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Success Rate of Endodontics Instrument Retrieval Using Magnification Devices: A Systematic Review and Meta Analysis

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Abstract---Retrieval of the broken instrument in the root canal is critical for the endodontic success. Hence in the present study we aimed to conduct a systematic review and meta-analysis to assess the success of the endodontics instrument retrieval using magnification devices. We piloted a prospective clinical trial comparing endodontic therapy performed with or without using magnification devices that was based on the clinical and radiographic estimation after a year of follow-up. The key terms searched were: “endodontic treatment, endodontic therapy, endodontic surgery, apicoectomy, periapical surgery, microscope, endoscope, loupes, magnification devices”. The

sources searched were “MEDLINE, Embase, Cochrane Oral Health Specialized Register, Cochrane Central Register of Controlled Trials”, the period of searched was from September 2009 to 2021. Statistical analysis was performed using the software Review Manager. Of 470 studies only 3 studies were finalized. No significant variation in outcomes was found among patients treated using magnifying devices. Correspondingly, no variation was found with or without using the endoscope. No comparative study on magnification devices was found regarding orthograde endodontic treatment. The efficiency of the dentist is the key factor in the retrieval of the broken instrument, rather than the magnification devices.

Keywords---magnification, apicoectomy, surgical endodontics, loupes, endoscopic devices.

Introduction

Endodontic orthograde therapy or retreatment requires good cleaning, shape, and obturation of the root canal system, whereas periradicular surgery requires correct root-end management and root-end seal. Furthermore, a thorough understanding of root canal morphology is essential, since teeth having endodontic therapy can have a broad range of anatomic variance. Microsurgical instruments and, as a result, well-focused lighting and magnification systems inside dental equipment have increased the clinician's capacity to treat elusive locations within the root canal system, boosting the effectiveness and quality of endodontic therapy.¹⁻⁴ Loupes and surgical microscopes are the most popular magnification instruments used in endodontics as well as the endoscope, which was introduced more recently. In both non-surgical and surgical endodontic treatment, working with such devices has become commonplace. These devices may increase diagnostic capabilities by improving vision of the treatment field, in addition to boosting the precision of operating operations. They enable the discovery of isthmuses, auxiliary canals, and root microfractures, for example, which would otherwise be impossible to identify and treat without sufficient magnification. Furthermore, through improving working posture, the employment of magnifying loupes and the operating microscope has been demonstrated to prevent the development of repetitive stress injuries associated to improper posture.⁵⁻¹⁵ Hence in the present study we aimed to conduct a systematic review and meta-analysis to assess the success of the endodontics instrument retrieval using magnification devices.

Materials and Methods

We piloted a prospective clinical trial comparing endodontic therapy performed with or without using magnification devices that was based on the clinical and radiographic estimation after a year of follow-up. The key terms searched were: “endodontic treatment, endodontic therapy, endodontic surgery, apicoectomy, periapical surgery, microscope, endoscope, loupes, magnification devices”. The sources searched were “MEDLINE, Embase, Cochrane Oral Health Specialized Register, Cochrane Central Register of Controlled Trials”, the period of searched

was from September 2009 to 2021. English articles were included as well as other articles of other languages that were translated. The duplicate articles were identified and excluded. Two reviewers were employed to check for the abstracts of the included articles. Disagreements were fixed by discussion. The primary goal of this systematic review was to examine if the therapy was effective on a patient-by-patient basis at 1-year and 4-year follow-up, as assessed by clinical and radiographic healing assessments. The results were categorized as “success”, “complete healing” and “incomplete healing”, “uncertain healing” and “failure”. The quality assessment was done for all the included studies.¹⁶⁻¹⁹ Along with the outcomes the following parameters were also considered Masking, randomization, sample size calculation, determined exclusion/inclusion criteria, criteria for success, case and control comparisons. The studies were categorized by the GRADE System: high, moderate, low and very low quality of evidence.²⁰ The relative risks as well as the 95% confidence intervals were calculated to estimate the effect of interventions. Clinical heterogeneity was assessed by examining the types of participants, teeth, interventions and outcomes in each study. Only if studies of similar comparisons reporting the same outcome measures were found a meta- analysis was attempted, using a random effects model. The Statistical analysis was performed using the software Review Manager (RevMan) version 4.2.9 for Windows

Results

Of the total 470 studies only 3 studies were finalized that were as per the inclusion criteria of the present study.¹¹⁻¹³ Over 150 teeth and nearly 100 patients were included in the study. Three different magnification devices were used in these three studies. They were surgical loupes, endoscope and surgical microscope. The studies were conducted during the periods 2001-04. All the patients in the study were followed for minimum of one year. Anterior teeth, premolars and molars were treated. All the three studies were of moderate to low grade however all the three studies followed the protocols to assure the quality of the study. All the patients characteristics like age etc of these three studies were comparable. When the three magnifying devices were compared we observed that there was no statistically significant difference was found for surgical treatment outcome between the case and the control groups at the end of follow up for all the three studies. In the group treated with endoscope there were two cases of uncertain healing in two patients with persistence of symptoms that were accordingly classified among unsuccessful cases. The overall success rate at the end of the follow-up was over 93%. When the three devices were compared we noted that endoscope performed slightly better than the magnifying loupes. RR for the all the three devices and the device vs the naked eye are represented in figures 1-3.

Discussion

Many studies in the endodontic literature have shown that magnification technologies such as the microscope or endoscope can identify microstructures that are not visible to the human eye. As a natural result, it's been proposed that such devices can assist improve therapeutic results, at least in principle, because all aspects of root/root-end treatment can be handled with more precision. In

contrast, as revealed in this study, prospective comparative clinical trials comparing the outcome of endodontic treatment utilising various magnification equipment are exceedingly rare.²¹⁻²⁵ The patients in this study were divided into two groups: those who were treated without magnification equipment and those who were treated using a surgical microscope. However, the surgical methods and materials used in the two groups were different. After a year of follow-up, the outcome for cases treated with the endoscope was better (but not substantially better) than control cases treated with the naked eye and micro-mirrors, according to von Arx et al.¹¹ After dichotomization according to the parameters of the current evaluation, the tooth-based success rates for this trial were 94.5 percent for the group treated with an endoscope and 88.5 percent for the group treated without magnifiers. Patients were randomised to various treatment groups in the later experiment, and the results were given on a tooth-by-tooth basis, as is the standard approach of publishing data in the endodontic literature. This mismatch was due to technical issues, since treating several teeth of the same patient with various magnification devices was problematic due to the fact that each one required a unique technical setup before surgery could begin. However, in this study, data could be analysed and presented on a patient-by-patient basis as well as using an intention-to-treat analysis. According to the findings of this randomised study, there was no significant difference in clinical outcomes between treatment groups using different types of magnification devices at any observation period. Taschieri et al. presented two publications, the first of which was a preliminary study in which no molar teeth were treated.¹³ The reasoning for this decision was that, like other new medical methods, the endoscope required training, or the so-called learning curve. During this time, the most challenging instances, such as molar teeth, were not chosen for this study because anatomical placement rendered both instrument access and optimal magnifier positioning (and, as a result, a right view angle) impossible. Following that, the endoscope was frequently utilized to treat molar teeth, and these patients were included in the second clinical report during the last year of recruiting.²⁴ The results of this study's external validity might thus be limited to anterior teeth and premolars, while the impact of utilizing a specific magnifier for the treatment of molar teeth has to be determined. More targeted research is needed to determine if the use of visual enhancers in the treatment of molar teeth is beneficial. If the number of patients and the number of teeth treated were equal, the 95 percent CIs would be smaller than they should be, further raising the risk. There has been no systematic examination of any of the secondary characteristics that may indicate a superiority of one magnification device over the others. In the absence of disparities in clinical results, a detailed assessment of these secondary characteristics might be critical in determining which magnification device to use. Despite the fact that the use of magnification equipment is an extensively discussed topic among endodontists, the general quality of research on the subject is poor, as evidenced by various evaluations targeted especially at analyzing the level of evidence in the endodontic literature. The limitation of the present study was that only three studies were compared. The included studies were also low quality. Further well designed studies are suggested to identify the advantage of the magnifying devices.

Conclusion

Within the limitations of the present study we can suggest that no apparent advantage of using a specific type of magnification device as an aid for better visualization in endodontic surgery. Significant indications in the endodontic literature derived from in vitro research or studies with low and very low evidence levels imply that using a device for visual enhancement may have many technical and therapeutic benefits in most endodontic operations. On the other hand, there is minimal evidence that using a magnification device during any endodontic operation results in a superior clinical outcome as compared to procedures conducted without them.

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