failure.

INTRODUCTION

Apical resection is a simple, logical, minute and elegant surgical intervention, with non-significant failure, if the indications, the pre-surgery preparation and the technical details are correctly followed.

If the scope of apical resection is attained (correct obturation of the radicular canal, removal of the apical and periapical pathological focus), the conditions for a complete bone restructuring and tooth preservation, that is, prevention of some possible edentations, are met.

Nevertheless, an incorrect evaluation of the tooth, not only endodontically but also periodontally may prevent a corresponding post-surgery healing [1,2]. Classical approaching of the combined endo-periodontal lesions may be improved by the newly-created techniques of both endodontic and periodontal microsurgery [2]. Numerous studies have been devoted to the ways of post-surgery healing as a function of the quality and quantity of alveolar bone and soft tissues, in other words of the type of periodontium: thin or thick. The scope of endodontic surgery is to realize a rapid primary healing after the surgery, while the periodontal one first aims at stabilizing the periodontal disease and only later on, at the reconstruction – according to their clinical condition – of the periodontal tissues. That is why, the surgical techniques have their own peculiarities [3-5]. Things get complicated when the tooth has a complex, both endodontic and periodontal diagnosis.

Following apical resection, prognostication gets increasingly complicated as the periodontal disease advances, up to becoming inconsistent over a certain value. As endodontic surgery depends on the anterior – mainly periodontal – conditions of the tooth, for a correct estimation of the chances of success, Kim et al. proposed a classification of teeth with indication of apical resection according to the extent of endodontic and periodontal affection [2], as follows:

- Class A – radiographic absence of the periapical lesion, without mobility or periodontal pockets, obtained by a previous
endodontic treatment. The symptoms persist after the endodontic non-surgical treatment, the only surgical indication being of symptomatological nature.

- Class B – the presence of a small periapical lesion, accompanied by clinical symptomatology. The tooth shows no mobility, probing depth is normal – the ideal case for endodontic surgery.
- Class C – the tooth has an extended periapical lesion, advancing towards the crown area, absence of periodontal affection or mobility
- Class D – similar with class C, yet accompanied by deep periodontal pockets
- Class E – extended periapical lesion, communicating with the periodontal pocket
- Class F – tooth with extended periapical lesion and complete exposure of the root in the oral cavity

Figure 1 – Surgical classification of the teeth with indication of apical resection (according to Kim et al.)

Once known that a correct evaluation of some surgical methods involves study of possible failures, the scope of the present investigation was to identify the probable causes of failure after endodontic surgery.

According to the literature of the field, a first failure cause may be an insufficient analysis of the dental periodontal support, followed by others, related to tooth anatomy (aberrant lateral canals) or to some technical mistakes (insufficient canal obturation, root perforation) [1,6,7].

MATERIALS AND METHOD

The material for the clinical-radiographic study was represented by 89 cases viewed as failures. Among them, 69 cases also presented periodontal problems, either at the tooth under analysis or at other teeth from the arch. The cases in which the radiographic re-examination performed after 6 months showed no periapical remineralization (while, clinically, some inflammation signs in front of the apex, fistula or dental mobility higher than degree 1 were observed), were considered as failures. The material for the histological study included 9 surgery pieces obtained from cases with uncertain/unsatisfactory healing, requiring a new intervention.

The methodology of anatomo-pathological examination was the same as in the anterior stage of our researches. To obtain a quantitative evaluation of the development of periapical inflammation, serial sections of the surgical specimens were made for each case in part, the action being made on the section representing the maximum of inflammatory modifications.

RESULTS

As the pre-surgery etiological treatment of the periodontal disease is assumed, the initial periodontal diagnosis should exclude gingivites and the active forms of periodontal disease. Also, the operated teeth suffered only from a superficial periodontitis of the adult, with bone lysis up to 25% of root length (30 teeth), the remaining cases showing a healthy periodontium on the operated tooth, even if with various stages of periodontitis in other teeth. The types of teeth considered as failures of apical resection are listed in table 1.

Out of the total number of 89 teeth considered in the study, 36 had been backwardly obturated, the other 63 cases being obturated orhtogradually with gutta-percha.
Table 1 – Types of analyzed teeth considered failures of apical resection

<table>
<thead>
<tr>
<th>Tooth type</th>
<th>No. of total cases</th>
<th>No. of cases with superficial PA on the operated tooth</th>
<th>No. of cases with BP on other teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxillary incisors</td>
<td>27</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Maxillary canines</td>
<td>6</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Maxillary premolars</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Maxillary molars</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mandibular incisors</td>
<td>31</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>Mandibular canines</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mandibular premolars</td>
<td>17</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Mandibular molars</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2 lists the main possible causes for the failures detected during the present investigation, presented in the order of their frequency:

Table 2 – Possible causes of apical resection failure

<table>
<thead>
<tr>
<th>Cause</th>
<th>No. cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental implanting in a quantitatively and qualitatively poor bone</td>
<td>30</td>
</tr>
<tr>
<td>Incomplete radicular obturation</td>
<td>21</td>
</tr>
<tr>
<td>External root resorptions</td>
<td>15</td>
</tr>
<tr>
<td>Supernumerary radicular canals (non-identified or inaccessible)</td>
<td>5</td>
</tr>
<tr>
<td>Mechanical root perforation</td>
<td>4</td>
</tr>
<tr>
<td>Signs of radicular fracture</td>
<td>1</td>
</tr>
<tr>
<td>Other insufficiently clear causes</td>
<td>6</td>
</tr>
</tbody>
</table>

The type of marginal periodontium is very important in the management of any oral surgical intervention. 30 cases in which a slight bone lysis was present were identified, while teeth with periapical processeses, to be subjected to resection, were diagnosed with adult periodontitis in superficial form. Other 39 cases were identified with bone lysis at the level of other teeth or with a fine-type periodontium.

Root fracture might have been produced by the abnormal mobility of a coronary fragment, correlated with the application of radicular pivots. Direct observation on the radicular fracture was possible in none of the cases, however the lack of clearness and the unilateral darkness of the periodontal space suggested root fracture.

A more advanced marginal periodontitis was also observed. In some of these cases, bone loss was extended towards the apex.

The comparisons with the marginal condition of the neighbouring tooth showed that the periodontal inflammation derived from the marginal periodontium.

Mechanical perforations of the root were discovered in 4 cases, a lateral incisive maxillary with curved root, 2 canines and a prime mandibular premolar.

In all these cases, radicular obturation exceeds the main canal in the apical part of the root. In 21 cases, an incomplete radicular obturation was discovered.

It was impossible to determine radiographically whether the backward obturation with amalgam was insufficient, with the exception of the cases with severe root resorption.

In 5 cases, supernumerary roots or canals were discovered. Variation of the number of canals could be radiographically evidenced only when they were more or less obturated with a sealer. The lateral canals could be observed radiographically only if they had been obturated with a sealer, being evidenced in 2 cases of central mandibular incisor.

Indirectly, the presence of the lateral canals may be presumed, due to rarefaction, localized on one side of the root. External root resorption occurred in 15 cases, where radicular obturation was seen as extending outside the root.

The high value (0.328) of the correlation coefficient demonstrates a close correlation between the failure of apical resection and the non-observance of certain procedural indices.
DISCUSSION

The cases monitorized for a long period after surgery may show complications in no way related to the endodontic surgery therapy. These secondary complications, usually manifested post-surgically, may refer to root fracture, formation of a periodontal pocket, percolation of radicular obturation or some mechanical root perforation for the application of crown-radicular devices.

Generally, such complications may appear after the surgery, the success of the intervention being firstly related to the observance of its indications and counterindications, as well as on the precision of the technical work.

A first possible cause of failure is non-observance of the counterindications on the practical realization of apical resection, against the background of some general diseases which might cause complications or will not permit bone restructuring and morpho-functional reconstruction of the tooth.

Also, the local indications referring to the morpho-functional condition of the tooth should be obeyed. In such cases, the periodontium should be analyzed from several perspectives, namely:

- The teeth with inflammations of the marginal periodontium, be them gingivites or periodontites in active phase, represent a risk for a complete post-surgery healing. The existence of such an inflammation assumes either a patient with a poor health condition, or an unsatisfactory hygiene. In both cases, the surgery should be delayed up to reaching a stable status, through a correctly administered etiological treatment. The same problem also appears in cases in which the tooth to be operated shows no marginal inflammation, the phenomenon being nevertheless present in other sites of the oral cavity [8-10].
- Teeth without marginal inflammation, yet with bone lysis of the alveolary bone margin. Even if most authors agree that resection should involve only the apical 1/3 of the tooth, so that at least 2/3 of the root implanted in the bone will occur in the healthy bone, the experience showed that, in some situations, resection may exceed the apical 1/3 part, up to even 1/2 of the root, on condition that the marginal periodontium is complete. Also, when apical resection is made to teeth with the crown destroyed by caries, the root itself should be sufficiently resistant to assure a solid retention of the radicular reconstruction device. Having all these in view, it goes without saying that apical resection performed in extended destructions of the crown-root substances or in important resorptions of the alveolar bone will always fail. At the same time, apical resection is not indicated in the moderate and advanced forms of periodontal diseases. One should always anticipate the remaining amount of bone, starting from correlated information on: anatomical length of the root, extent of marginal bone lysis, extent of the periapical process and its positioning vs. the apex [11-13]. Also important is to know the type of bone lysis: horizontal or vertical. In such cases, more recommended is a trapezoidal flap which should evidence the whole amount of bone, concomitantly with the realization of apical resection and of other interventions of periodontal surgery, suitable to the respective situation, such as: periodontal curetting, guided tissular regeneration etc. [14,15].
- Teeth with thin periodontium, characterized by: reduced connective tissue, or frequently dehiscent alveolary bone and rarefactions, thin or absent interdental septa, reduced or absent attached gingiva. The existence of such a periodontium creates several technical difficulties during suture, approaching of plague’s margins is difficult, the suturing thread may tear up the flap. Dehiscence of the post-surgery plague, followed by healing per secundam or, in cases of failure, persistence of fistulae, are frequently observed. To avoid
these, special attention should be given to a proper selection of the suture needle (the one with triangular section and the peak towards the exterior being the most recommended), and also of the suture thread, with a thickness of 4/0 – 5/0, monofilament. The opportunity of a surgical intervention for the creation and thickening of the attached gingiva should be here considered [16-18].

• There also exist situations in which periodontal affection is secondary to the surgery. Mainly incriminated here is the accumulation of bacterial plaque in the first days as, because of the pain felt and of the presence of the oedema, the patient is afraid of taking the usual hygienic measures. In this way, the bacterial plaque is soon accumulated around the suture threads, which become retentive. One should not forget the quality of the material from which the suture threads are made. Thus, silk fibers are easy to use, easy to bind, very comfortable for the patient, however, being a foreign protein, they induce a local inflammatory response in the mucous tissues, which may compromise the surgical result. Several studies have shown that silk retains the bacterial plaque much more than the polyester and polytetrafluoroethylene fibers [2,14,15,17]. Another problem is represented by the moment of suture threads’ removal. A recent idea states that the threads should not be kept for 7-8 days, any longer, as reattachment at connective level occurs in the first 24 hours. Consequently, numerous authors recommend their elimination at 48-72, maximum 96 hours [2, 17].

Technical mistakes in the realization of unloading incisions at papillary level may lead to the occurrence of recessions, after healing [11, 18].

• An incorrect post-surgical therapeutic management of the tooth may also cause failures. Especially important is the functional charge of the operated tooth, frequently preserved for the application of an aggregation element of a conjunct gnathoprosthesis. On one hand, if the specialist knows the surgical status of his patient, he will view apical resection as a factor diminishing the index of biomechanical competence of the respective tooth while, on the other, if he does not know the exact condition of all abutment teeth, he should perform all the necessary paraclinical investigations, for an exact determination of the implanting status of the future abutment teeth. The tooth with a deficitary alveolar bone should be immobilized at least in the first weeks after the surgery [19,10]. If dental mobility persists, a more ample prosthetic system, assuring permanent immobilization, will be applied.

Other failure causes of apical resection have been either individual or combined with various – already discussed – periodontal diseases.

For example, vertical or oblique root fractures are frequently observed. When the fracture cannot be observed, the diagnosis may be only guessed, if some enlargement of the periodontal space is noticed. Among the failure causes that may be attributed to the surgical technique, one may also include its incorrect application or a poor knowledge on root anomalies. [2]

The observations put forward in this stage of the investigation seem to indicate that the most frequent causes of periapical inflammatory resorption are insufficient cleaning and an incorrect radicular obturation. These factors appear as responsible for 59% of the failures registered after conservative endodontic surgical therapy.

Usually, an irregular shape of the canal is responsible for the incomplete cleaning and mechanical preparation, which creates a space between the obturation material and the walls of the canal, inside which pulp necrotic tissue – with or without bacteria – may be introduced. [20,21].

More than that, it is known that periapical rarefaction may appear along the tooth with necrotic pulp even in cases when the bacterial culture was negative.
Together with the discoveries of the present investigation, these results support the assertion that the products of tissular degradation may cause periapical inflammation. The experiments made on extracted teeth evidenced the penetration of a radioactive solution outside the canal root, as well as insufficient obturation. It has been assumed that the tissular fluid may invade the space between radicular obturation and the walls of the canals, being manifested as a culture medium for bacteria.

More than that, the conclusion may be drawn that the role of insufficient root obturation in periapical inflammation is apparently explained, first of all, by the presence of the rests of necrotic tissue, either infected or not, in the space between radicular obturation and the walls of the canal.

In this research stage, one of the cases with insufficient radicular obturation could be observed histologically, due to an accidental perforation of canal’s wall, as a result of an apical curvature.

In other 4 unsuccessful cases, accidental perforation was diagnosed radiographically. Similar cases had been reported by other specialists. If perforation occurs in the apical zone of the root, failure may be avoided, through adequate apicectomy.

Apparently, in several cases, it is the lateral canals that cause the failure. In the cases in which obturation of the lateral canals was also performed, spaces through which the infected material escaped from the non-obturated zone of the root towards the periapical one were discovered. Aberrant canals such as, for example, the lateral ones, were discovered, in some cases, as being obturated with sealer. [2, 20, 21].

Anyway, such canals were not always cleaned, and obturation with sealant was apparently insufficient.

The apical ramifications of the root, frequently discovered in permanent dentition, have been assumed as constituting an important cause of endodontic failures.

These ramifications may also contain vital pulp tissue fed from the periodontal membranes, or they appear as having been obturated with a sealant. On the other hand, if they had to contain necrotic tissue, this would have been quantitatively limited, the periapical tissue producing only a mild inflammatory response, which is quite difficult to be observed radiographically.

In the experimental group here analyzed, the external resorptions of the root appeared in 22 of the cases treated through endodontic surgery. Among them, 5 cases were failures, 4 appearing in the teeth with backward obturation of the root, which raises an important question: is the material of radicular obturation responsible for the inflammatory modifications produced in the periodontium?

Another problem that should be considered refers to the possible occurrence of changes in the material of radicular obturation, when this is placed in the tissue.

Some in vitro studies showed that – when used in retro-obturation – amalgam has excellent sealing properties. A question to be raised is whether the extent of the future changes or corrosion may invalidate the adaptation between amalgam and the walls of the canal.

In 3 cases in which the cyst was diagnosed during the surgery, a preceding biopsy punch evidenced its re-formation. Apparently, some of the cyst’s epithelium remained during the initial intervention, which stresses the importance of a correct removal of the cover of cyst’s relining.

The results obtained through re-intervention in 12 failed cases after endodontic surgery showed an incomplete healing in half of them. As, after checking, 60% of the re-operated cases had a backward radicular obturation, and as the control periods were of only 1-2 years,
the results obtained after re-intervention were not much different from those of the main material.

Figure 3. Partially necrotic bone lamellae, included in the inflammatory infiltrate

Such a situation shows that re-intervention in the cases of failure of endodontic surgery may be attempted at, with a reasonably high success ratio.

Introduction of human osteoinducing substances in the plague (osteoporogenous fibroblastic I protein) is financially prohibitive, being possibly applied only experimentally. However, simple methods, both as to their application and costs, are available, permitting qualitative bone healing.

CONCLUSIONS

Apical resection remains a valuable technique assuring preservation, on the arch, of some odonto-periodontal units otherwise compromised from both morphologically and functionally.

The success of the above-presented technique depends on a correct – both local and general – evaluation of the patient. A correct analysis of the marginal periodontium condition and realization of a theoretical model capable of anticipating the evolution of the alveolar bone may differentiate between the failure and the success of this surgical technique.

References


