CLINICAL AND RADIOGRAPHIC OUTCOMES OF SURGICAL MANAGEMENT OF CHRONIC PERIAPICAL LESIONS IN MULTIROOTED TEETH

Igor REPIĆ1, Gordana REPIĆ2, Dragana ZARIĆ3 and Andelija PETROVIĆ3

Summary
Introduction. Chronic periapical lesion is a pathological process of the root apex and the surrounding alveolar bone. Granuloma, which is a term that usually describes a chronic periapical process, represents a mass of granulation tissue at the apex of a devitalized tooth. Such lesions are treated by conventional (endodontic) therapy or surgery. The aim of this study was to assess clinical and radiographic outcomes of surgical treatment of chronic periapical lesions in multirooted teeth. Material and Methods. This prospective study included 30 patients who underwent a standard Partsch surgical procedure. The root canals, without previous endodontic treatment, were obturated immediately before surgery, or intraoperatively. The canals with short fillings or teeth with fixed prosthetics were retrogradely obturated. Zinc-phosphate cement condensed with gutta-percha cone was used for obturation. Evaluation of clinical outcomes was performed 6, 12 and 24 months after surgery, and radiographic outcomes after 12 and 24 months, respectively. Results. After surgery, a statistically significant improvements of treatment outcomes were observed between the follow-ups (p < 0.000). The overall success rate of chronic periapical lesions in multirooted teeth 24 months after surgery was 83.3% for clinical and 66.7% for radiographic outcomes. Conclusion. The results of clinical and radiographic parameters after surgical treatment outcomes in multirooted teeth were satisfying. Therefore, we may conclude that surgical treatment can be considered as a primary treatment option in the management of chronic periapical lesions.

Key words: Periapical Diseases; Chronic Disease; Periapical Granuloma; Tooth Root; Treatment Outcome; Radiography, Dental; Root Canal Obturation; Oral Surgical Procedures

Introduction
Chronic periapical lesion is defined as a pathological process of the root apex and the surrounding alveolar bone. Granuloma, which is a term that usually describes a chronic periapical process, represents a mass of granulation tissue at the devitalized tooth. It develops as a defense mechanism and forms a margin towards the tissue destruction products within the root canal [1].

Sažetak

Ključne reči: periapikalne bolesti; hronične bolesti; periapikalni granulom; koren zuba; ishod lečenja; dentalna radiografija; opturacija kanala korena zuba; oralne hirurške procedure

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Dental pulp degeneration may occur even before the development of complete dentin destruction and such tissue response divides pulp from the curious defect. The process of pulp degeneration inevitably leads to necrosis. Extensive chronicity of this disease affects the periodontium and at that point radiographic changes are seen as lighter shades of the periapical bone, as well as widening of the periodontal space or thickening of the lamina dura. Changes on periapical tissues also might be seen in the stage of chronic open pulpitis, when pulp tissue is directly exposed to external effects (ie. infection). The exposed part of the pulp becomes gangrenous, while the healthy pulp reacts by creating an ulcer towards the infected part. This phenomenon has a progradent course until the whole pulp become gangrenous. Changes of the periapical tissue manifest radiographically in the stage of chronic ulcerative pulpitis. According to some authors, radiographically visible changes can be seen only when the pulp tissue is completely affected by the gangrenous process [2, 3]. However, some authors claim that clinical diagnosis does not necessarily correlate with histopathological findings [4].

In regard to the etiopathogenesis, there are four main causes of chronic periapical lesions: infective agents (bacteria, viruses, and their toxins), physical agents (mechanical trauma, heat, cold or radiation), chemical damages (organic and inorganic poisons) and immunological agents like cell-mediated and antigen–antibody reactions [5].

Most frequently, infection affects the periapex through the apical foramen (foramen apicis dentis). It is also documented that infection may spread by hematogenous and lymphogenous routes. [6]. During an intracanal treatment, it is necessary to achieve two main goals: to extract the content of radicular canal, to reshape the morphology of the existing radicular canal, and to make it fit for definitive obturation and canal restoration [2–4, 7].

Apicoectomy is referred to as a surgical removal of the apical segment of the root. Criteria and indications for apicoectomy include:

1. Active periapical inflammation despite endodontic management
2. Perforation of non-resorbable material and gutta to periapical region
3. Severely curved apex of the root canal which does not allow instrumentation
4. Extremely long root
5. Breakage of instrument in the root canal
6. Root fracture in the apical portion
7. Continuous discharge through the root canal which does not allow adequate conservative treatment
8. If there is a need to complete the management in one visit [8].

The surgical treatment should be performed after adequate canal obturation, as part of the endodontic management of the affected tooth, or as an addition to endodontic management, respectively. If treatment was not performed before surgery, the canal has to be obturated either immediately before the surgery or intraoperatively. It is not recommended for a root canal to be filled a day or even a few hours prior to surgery, because the restoration may cause an inflammatory process. If the canal can be dried properly, it can be filled immediately prior to the surgery. Such filling is usually referred to as orthograde and it shortens the duration of the intervention, but in such cases it is necessary to perform a control X-ray [9].

After lifting the mucoperiosteal flap, the pathological process, which either thinned the bone or perforated it, can be found. After partial or complete removal of the periapical lesion, the root apex is being resected or curved with a rounded and fissure auger, with massive watering of the operative field, in order to prevent tissue heating. In case of solid thickness of the cortical bone layer and the absence of deterioration of the pathological process, fenestration with special trepan borers is performed, with returning the bone fragment on the original site after resection of the root tip; such procedure enables conditions for advanced coagulum organization and its later ossification. The wound has to be properly irrigated with saline solution in order to remove remains of granulation tissue, and in case of their partial removal, it has to be performed all the way to the visibly healthy bone [10].

In most cases, the healing and regeneration of the bone takes 12 – 18 months after surgery. This period of time is sufficient for complete ossification of the bone defect [11].

The aim of this study was to assess clinical and radiographic outcomes of surgical treatment of chronic periapical lesions in multirooted teeth.

Material and Methods

A prospective study was conducted at the dentist office “Dr. Repić”. It included 30 patients with clinically and radiographically verified chronic periapical lesions in multi-rooted teeth. Beside the inclusion criteria, patients in whom exclusive endodontic treatment was impossible were included as well.

The basic statistical unit was an impacted tooth. The following criteria were preoperatively assessed: localization of chronic periapical lesion, previous endodontic treatment, type of previous canal restoration, canal passage, presence of fistula, X-ray characteristics and presence of clinical symptoms (spontaneous pain and sensitivity to palpation or percussion, respectively).

During the preoperative diagnostic procedure and management planning, the passage of the root canal and presence of communication between periapical lesion and oral cavity were specifically assessed. Also, the canal was considered as fully closed if there was a fixed prosthetic work with correct canal restoration.

All of the patients were surgically treated using a standard Partsch procedure (Figure 1). Root canal obturation of the teeth that were not previously endodontically managed was performed immediately before the surgical procedure or intraoperatively. Zinc-phosphate cement condensed with gutta-percha cone was used for obturation.
Canals with short fillings were obturated with amalgam filling afterwards. The same procedure was performed in teeth with inadequately filled canals, which were also carriers of fixed prosthetic work or there was no possibility for revision of previous obturation. A classic surgical technique for apicoectomy was performed. Three types of incisions were used: according to Partsch, Novak-Peter and Pichler. The approach to periapical lesions was done by bone trepanation with steel borers, with minimal bone extraction, at the lowest possible level which was necessary for adequate lesion approach. In a certain number of cases bone opening was done using trepan-borers and it was replaced after root resection, with the aim to enhance the healing process. If the vestibular cortex was significantly damaged, the bone cavity was filled with artificial bone replacement (Bio Oss) after the resection and covered with guided tissue regeneration membranes (Figure 2).

The mucoperiosteal flap was sutured with non-resorptive fibre (Mersilk, 3-0), and the sutures were removed seven days later. Patients were instructed about proper hygiene of the oral cavity during the immediate postoperative period.

Antibiotic prophylaxis was administrated postoperatively, as well as corticosteroid therapy, if extensive edemas were expected. Patients were also advised to take mashed foods and analgesics, if needed.

The management outcomes were evaluated six, twelve and twenty-four months after surgery. The assessment was performed based on clinical parameters, but also taking into consideration the subjective status and radiography.

All statistical analyses were conducted using SPSS version 18.0. Various descriptive measures were used (frequency distribution, mean values, standard deviation). Chi-square test and Kruskal-Wallis test were used to assess the differences with a statistical significance criterion of p < 0.05. The results were presented in tables.

**Results**

A total of 30 patients were included in the study. The male/female ratio was 36.7 : 63.3. They were aged between 20 – 62 years (M = 32.0, SD = 10.05). Almost half of the patients were aged from 20 to 29 years.

**Clinical findings**

The initial clinical evaluation was performed during the examination prior to the indicated apical surgery. The following criteria were examined: localization of chronic periapical lesions, obturation of molars, canal passage, tenderness to pain, presence of communication between periapical lesion and the oral cavity and clinical presentation.

In our study, most of the chronic periapical lesions were located on the lower left molars (33.3%); the same number of lesions were found on the upper right (23.3%) and lower right (23.3%) side, while six cases (20%) were found in the upper left molars.

The preoperative canal passage was also one of the parameters in the clinical evaluation prior to the apical surgery. Almost half of the canals were closed (46.7%), wether due to fixed prosthetics or due to correct restoration; one third was gangrenous (33.3%) and one fifth was opened (20%).

Percussion sensitivity is a very important clinical parameter in the diagnosis of chronic periapical lesions, regardless of the presence of spontaneous pain. Three types of pain were assessed: spontaneous, by percussion and by palpation. In almost half of the patients (46.7%), the pain was provoked by percussion.

In regard to the clinical presentation, in more than half of the patients (56.7%) tumefact was found, while 43.3% were diagnosed with intraoral fistula (Table 1).

In our study no extraoral fistulas were found.

**Figure 1.** Suture by Partsch performed on the chronic periapical lesion of the tooth #36  
**Slika 1.** Pristup hroničnoj periapikalnoj leziji na zubu 36 primenom reza po Parču

**Figure 2.** Bone defect after root resection of the tooth #16 and cavity replacement by Bio Oss (one month after surgery)  
**Slika 2.** Koštani defekt nakon resekcije korenova zuba 16 i ispunjavanja nastale šupljine veštačkom zamenom za kost (BioOss) (mesec dana nakon intervencije)
Radiography assessment was based on retroalveolar imaging and orthopantomograph. Two parameters were assessed: dimension of the lesion and its diffusion. The radiographic presentation showed radiolucent lesions and all that sized up to 10 mm in diameter were considered as moderate, while those with diameter longer than 10 mm were considered as large. Also, chronic periapical lesions were considered as circumscribed if there was a clearly visible bone condensation zone at the periphery of the lesion; they appeared as narrow shadows on the outer parts of pathological radiolucency.

Radiography was performed to determine the size of the lesions. Moderate were present in 56.7% of patients; 43.3% had large lesions. Almost half of the lesions (53.3%) were diffuse, while 46.7% were circumscribed (Table 2).

Clinical evaluation 6, 12 and 24 months after surgery

In the first follow-up, scheduled six months after surgery, postoperative outcomes were assessed exclusively based on clinical parameters. In later follow-up appointments, both clinical and radiographic assessments were included.

Lack of clinical symptoms was found in most of the patients and the number of such patients increased with time elapsed after surgery. There were no patients who reported spontaneous pain.

On the second follow-up (12 months after surgery), a fistula was found in one patient (3.3%). It persisted through the last follow-up in the same patient. The presence of a fistula might be discussed as the treatment failure, while the other symptoms (sensitivity to percussion or palpation) may not indicate a failure.

The number of patients with pain on percussion decreased during time, while the incidence of pain on palpation decreased between the first and second follow-up, but maintained up to the third follow-up. Statistically significant improvement was found both between the first and the second follow-up (Kruskal-Wallis H = 21.069, df = 2, p < 0.000) and first and third follow-up (Kruskal-Wallis H = 19.469, df = 2, p < 0.000) (Table 3).

Radiographic evaluation 12 and 24 months after surgery

Assessment of radiographic parameters of bone healing was performed 12 and 24 months after surgery using retroalveolar and orthopantomograph images. Good ossification of the bone defect was observed in 60% of patients after 12 months, and in 66.7% of patients 24 months after surgery, respectively. Fibroseal type of bone restitution persisted in 10% of patients who reported spontaneous pain.

Clinical findings prior to the surgery

<table>
<thead>
<tr>
<th>Localization of CPL</th>
<th>Upper left</th>
<th>Upper right</th>
<th>Upper left</th>
<th>Lower right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gore levo</td>
<td>6/20.0%</td>
<td>7/23.3%</td>
<td>10/33.3%</td>
<td>7/23.3%</td>
</tr>
</tbody>
</table>

Definitive canal obturation quality

<table>
<thead>
<tr>
<th>Kvalitet definitivnog kanalnog ispuna</th>
<th>Not performed</th>
<th>Insufficient</th>
<th>Ideal</th>
<th>Extreme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nije izveden</td>
<td>20/66.7%</td>
<td>7/23.3%</td>
<td>2/6.7%</td>
<td>1/3.3%</td>
</tr>
</tbody>
</table>

Preoperative canal passage

<table>
<thead>
<tr>
<th>Preoperativna prohodnost kanala</th>
<th>Closed</th>
<th>Gangre nous</th>
<th>Opened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zatvoren</td>
<td>14/46.7%</td>
<td>10/33.3%</td>
<td>6/20.0%</td>
</tr>
</tbody>
</table>

Pain

<table>
<thead>
<tr>
<th>Bol</th>
<th>Spontaneous</th>
<th>By percussion</th>
<th>By touch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontani</td>
<td>10/33.3%</td>
<td>14/46.7%</td>
<td>6/20.0%</td>
</tr>
</tbody>
</table>

Clinical presentation

<table>
<thead>
<tr>
<th>Klinički nalaz</th>
<th>Tumefaction</th>
<th>Intraoral fistula</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/56.7%</td>
<td>13/43.3%</td>
<td></td>
</tr>
</tbody>
</table>

N/%, CPL – chronic periapical lesion/HPL.

Table 2. Radiographic findings prior to surgery

<table>
<thead>
<tr>
<th>Size of lesion (in mm)/Veličina lezije (u mm)</th>
<th>&lt;10 mm</th>
<th>&gt;10 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/56.7%</td>
<td>13/43.3%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of lesion/Tip lezije</th>
<th>Diffuse/Difuzna</th>
<th>Circumscribed/Cirkumskriptna</th>
</tr>
</thead>
<tbody>
<tr>
<td>16/53.3%</td>
<td>14/46.7%</td>
<td></td>
</tr>
</tbody>
</table>
The results of our study showed that the peak age prevalence was between 20–29 years; about two thirds of registered periapical lesions may be earlier than the patients see their dentists due to the appearance of the first symptoms. However, Akinyamoju et al. analyzed medical records of 104 patients with periapical lesions and found that most cases were found among females aged from 20–29, which is in accordance with our findings [14]. The assessment of apical surgery outcome can be performed by using the combination of clinical and radiographic healing criteria [15]. In the study group, 24 months after surgery, the success rate was 83% concerning clinical parameters, and 66.7% concerning radiographic parameters, respectively. The successful outcome group also included 10.0% of patients with positive percussive pain, but without any other clinical signs, 20% of patients with fibroseal tissue restitution, and 10% with fibroosseal tissue restitution, but without any other clinical signs. Quadir et al. reviewed outcomes of periradicular surgery and came to the conclusion that success rate ranged from 30–80%.

Discussion

Apical periodontitis can be defined as an inflammation and destruction of periradicular tissues caused by etiological agents of endodontic origin [12]. It is well documented that the actual prevalence of chronic periapical lesions in our region is significantly higher than in Western countries. This may be explained by poorer oral health status and proportionally higher percentage of carious teeth in our country. Moreover, it leads to the assumption that the proportion of registered periapical lesions may be higher than reported, due to insignificant symptoms. This is why in many cases, at the moment of lesion detection, massive bone destruction of the alveolar extension and development of endo-periodontal lesions has already occurred, which aggravate the possibility of adequate conventional treatment. In our study, the majority of chronic periapical lesions were closed, due to canal treatment, fixed prosthetic work or conservative restoration which were previously performed. The size of this sample might not be adequate for epidemiological conclusions (N = 30 patients), but these findings may suggest insufficiently defined concensus for determining indications for prosthetic or conservative treatment regarding assessment of pulp biological potentials [13].

The results of our study showed that the peak age prevalence was between 20–29 years; about two thirds of patients were female. The age distribution of treated patients suggests that the most probable occurrence of chronic periapical lesions may be earlier than the patients see their dentists due to the appearance of the first symptoms. However, Akinyamoju et al. analyzed medical records of 104 patients with periapical lesions and found that most cases were found among females aged from 20–29, which is in accordance with our findings [14]. The assessment of apical surgery outcome can be performed by using the combination of clinical and radiographic healing criteria [15]. In the study group, 24 months after surgery, the success rate was 83% concerning clinical parameters, and 66.7% concerning radiographic parameters, respectively. The successful outcome group also included 10.0% of patients with positive percussive pain, but without any other clinical signs, 20% of patients with fibroseal tissue restitution, and 10% with fibroosseal tissue restitution, but without any other clinical signs. Quadir et al. reviewed outcomes of periradicular surgery and came to the conclusion that success rate ranged from 30–80%. However, these studies were not consistent in sample size, type of teeth, surgical technique, type of root end filling materials and radiographic evaluation criteria. They also argued that some longitudinal studies reported a higher success rate in periradicular surgery of teeth with unsuccessful orthograde endodontic treatment [16], which is in accordance with our study. The literature review of Von Arx, presented results of success rate of apical surgeries and concluded that they widely ranged, from 44 – 90%; however, with the introduction of microsurgical methods they considerably rased up to about 90% or more [17]. Tolarasia and Das found that periapical surgery may be the only alternative when the tooth with periapical lesion fails to respond to calcium hydroxide which was used as intracanal medication during endodontic management [18]. Singh et al. used platelet rich fibrin for stimulation and acceleration of soft tissue and bone healing with

Table 3. Evaluation of clinical parameters 6, 12 and 24 months after surgery

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>After 6 months Nakon 6 meseci</th>
<th>After 24 months* Nakon 24 meseca*</th>
<th>After 48 months** Nakon 48 meseci**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneous pain</td>
<td>0/0.0%</td>
<td>0/0.0%</td>
<td>0/0.0%</td>
</tr>
<tr>
<td>Percussion pain</td>
<td>6/20.0%</td>
<td>4/13.3%</td>
<td>3/10.0%</td>
</tr>
<tr>
<td>Palpation pain</td>
<td>3/10.0%</td>
<td>2/6.7%</td>
<td>2/6.7%</td>
</tr>
<tr>
<td>Presence of fistula</td>
<td>0/0.0%</td>
<td>1/3.3%</td>
<td>1/3.3%</td>
</tr>
<tr>
<td>No symptoms</td>
<td>21/70.0%</td>
<td>23/76.7%</td>
<td>24/83.0%</td>
</tr>
</tbody>
</table>

N/%; *p<0.000; **p<0.000

Table 4. Evaluation of radiographic parameters 12 and 24 months after surgery

<table>
<thead>
<tr>
<th>Symptoms/Simptomi</th>
<th>After 12 months/Nakon 12 meseci</th>
<th>After 24 months*/Nakon 24 meseca*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osseal/Osealno</td>
<td>18/60.0%</td>
<td>20/66.7%</td>
</tr>
<tr>
<td>Fibroosseal/Fibrooselno</td>
<td>8/26.7%</td>
<td>6/20.0%</td>
</tr>
<tr>
<td>Fibrous/Fibroznio</td>
<td>3/10.0%</td>
<td>3/10.0%</td>
</tr>
<tr>
<td>Recidives with fistula/Recidiv sa fistulom</td>
<td>1/3.3%</td>
<td>1/3.3%</td>
</tr>
</tbody>
</table>

N/%; *p<0.000
surgical procedure combined and it proved to be very successful. Six months after surgery, complete bone regeneration was found in all patients [19].

Conclusion

The study showed that chronic periapical lesions in multiple rooted teeth can be successfully treated by combined endodontic-surgical treatment, in the environment of fully equipped private dental practice, with application of the main management principles of endodonty and surgery. Respecting the fact that the principle of maintenance of teeth is condition sine qua non, it is necessary to perform all possible procedures to maintain the teeth and to enable their adequate functioning in the long run, and in favour of the patients.

References


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