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THE IMPACT OF OPERATING MICROSCOPE ON THE OUTCOME OF ENDODONTIC TREATMENT PERFORMED BY POSTGRADUATE STUDENTS

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Abstract

Aim of our study. To assess the impact of the operating microscope on the success rate of primary endodontic treatments performed by postgraduate students, during their training program in Endodontics. As null hypotheses we considered that the use of a dental operating microscope in cleaning and shaping the root canals has no statistically significant influence on the treatment outcome in non-surgical treatment of apical periodontitis. **Material and methods.** We selected a series of 184 consecutively cases of necrotic teeth with chronic periapical lesions that met the inclusion criteria, in which the therapy was performed by postgraduate students or specialists in Endodontics. All patients were treated under the same conditions, regarding materials, techniques and instrumentation. **Results.** The outcome of the endodontic treatment was assessed based on the recommendations made by the European Society of Endodontics. At 6 months there was a statistical significant difference of the outcomes between study groups ($p=0.0151$) which became more evident after 18 months ($p=0.0078$). **Conclusions.** High-quality endodontic therapy is the basis for long-term clinical and radiological success in endodontic treatment of necrotic teeth. State of the art equipment and thorough knowledge are very important in reaching this goal.

Keywords: Endodontic treatment, operating microscope, apical periodontitis

Introduction

One of the greatest achievements in the history of dentistry is considered to be the introduction of the operating microscope (OM), which improved the clinical performance in many treatment procedures. Despite numerous experimental and clinical data that demonstrated the beneficial influence of the OM in solving difficult cases in endodontics and dental surgery over the years, the acceptance of this instrument is still slower than expected. It is still imperative for dentists to have a thorough knowledge upon the anatomy of the pulp chamber and root canal system in order to increase the efficiency and the success rate of endodontic treatment, but it is strongly believed that the microscope will increasingly influence all treatments procedures in the years to come (Mamoun 2009, Kersten et al 2008).

Some of the advantages of the OM are: magnification, appropriate lighting, higher quality and precision of treatment, proper ergonomics, possibility of case documentation and better communication ability through integrated video (Das Kumar et al 2013, Buchanan 2002). The long-term success of primary but especially retreatment cases in endodontics rely on the accuracy of technique used during cleaning, shaping and filling of the root canals, which are enhanced especially by improved lightning and magnification (Cabral dos Santos et al 2013).

The aim of our study was to assess the impact of the operating microscope on the success rate of primary endodontic treatment. We evaluated the outcome of endodontic therapy performed by postgraduate students during their training program in Endodontics by measuring the rate of clinical success and correlating the results to their treatment protocols. The null hypotheses to be tested was that the use of a dental operating microscope in cleaning and shaping the root canals has no statistically significant influence on the treatment outcome in non-surgical treatment of apical periodontitis.

Material and Methods

The investigation was conducted on 184 teeth with the diagnosis of apical periodontitis and radiographic radiolucency with diameters between 1-5 mm, measured on radiographs obtained by paralleling technique.

Inclusion criteria: teeth with necrotic pulps with chronic apical lesions or combined endo-perio lesions, the possibility to use the same treatment protocol for all cases included in the study, a control period of more than 12 months, no furcation involvement and absence of periodontal pockets of 6 mm or more.

Exclusion criteria: root canal perforations during endodontic treatment, presence of separated instruments, vertical root fractures, signs of

root resorption before or during the control period, presence of deep periodontal pockets (over 6 mm).

All patients were treated under the same conditions, regarding materials, techniques and instrumentation. The treatments were performed by postgraduate students supervised by qualified endodontists, based on the following protocol. Aseptic techniques were systematically used with rubber dam isolation, reconstruction of missing walls with glass-ionomer cement (Fuji IX, GC). The working length was measured using an apex finder (Root ZX Morita) and the canals were instrumented at a minus 0,5 mm from the apical foramen. The root canals were shaped with hand files and Protaper system and irrigated with 10-15 ml of thermo-activated (50^0C) solution of sodium hypochlorite 5,25%. For each case we used 4 radiographs: preoperative, control of working length, adaptation of the master cone and final result. The treatment was completed during the first meeting, if the tooth was asymptomatic before the appointment and if the canal was dry at the end of the preparation. If not, calcium hydroxide was introduced by using a hand or Lentullo file. The root filling was performed by cold lateral condensation technique, with Endomethasone and gutta-percha cones. As temporary coronal filling we used glass ionomer cement (Fuji IX, GC Corp). The patient was advised not to delay for more than 3 weeks the final coronal restoration of the tooth.

The outcome of the endodontic treatment was assessed based on the recommendations made by the European Society of Endodontics. Evaluation criteria: the success was recorded by clinical examination, if the tooth was asymptomatic during the control period, with no pain or tenderness during mastication of percussion: by radiological criteria, success was considered if the periapical radiolucency decreased or disappeared during the follow-up period.

The outcome of the treatment was evaluated according to the following criteria: Healed – absence of radiolucency and clinical symptoms, Under healing – reduction of radiolucency and absence of clinical symptoms, Uncertain healing – absence of clinical symptoms but unmodified or decreasing with maximum 2 mm of the radiolucency, Failure- increased lesion and/or clinical symptoms as sensitivity to percussion or swelling.

Statistical analysis. We described the study population and the bivariate association between success, diagnosis, treatment methods (use of the operating microscope) and therapy outcome. Fisher exact 2 sided test and chi square test with 5% level of statistical significance using 1 tooth as statistical unit.

Results

The groups were comparable regarding the distribution of periapical lesions diameter: in the control group 87,60% and in the study group 81,8% were between 1-4 mm, with no statistically significant difference (p=0,289). There was no difference between the groups regarding treatment status: primary treatment was recorded in 88,40 % and 85,70% respectively (p=0,623). The same results were noted regarding the age of the patients: in the control group the mean age was 43, 85+/-16,71 and in the study group it was 39,57+/-12,68 (p=0,129). The correlation between these variables are presented in Table 1.

Table 1. Correlation of variables between the control and study group

Variable	Control group	DOM group	P value
Age	43,85+/-16,71	39,57+/-12,68	P=0,129
Single- root teeth	79,30%	76,80%	P=0,472
Primary treatment	88,40%	85,70%	P= 0,623
Lesion 1-4 mm	87,60%	81,80%	P=0,289

The clinical and radiographic evaluation after 6 months was done on a total number of 96 teeth in the control group and 78 teeth in the study group, due to complications as vertical root fractures, or the fact that some patients did not respond to control appointments (Table 2).

Table 2. Treatment outcome after 6 months

Treatment outcome	Conservative (number of teeth)	Conservative	DOM (number of teeth)	DOM
Healed	66	68,75%*	63	80,77%*
Improved	18	18,75%	11	14,10%
Failed	12	12,50%	4	5,13%

The analysis made between the results of the two groups has shown a statistical significant difference of the outcomes in the 6 months control period with p=0.0151.

Table 3. Treatment outcome after 18 months

Treatment outcome	Conservative (number of teeth)	Conservative	DOM (number of teeth)	DOM
Healed	71	81,61 %**	65	89,04 %**
Improved	9	10,34 %	5	6,85 %
Failed	7	8,05 %	3	4,11 %

After 18 months the evaluation was made on 87 and 73 respectively, due to endo-periodontal lesions, coronal sub-gingival fractures or refusal to come to scheduled control visit (Table 3). At this control period the statistical analysis is more significant with p=0.0078.

Discussion

The knowledge of dental morphology, location and cleanliness of the root canal system are prerequisites for successful endodontic treatments. In order to progress in the quality of treatments, the endodontists were looking for new technologies. The operating microscope offers many benefits such as proper access cavity preparation, identification of the root canals, removal of pulpal stones or fractured instruments (Glen 2009). For these reasons, in 1998 the American Dental Association requested that all graduate programs in the United States should teach the use of the operating microscope in nonsurgical or surgical endodontics (Kim et al 2004).

The operating microscope was not immediately adopted by all endodontists, although it is now considered o powerful clinical instrument. Howard Seldon (2002) was the first who published an article about the use of the OM and discussed its use in the conventional endodontic treatment.

The use of an operating microscope had an important impact on both nonsurgical and surgical techniques in endodontics. In the former, every challenge encountered in the straight part of the root canal even in the apical third can be easily observed and managed. For the latter, the microscope allows a thorough examination of the apical part of the root, enhances apical resection with an optimal bevel and allows easy preparation of retrograde cavities (Relvas et al 2013, Tsesis et al 2006, Perrin et al 2014).

After the initial learning course, endodontic treatments can be performed in less time and procedural errors can be reduced. Microscope improves the overall treatment quality and determines endodontists to renew their concepts, resulting in a positive impact on their clinical performances (Touboul et al 2014, Castelot-Enkel et al 2013).

We used the paralleling technique for preoperative and control radiographs as we wanted to maintain the same incidence angle, meaning that the x-ray tube was placed exact over the film holder, with no mesial or distal angulation. This is a bi-dimensional evaluation of a tri-dimensional lesion and therefore the results are not always exact, but for the purpose of our research we considered it acceptable, as a Cone Bean Computed Tomography was not available.

Magnification allows the dentist to better identify anatomical landmarks within the pulp chamber, remnants of the pulp, root canal orifices and pulp stones. During instrumentation, the improved ability to see specific canals allows endodontists to handle files into the canals more efficiently (Kumar et al2013). By the high levels of light the apparent resolution is increased, which is defined as ``the ability to distinguish two objects close to each other as separate and distinct``(Carr et al 2010).

The use of the OM proved extremely important in the retreatment of 4 cases refractory to repeated antibacterial endodontic dressing with calcium

hydroxide, in which it revealed the presence of longitudinal fractures, otherwise very difficult to diagnose clinically. These teeth were considered failures and were extracted.

During this study we could noticed that the occasional or intermittent use of the OM during the endodontic treatment had a negative effect on the final result, as it increased the duration of appointments and disrupted the clinical procedures. Therefore, the operators were advised to perform the whole treatment session under microscope. It proved to be extremely useful in locating calcified or missed canals and removing obstacles from the pulp chamber or root canal system, as stones or separated instruments.

Central to the success of the microscope will be the faculty training within the dental school for both undergraduate and postgraduate students, so they will become familiarized with this technique from the very beginning.

Conclusion

According to the results of our study the success rates of endodontic treatment performed with the use of a DOM improved the results of conservative endodontic therapy of necrotic teeth with chronic apical periodontitis.

The DOM allowed a better detection and removal of residual root canal materials and ensued a proper cleaning and shaping of the whole endodontic system.

Based on the clinical experience and the results of our study, the use of an OM proves to be an essential instrument in the endodontic armamentarium of the 21st century.

High-quality endodontic therapy is the basis for long-term clinical and radiological success in endodontic treatment of necrotic teeth. State of the art equipment and thorough knowledge are very important in reaching this goal.

Based on the results of our study, we encourage dentists in general and specialists in Endodontics in particular to use this technology, as it will dramatically influence the success rate of their difficult cases.

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