Clinical and Radiographic Assessment of Cases Referred to Endodontic Surgery

Klinička i radiološka procjena pacijenata upućenih na endodontsku kirurgiju

Abstract

Objective: The objective of the study was to assess the quality of root canal fillings of cases referred to endodontic surgery using preoperative radiographs and correlate it with endodontic surgery treatment decision. The objective was also to analyse clinical symptoms and size of periapical lesions on radiographs and correlate them with treatment decisions including non-surgical retreatment, endodontic surgery and extraction. Material and Methods: A questionnaire was composed to record the data. Eighty-six patients with 109 teeth, who were referred to endodontic surgery, participated in the research. The quality of root canal filling was assessed according to its homogeneity and filling length on digital radiographs. The data were analyzed using χ²-test and t-test. Results: Of the teeth referred to endodontic surgery, 97.2% were treated by a general practice dentist, endodontic retreatment was attempted in 20.6%, and root canal filling was homogenous and within 1 mm from the apex in 21.6%. Endodontic surgery, retreatment, extraction and no treatment were selected in 90.1%, 5.4%, 1.8% and 2.7% of the cases, respectively. Conclusions: Low percentage of adequate root canal fillings and high percentage of endodontic surgery decisions suggest that there is a need to increase awareness of non-surgical retreatment options.

Introduction

The purpose of endodontic treatment is to preserve the function of a tooth with pathologically altered pulp, without harming patients’ general health. According to the European Society of Endontology (ESE) and American Association of Endodontists (AAE) guidelines, the standard procedure includes cleaning, shaping, disinfection and sealing the root canals of the treated tooth (1, 2). The treatment is considered successful when clinical symptoms of periapical disease are absent and radiographic analysis confirms the healing of a periapical lesion (3, 4).

According to the literature, 14-16% of primary endodontic treatments result in failure (5). If radiographic and clinical findings indicate failure, three therapeutic options should be considered: non-surgical retreatment, endodontic surgery (including root-end resection and retrograde cavity filling) or tooth extraction (1, 6). The most frequent cause of failure is persistent infection in the root canal system and/or in periradicular area (7, 8). Other possible reasons include periradicular true cyst, accumulation of endogenous cholesterol crystals...
in periapical tissue and foreign body reaction due to a root canal overfilling or cellulose-containing materials extruded during treatment (7, 9). When there is residual intraradicular infection, procedural mistakes such as short filling or overfilling, perforations of root canal wall and separated instrument could lead to failure (8, 10).

In the endodontic surgery procedure root tip is surgically removed together with the inflammatory process around it and retrograde cavity prepared and filled (1, 2). Endodontic surgery is indicated when periapical lesions persist and root canal system cannot be adequately cleaned and sealed due to developmental anomalies or iatrogenic causes or when the retreatment would compromise the tooth, e.g. the removal of the intracanal post. Furthermore, endodontic surgery needs to be performed if there is a suspicion of perforation or fracture in the root’s apical third, when histopathological analysis is required and when retreatment is not possible due to the patient related reasons (1, 2, 11). Cohn et al. (12) reported that the success rate of surgical endodontics was 64%, which is considerably lower than the reported success rate of retreatments (80%) (13). Also, undesirable consequences of this surgical procedure are gingival recessions, scars and reduced resistance to occlusal forces and periodontal diseases due to root shortening (14, 15). It is, therefore, crucial that the indications for endodontic surgery are met and that each case is individually assessed (14, 15, 16). In the cases where neither retreatment nor endodontic surgery would enable inflammation regression and healing, tooth extraction is the treatment of choice (1).

It has been shown that the unsatisfactory quality of primary root canal fillings with inadequate length and homogeneity of the filling often leads to the development of a periapical process (17). An insufficient awareness of the etiology of persistent endodontic diseases and treatment possibilities leads to the increased referral to endodontic surgery (18).

According to the available literature, firm guidelines for failed root canal treatment seem to lack, and information about treatment decisions (orthograde retreatment vs. surgical treatment vs. extraction-implants) is modest (12, 18). The aim of this research was to determine the connection between the quality of root canal filling, symptoms, status of the tooth and surrounding tissues (clinical and radiographic) and treatment decision. The hypothesis was that endodontic surgery was the treatment of choice in the majority of the referred cases.

Material and methods

The study was conducted in surgical infirmaries and operating rooms at the Department of Oral Surgery, School of Dental Medicine, University of Zagreb and the Clinical Department of Oral Surgery, Clinical Hospital Dubrava, Zagreb from January to April 2017. The research has been conducted in accordance with the World Medical Association Declaration of Helsinki, and The Ethics Committee of the School of Dental Medicine, University of Zagreb approved the research and the consent procedure. The written consent was obtained from all the participants who were older than 18, and from the parents of the participants that were under 18 years of age.

ciju endogenih kolesteroljskih kristala u periapikalnom tkivu i reakciju na strano tijelo zbog prepunjenja ili ekstruzije celuloznih materijala u periapeks tijekom liječenja (7, 9). Ka-
daje razlogi za neadekvatno liječenje korijenskog sistema u stvari (12, 18). Studija je provedena u kliničkim ambulantama za oralnu kirurgiju Stomatološkog fakulteta Sveučilišta u Zagrebu i Kliničke bolnice Dubrava u Zagrebu, od siječnja do travnja 2017. Obavljeno je u skladu s Helsinski deklaracijom Sjeverne medicinske udruge, a odobrilo ga je Etičko povjerenstvo Stomatološkog fakulteta Sveučilišta u Zagrebu. Svi pacijenti stariji od 18 godina te roditelji onih mladih od 18 godina, potpisi su isporučeni pristankar.

Prije istraživanja dvije su istraživačice (B. B. i J. B.) za procjenu usklandile kliničke i radiološke dijagnoze. Kriteriji

Materijali i metode

Istraživanje je provedeno u kliničkim ambulantama Zava za oralnu kirurgiju Stomatološkog fakulteta Sveučilišta u Zagrebu i Kliničke bolnice Dubrava u Zagrebu, od siječnja do travnja 2017. Obavljeno je u skladu s Helsinki deklaracijom Sjeverne medicinske udruge, a odobrilo ga je Etičko povjerenstvo Stomatološkog fakulteta Sveučilišta u Zagrebu. Svi pacijenti stariji od 18 godina te roditelji onih mladih od 18 godina, potpisali su isporučeni pristankar.

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Prior to the research, two researchers (BB and JB) were calibrated for estimating clinical and radiographic diagnosis. The criteria for the assessment of clinical and radiographic findings were harmonized by analysing 51 digital retroalveolar and panoramic radiographs from the School of Dental Medicine, University of Zagreb database, recorded using Minray (for intraoral) and Cranex 3D Ceph (for orthopantomograms) X-ray machines and Scanora software (Soredex, Tuusula, Finland). The analyses were compared, and high degree of congruence was noticed. The results which did not match were processed and discussed and a 100% congruence was achieved.

Eighty-six patients referred to endodontic surgery participated in the study. Only the patients who signed the informed consent were included, and their anonymity was guaranteed. Clinical and radiographic finding, the decision of an oral surgery specialist about further procedure and intraoperative findings were recorded for each case. Dental history included data about previous procedures on the tooth and pain assessment. Clinical examination included tooth and soft tissue inspection. A radiographic analysis was conducted on panoramic (n=2) and intraoral (n=101) radiographs which included the assessment of homogeneity and filling length with respect to the radiographic apex, the presence of a separated instrument in root canal and the presence of perforation (19), the length and type of posts and the size of periapical transparency. When endodontic surgery was indicated, intraoperative findings of bone fenestration, dehiscence or vertical fracture of a tooth was recorded. The radiographs were made and analyzed using Minray and Cranex 3D Ceph machine (Soredex, Tuusula, Finland) and Scanora software (Soredex, Tuusula, Finland).

Cases referred to endodontic surgery for the first time and cases referred to repeated endodontic surgery were joined in one sample. When analyzing the data of patients that had multiple teeth referred for apicectomy, each tooth was observed and analyzed individually.

The relationships between radiographically estimated quality of root canal filling (according to homogeneity and filling length), clinical and radiographic variables, variables from dental history and decision about the procedure were statistically analyzed. The χ2-test was used for the analysis of discrete variables and t-test for continuous variables (p < 0.05). The analysis was done using SAS statistical package on Windows platform.

Results

Out of 86 patients that participated in the study, 59.5% were female and 40.5% of them were male. More cases were evaluated in the operating room than in the surgical infirmary (3.8:1). There were no statistical differences between males and females for any variable (p>0.05). Patients’ average age was 44.4 years (14-81 years). Out of 106 analyzed teeth, 97.2% were treated by a general practice dentist. Endodontic retreatment before referring to endodontic surgery was performed in 20.6% of cases. The most common treatment selection was endodontic surgery (90.1%), while retreatment for procjenu kliničkoga i radiološkog nalaza usklađeni su analiziranjem 51 digitalne retroalveolarne i panoramske snimke iz baze snimaka Stomatološkog fakulteta Sveučilišta u Zagrebu učinjenih uređajima Minray (za intraoralne) i Cranex 3D Ceph (za ortopantomograme) te obradjenih softverom Scanora (Soredex, Tuusula, Finska). Analize su uspoređene te je postignut visok stupanj podudarnosti. Rezultati koji se nisu podudarali analizirani su i o njima se raspravljalo te je postignuta podudarnost u 100 % slučajeva.

U istraživanju je sudjelovalo 86 pacijenata upućenih na endodontsko-kirurški zahvat (apikotomiju). Samo su oni koji su potpisali informirani pristanak sudjelovali u istraživanju, a anonimnost je bila zaintezirana. Klinički i radiološki nalazi, odluka specijalista oralne kirurgije o daljnjem postupku te intraoperativni nalazi, zabilježeni su za pojedini slučaj. Dentalna anamneza uključivala je podatke o ranijim postupcima na zubu i procjenu boli. Klinički pregled uključivao je inspekciju zuba i okolnih mekih tkiva. Radiološka analiza učinjena je na ortopantomogramima (n = 2) i intraoralnim radiogramima (n = 101) te je obuhvaćala procjenu homogenenosti i duljine punjenja prema radiološkom apskusu, prisutnost separiranog instrumenta u korijenskom kanalu i perforaciju korijena (19), duljinu i vrstu nadogradnje te veličinu peripikalne transparencije. Ako je bio indiciran endodontsko-kirurški zahvat, zabilježen je intraoperativni nalaz fenestracije, dehiscencije ili vertikalne fraktura. Radiogrami su snimljeni i analizirani uređajima Minray i Cranex 3D Ceph (Soredex, Tuusula, Finska ) te softverom Scanora (Soredex, Tuusula, Finska).

Slučajevi koji su prvi put upućeni na endodontsko-kirurški zahvat te oni upućivani više puta, spojeni su u jedan uzorak. Kod pacijenta upućenih zbog dvaju ili više zuba, svaki je zub promatran i analiziran posebno. Statistički su analizirani odnosi između radiološki procjenjenih kvalitete punjenja korijenskog kanala (prema homogenosti i duljini punjenja), kliničkih i radioloških varijabli, varijabli iz dentalne anamneze i odluke o postupku. χ2-test korišten je u analizi diskretnih varijabli, a t-test kontinuiranih varijabli (p < 0,05). Analiza je obavljena u statističkom paketu SAS na platformi Windowsa.

Rezultati

Među 86 pacijenata koji su sudjelovali u istraživanju, 59,5 % bile su žene, a 40,5 % muškarci. Više slučajeva analizirano je u operacijskoj dvorani, negoli u ambulanti (3,8 : 1). Nije bilo statistički značajnih razlika među spolovima ni za jednu varijablu (p > 0,05). Prosječna dob pacijenta bila je 44,4 godine (14 – 81 godinu). Od 106 analiziranih zuba, 97,2 % tretirao je primarni liječnik dentalne medicine. Rezacija endodontskog liječenja prije dolaska na endodontsku kirurgiju učinjena je u 20,6 % slučajeva. Najčešći odabrani postupak bio je endodontsko-kirurški (90,1 %), a revizija (5,4
Table 1  Numbers and percentages of particular clinical and radiological findings recorded in 109 teeth of 86 patients referred to endodontic surgery.

| Tooth                        | N  | %       |
|------------------------------|----|---------|
| 11 - maxillary right central incisor | 13 | 11.9    |
| 12 - maxillary right lateral incisor | 18 | 16.5    |
| 13 - maxillary right canine  | 11 | 10.1    |
| 14 - maxillary right second premolar | 2 | 1.8     |
| 21 - maxillary left central incisor | 20 | 18.3    |
| 22 - maxillary left lateral incisor | 21 | 19.3    |
| 23 - maxillary left canine  | 4  | 3.7     |
| 24 - maxillary left first premolar | 5  | 4.6     |
| 25 - maxillary left second premolar | 3 | 2.8     |
| 26 - maxillary left first molar | 1  | 0.9     |
| 32 - mandibular left lateral incisor | 1 | 0.9     |
| 33 - mandibular left canine  | 1  | 0.9     |
| 34 - mandibular left first premolar | 1 | 0.9     |
| 35 - mandibular left second premolar | 1 | 0.9     |
| 41 - mandibular right central incisor | 1 | 0.9     |
| 42 - mandibular right lateral incisor | 1 | 0.9     |
| 43 - mandibular right canine  | 3  | 2.8     |
| 44 - mandibular right first premolar | 2 | 1.8     |

Prosthetically reconstructed tooth

| Yes | 66 | 62.9  |
| No  | 39 | 37.1  |

Single crown

| Yes | 33 | 31.4  |
| No  | 72 | 68.6  |

Bridge carrier

| Yes | 33 | 31.4  |
| No  | 72 | 68.6  |

Number of previous treatments

| 0   | 3  | 2.9  |
| 1   | 69 | 65.7 |
| 2   | 30 | 28.6 |
| 3   | 3  | 2.9  |

Attempted revision prior to referral

| Yes | 22 | 20.6 |
| No  | 85 | 79.4 |

Tooth treated by

General dentist

| Yes | 106 | 97.2 |
| No  | 3   | 2.8  |

specialist in endodontics

| Yes | 3   | 2.8  |
| No  | 106 | 9.2  |

Symptoms

Spontaneous pain

| Yes | 55  | 50.0  |
| No  | 55  | 50.0  |

Pain upon biting

| Yes | 31  | 29.2  |
| Ne  | 75  | 70.8  |

Pain to hot/cold

| Yes | 16  | 14.8  |
| No  | 92  | 85.2  |

swelling

| Yes | 71  | 65.1  |
| No  | 38  | 34.9  |

Sinus tract

| Yes | 49  | 46.7  |
| No  | 56  | 53.3  |

Root canal length

| Within 1mm from the apex | 46 | 42.4 |
| > 1 mm short of apex      | 39 | 40.2 |
| > 1 mm overfilled         | 12 | 12.4 |

Homogenous filling

| Yes | 45  | 45.0 |
| No  | 55  | 55.0 |

Separated instrument within root canal

| Da | 3   | 2.9 |
| Ne | 101 | 97.1 |

Intracanal post

| Yes | 8   | 7.7  |
| No  | 96  | 92.3 |

Metal confection

| Yes | 22  | 21.2 |
| No  | 82  | 78.8 |

Fiber reinforced composite resin

| Yes | 3   | 2.9  |
| No  | 101 | 97.1 |

Post length

| < 5 mm in root canal | 13 | 43.3 |
| > 5 mm in root canal | 17 | 56.7 |

Canal not found

| Yes | 1   | 1.0 |
| No  | 102 | 99.0 |

Size of radiolucency

| No radiolucency | 2  | 2.0 |
| Radiolucency < 2 mm | 19 | 19.0 |
| Radiolucency 2 - 5 mm | 47 | 47.0 |
| Radiolucency > 5 mm | 27 | 27.0 |
| Lateral radiolucency | 5  | 5.0 |

Perforation

| Yes | 23  | 23.2 |
| No  | 76  | 76.8 |

Treatment decision

| No treatment | 3  | 2.7 |
| Orthograde retreatment | 6  | 5.4 |
| Apicoectomy | 100 | 90.1 |
| Extraction | 2  | 1.8 |

Intraoperative finding

| Bone fenestration | 65  | 71.4 |
| Dehiscence       | 26  | 28.6 |

Vertical fracture

| Yes | 28  | 31.8 |
| No  | 60  | 68.2 |

Vertical fracture

| Yes | 0   | 0.0 |
| No  | 88  | 100.0 |
(5.4%), not doing any procedure (2.7%) and extraction (1.8%) were less frequently selected. The majority of the examined teeth were upper incisors (66%). Most of the teeth were prosthetically reconstructed (62.9%) and more than half (53.5%) were supplied with an intracanal post (Table 1).

Root canal filling was homogeneous and within 1 mm from the apex in 21.6% of cases, while in 78.4% of cases filling was unsatisfactory according to either length or homogeneity. Considering all the variables and the homogeneity of filling (homogeneous or non-homogeneous), a statistically significant difference was noted only with respect to the length of the root canal filling (p = 0.023, χ²-test).

Comparing all the variables with respect to the length of the root canal filling, statistically significant differences were found for the following: the number of previous treatments/retreatments, attempted endodontic retreatment before endodontic surgery, homogeneous filling, spontaneous pain, the presence of intracanal posts (metal individual and composite) and the presence of bone dehiscence (Table 2).

### Table 2

| Filling length | Total | Within 1 mm | Less than 1 mm | Overfilled |
|----------------|-------|-------------|----------------|------------|
|                | N     | %           | N              | %          | N          | %         | N          | %         | p    |
| Number of previous treatments |       |             |                |            |            | |            | |       |
| 0              | 1     | 1.1         | 0              | 0.0        | 0          | 0.0       | 1          | 8.3       | 0.031   |
| 1              | 62    | 66.7        | 30             | 71.4       | 28         | 71.8      | 4          | 33.3      |         |
| 2              | 27    | 29.0        | 10             | 23.8       | 10         | 25.6      | 7          | 58.3      |         |
| 3              | 3     | 3.2         | 2              | 4.8        | 1          | 2.6       | 0          | 0.0       |         |
| Was revision attempted before root-end resection |       |             |                |            |            | |            | |       |
| Yes            | 20    | 21.1        | 8              | 18.2       | 6          | 15.4      | 6          | 50.0      | 0.030   |
| No             | 75    | 78.9        | 36             | 81.8       | 33         | 84.6      | 6          | 50.0      |         |
| Symptoms       |       |             |                |            |            | |            | |       |
| Spontaneous pain |      |             |                |            |            | |            | |       |
| Yes            | 50    | 51.5        | 29             | 63.0       | 18         | 46.2      | 3          | 25.0      | 0.043   |
| No             | 47    | 48.5        | 17             | 37.0       | 21         | 53.8      | 9          | 75.0      |         |
| Homogeneous filling |    |             |                |            |            | |            | |       |
| Yes            | 42    | 43.8        | 21             | 46.7       | 12         | 30.8      | 9          | 75.0      | 0.023   |
| No             | 54    | 56.3        | 24             | 53.3       | 27         | 69.2      | 3          | 25.0      |         |
| Intracanal post |       |             |                |            |            | |            | |       |
| Metal individual |      |             |                |            |            | |            | |       |
| Yes            | 21    | 22.1        | 8              | 18.2       | 13         | 33.3      | 0          | 0.0       | 0.036   |
| No             | 74    | 77.9        | 36             | 81.8       | 26         | 66.7      | 12         | 100.0     |         |
| Fiber reinforced composite sticks |       |             |                |            |            | |            | |       |
| Yes            | 3     | 3.2         | 0              | 0.0        | 1          | 2.6       | 2          | 16.7      | 0.013   |
| No             | 92    | 96.8        | 44             | 100.0      | 38         | 97.4      | 10         | 83.3      |         |
| Presence of bone dehiscence |      |             |                |            |            | |            | |       |
| Yes            | 25    | 32.1        | 17             | 47.2       | 8          | 24.2      | 0          | 0.0       | 0.011   |
| No             | 53    | 67.9        | 19             | 52.8       | 25         | 75.8      | 9          | 100.0     |         |

Table 2. The variables that were significantly related to the length of the root canal filling were determined using χ²-test.

Discussion

Endodontic surgery was the preferred procedure in 90% of the referred cases. The main hypothesis of the research was thus affirmed. Non-surgical retreatment was attempted in a percentage of cases, but not doing any procedure or extraction was less frequently selected. The majority of the examined teeth were upper incisors, and more than half were supplied with an intracanal post.

Punjenje korijskog kanala bilo je homogeno i unutar 1 mm od apeksa u 21.6 % slučajeva, a u 78.4 % slučajeva punjenje je bilo nezadovoljavajuće prema kriteriju homogenosti i/ili duljine punjenja. Analizom odnosa homogenosti punjenja (homogeno ili nehomogeno) i svih ostalih varijabli, statistički značajna povezanost ustanovljena je jedino za duljinu punjenja (p = 0.023, χ²-test).

Usporedujući sve varijable s duljinom punjenja korijskog kanala, statistički značajne razlike ustanovljene su za sljedeće varijable: broj prethodnih liječenja/revizija, pokušaj revizije prije endodontske kirurgije, homogenost punjenja, spontana bol, prisutnost intrakanalne nadogradnje (metalne individualne i kompozitne) i dehiscijencija kosti (tablica 2.).

Discussion

Endodontic surgery was the preferred procedure in 90% of the referred cases. The main hypothesis of the research was thus affirmed. Non-surgical retreatment was attempted in a
relative low percentage of the referred cases (20.6%), even though root canal fillings were unsatisfactory in most of them. Residual infection due to inadequate cleaning and disinfection of the root canal space, or secondary infection due to inadequate obturation/sealing may lead to endodontic treatment failure (20). Intra-radicular microflora is polymicrobial, predominantly anaerobic and resembles to that of an untreated necrotic pulp (21). Therefore, in cases where an orthograde approach is possible, endodontic retreatment should be the treatment of choice. It was reported that the healing of periapical lesions after endodontic retreatment occurs in 74–98% of the cases, while the success rate of endodontic surgery, without previous retreatment, was significantly lower (13, 12, 20). Furthermore, research by Torabinejad et al. (22) showed that the success of orthograde treatment lasted longer. Previous studies also report significant percentage of cases in which endodontic surgery was conducted, although according to the scientifically grounded criteria, orthograde retreatment should have been the treatment of choice (18, 23). It was concluded in previous studies that general dental practitioners do not appreciate endodontic retreatment as a treatment option, and the inclusion of a specialist of endodontics in the decision-making process on endodontic surgery was suggested (18, 23, 24). Moreover, in almost 3% of the cases endodontics was not performed and in more than 65% of cases endodontic treatment was conducted only once, less than 3% performed by a specialist of endodontics.

Oral surgery specialization bias in decision making was the subject of some previous studies where the referred patients were reassessed and based on audit criteria the authors reported that the endodontic surgery had not been indicated in considerable number of the patients (18, 23, 25). Abramowitz et al. (18) came to conclusion that the percentage of "unnecessary" resections was 55%. Anyway, it is important to point out that the concept of endodontic surgery implies root-end resection with retrograde cavity filling, and that omitting the retrograde filling should negatively affect the outcome of the surgery. Since the purpose of our research was not to define the percentage of "unnecessary" endodontic surgeries, we are unable to give such assessments for our sample. However, we can conclude that certain number of cases could have been treated more conservatively, by an orthograde retreatment approach, especially considering intraradicular infection remaining after endodontic surgery in cases that had not been orthograde treated before. Nevertheless, it would be interesting to follow up the cases referred to oral surgery that had been treated surgically and those that had been forwarded to an endodontics specialist for orthograde retreatment. At this point there is no systematic follow up of patients referred to Oral surgery and Endodontics at the School of Dental Medicine, and majority of patients are followed by their primary dentist. It was therefore at this point difficult to obtain the data necessary for the assessment of the success rates of surgical and conservative treatments, and asses the percentage of unnecessary surgeries. We can however notice that in the von Arx et al. (25) study, the percentage of teeth in which an oral surgery specialist decided for root-end resection was significantly lower (59.1%) malom postotku (20,6 %), premda punjenja korijskih kanala uglavnom nisu zadovoljavala.

Rezidualna infekcija zbog neadekvatnog čišćenja i dezinfekcije korijskog kanala ili sekundarne infekcije zbog neadekvatne optarivanja mogu rezultirati neuspjehom endodontskog liječenja (20). Intraradikularna mikroflora je polimikrobna i prevladavajuća anaerobna te je nalik na onu u netretiranoj nekrotičnoj pulp (21). Zato bi u slučaju kada je moguć ortogradni pristup, revizija endodontskog liječenja trebala biti postupak izbora. Podatci iz literature pokazuju da se cijeljenje perilapidalnih lezija nakon revizije liječenja događa u 74 do 98 % slučajeva, a značajno je manji postotak uspješnosti endodontske kirurgije, bez prethodne revizije (13, 12, 20). Nadalje, istraživanje Torabinejada i suradnika (22) pokazalo je da je uspjeh nakon ortogradne revizije dugo trajniji. Randija istraživanja također govore o značajnom postotku slučajeva za koje je provedena endodontska kirurgija, a prema znanstveno utemeljenim kriterijima postupak izbora trebala je biti ortogradna revizija (18, 23). U ranijim istraživanjima zaključeno je da primarni stomatolozi ne cijene endodontske reviziju kao terapijsku mogućnost te je predloženo uključivanje specijalista endodontije u proces odlučivanja o provedbi endodontsko-kirurškog zahvata (18, 23, 24). Nadalje, u gotovo 3 % slučajeva endodontija nije nikad provedena, u 65 % slučajeva endodontski je tretman obavljen samo jedanput, a u manje od 3 % liječio ju je specijalist endodontije.

Utkicaj specijalizacije iz oralne kirurgije na odluku o postupku, bio je tema nekoliko ranijih istraživanja u kojima se upućene pacijente ponovno procjenjivalo prema revidiranim kriterijima pa su autorii naveli da endodontsko-kirurški zahvat nije bio indiciran u velikom broju slučajeva (18, 23, 25). Abramovitz i suradnici (18) zaključili su da je postotak nepotrebnih resekcija 55 %. Ipak, važno je istaknuti da koncept oralne kirurgije obuhvaća reviziju štanka korijska s retrogradnim punjenjem, a izostavljanje retrogradnog punjenja negativno utječe na ishod operativnog zahvata. Budući da svrha ovog istraživanja nije bila utvrditi postotak nepotrebnih kirurških zahvata, nismo u stanju dati takvu procjenu za naš uzorak. No možemo zaključiti da je određeni broj slučajeva mogao biti tretiran konzervativnije, posebno ako se uzme u obzir intraradikularna infekcija koja ostaje u kanalu nakon endodontsko-kirurškog zahvata u slučaju da prije nije učinjena revizija. Ipak, bilo bi zanimljivo pratiti slučajeve upućene na oralnu kirurgiju koji su kirurški tretirani i one prošlijene specijalistu endodontije zbog ortogradne revizije liječenja. Trenutačno ne postoji sustavno praćenje pacijenata upućenih i obrađenih u Zavodu za oralnu kirurgiju i Zavodu za endodontiju te je većinu pratio njihov primarni stomatolog. Zato je zasad teško doći do podataka na temelju kojih bi se određio postotak uspješnosti kirurškog i konzervativnog tretmana te postotak nepotrebnih operacija. Možemo ipak istaknuti da je u istraživanju von Arx i suradnika (25) postotak zuba za koje se specijalizirane oralne kirurgije odlučio za resekciju bio značajno niži (59,1 %), negoli u našem istraživanju (90 %). To može biti zbog toga što se naš uzorak većinom sastojao od pacijenata s već dogovorenim operacijama.

Radiološki procijenjena kvaliteta punjenja korijskih
than in our study (90%). The reason for this difference is that our sample consisted mostly of patients with an already scheduled surgery.

Radiographically estimated quality of root canal fillings done by general practitioners in Sweden was satisfactory in only 31% of the cases and after a course in machine endodontics, the quality was significantly improved and was satisfactory in 51% of the cases (26). Similarly, in our research, 45% of fillings were estimated as homogeneous (Table 1). The Swedish authors reported that the homogeneity and filling length had no influence on the size of the periapical lesion, also similar to our results.

When it comes to symptoms before operation, we found significant connection between the filling length and spontaneous pain (p<0.05). It is interesting that spontaneous pain and alveolar bone loss (presence of dehiscence) were more commonly recorded when the filling was the satisfactory in length (p<0.05), i.e. within 1 mm from the apex.

In our research 21.6% of the cases with adequate fillings had symptoms or did not show signs of healing. The reason for that can be intraradicular infection with microorganisms resistant to intracanal medicaments and irrigants, which lead to failure after lege artis endodontic treatment (7, 27). Additionally, the elimination of infection from the apical part of the canal and consequent failure might be caused by procedural mistakes done during primary endodontic treatment, that are not necessarily radiographically detectable, e.g. transposition and transportation of apex (20, 28). The decision about the treatment should therefore not be based solely on the radiographic finding (17). In our research, the connection between the treatment decision and radiographically estimated quality of filling was not significant (p<0.05). Although the diagnostic value of panoramic radiographs is inferior (29), the panoramic radiographs were in our study included in the analysis. The reason for including them is their low number (only 2), and their reported sufficient diagnostic value in diagnosing apical periodontitis (30).

In addition to intraradicular infection, the cause of failure of endodontic treatment can be an extraradicular infection in the form of periodaradiculal actinomycosis, foreign body reaction or true cyst (7, 9). In these cases, healing and/or withdrawal of symptoms after endodontic retreatment cannot be expected, and surgical approach is indicated: root-end resection and the removal of foreign body or excochleation of the radicular cyst (9). However, these treatment failure causes are relatively rare, and extraradicular microbial infection in the apical part of root canal remains the most common cause of endodontic treatment failure (7, 10).

Almost 63% of the cases in our study were prosthetically reconstructed and more than 30% had intracanal post. This made orthograde approach to root canal difficult, and presumably this was the main reason these patients were referred to endodontic surgery, although, according to the criteria of radiographic appearance of the fillings, orthograde retreatment should have been the first choice. In the context of the rationalization we realize that endodontic surgery seems like a favourable choice in such cases, because prosthetic work is preserved. Within our sample, 50% of the referred crowned
Conclusions

Endodontic surgery was a procedure of choice for most patients referred by a general practitioner to an oral surgery specialist. Considering that the percentage of radiographically assessed teeth with unsatisfactory root canal fillings was high, and the percentage of teeth in which orthograde retreatment was attempted prior to the referral to oral surgery specialist was low, we can conclude that the awareness about the possibilities of successful treatment by non-surgical approach is insufficient.

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Conflict of interest

The authors report no conflict of interest.

Zaključak

Endodontska kirurgija bila je postupak izbora za većinu pacijenata koje je primarni stomatolog uputio oralnom kirurgu. Uzimajući u obzir da je postotak zuba s radiološki utvrđenim neadekvatnim punjenjem bio visok, a postotak onih na kojima se pokušala učiniti revizija prije upućivanja na kirurgiju mali, zaključujemo da znanje o mogućnostima uspješnog nekirurškog liječenja nije dovoljno.

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