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SYSTEMATIC REVIEW

Success Rate of Contemporary Regenerative Endodontic Therapy and the Expected Outcomes of the Endodontic Microsurgery: A Systematic Review and Meta-Analysis

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ABSTRACT

Objective: To examine the level of the accumulating success of the modern Resin-Based Endodontic Surgery (RES) and comparison with Endodontic Microsurgery (EMS) and finally offer a replacement at the predicted final results of EMS. **Material and Methods:** MEDLINE, PubMed, Cochrane Library, Embase, ISI, Google Scholar have been utilized as electronic databases for systematic literature until 2019. Therefore, Endnote X9, which can be provided in the market, has been applied to manage the electronic titles. Searches have been made with keywords "Endodontic Microsurgery OR EMS ", "Resin-Based Endodontic Surgery OR RES", "Regenerative Endodontic Therapy"," Root-End Filling", "Root-End Surgery", "Periapical Surgery" and "Endodontics". Thus, this systematic review has been conducted concerning the basic investigation of the PRISMA Statement-Preferred Reporting Items designed for the Meta-analyses and Systematic Reviews. **Results:** A total of RES =19 and EMS =31 with potential pertinent abstracts and topics were discovered in manual and electronic searches. Then, three articles for RES and four studies for EMS publications satisfied our inclusion criteria necessary for systematically reviewing the studies. The analysis showed the success rate for EMS as equal to 1.16 times the probability of the success rate for RES. **Conclusion:** Micro-surgical procedures superiorly achieved the predictable high success rate for the Root-end surgery compared to conventional methods.

Keywords: Endodontics; Tooth, Nonvital; Root Canal Therapy; Root Canal Filling Materials.

Introduction

Studies showed that surgical endodontic therapy is a choice for those teeth with apical periodontitis. Therefore, it can be indicated for the tooth with unsuccessful former endodontic treatments or with a high probability of unsuccessfulness for a non-surgical procedure, wherein a biopsy would be necessary [1].

Root-end surgery is the contemporary term applied inside American affiliation of the Endodontics glossary of the Endodontic terms, which deals with the endodontic surgical procedure the use of the modern methods, regarding the root-end instruction and root-end filling, or the remaining strategies of the retrograde sealing of the root surfaces with the apical resection [2,3].

Experts in the field significantly converted a small number of dental methods into endodontic surgery. Therefore, various methods have been advised to make system procedures easier to execute, more secure for the affected person, and extra foreseeable [4]. However, over the decades, the nation of the art turned into the conventional method having surgical bur and amalgam to fill the root-end [5].

Cutting-edge techniques comprise the usage of the ultra-sonic tips and the filling substances with greater biocompatibility along with inter-mediate restorative materials [6], in fact, SuperEBA and mineral trioxide aggregates (MTA) [7].

Notably, the endodontic microsurgery (EMS) has been considered the maximum current activities within the emergence of the peri-radicular surgical operation, making use of now not handiest cutting-edge ultrasonic instruction and the filling substances; however, additionally combining microsurgical instrumentations, excessive-strength magnifications, and illuminations [2,3]. Any other technique of the bonded RES for sealing the roots end following the root resection [8,9].

If microsurgical endodontic surgical treatment strategies offer more acceptable analysis than conventional or non-microsurgical techniques, different outcomes and the possibility for achievement, with the aid of comparison of the above methods, need to be established for facilitating decisions for a higher affected person [10,11]. Thus far, no research has demonstrated increasing achievement prices for conventional and modern non-microsurgical or micro-surgical procedures. Therefore, for making an illuminated decision for medical care; however, most appropriate documents for any treatment would be suitable [2,3,12-14].

The present meta-analysis and systematic review aimed to examine the accumulating level of success of the modern RES and comparison with EMS and finally offer a replacement at the predicted final results of EMS.

Material and Methods

Search Strategy

Medline, PubMed, Cochrane Library, Embase, ISI, and Google Scholar have been utilized as electronic databases for systematic literature until 2019. According to the research design, Endnote X9 has been applied for electronically managing the titles.

The searches were made with the keywords “Endodontic Microsurgery OR EMS”, “Resin-Based Endodontic Surgery OR RES”, “Regenerative Endodontic Therapy”, “Root-End Filling”, “Root-End Surgery”, “Periapical Surgery” and “Endodontics”. The current systematic review has been accomplished based on the fundamental investigation of the PRISMA Statement-Preferred Reporting Items for the Systematic Reviews and Meta-Analysis [15].

Selection Criteria

The following inclusion criteria were adopted: 1) The randomized controlled trials, the controlled clinical trials, prospective and retrospective cohort research, clinical study; 2) Studies with sample size; 3) Follow-up comparing; 4) The level of success and failures have been assessed per tooth; 5) Radiographic parameters and clinical assessment; 6) Study about humans and 7) Publication in English.

As exclusion criteria, the following were established: 1) In vitro studies, case studies, case reports, and reviews; 2) Lack of the evaluation of the outcomes of the root-end surgical operations in the studies; 3) Outcomes have been not assessed based on the success and failures criteria mentioned previously and 4) Animal study.

Data Extraction and Method of Analysis

The following data were extracted from the research included: study, years, study design, follow-up period, sample size, success, and grouping. Success rates were analyzed by meta-analysis. Then, the forest plots have been evaluated using a software program (Comprehensive Meta-Analysis Stata V14, Biostat, Englewood, NJ, USA).

Results

A total of RES = 19 and EMS = 31 potentially pertinent abstracts and topics have been discovered via electronically and manually searching. Over the first phase of the research selection, RES = 9 and EMS = 18 research have been discarded based on abstracts and titles. Subsequently, the detailed full-text papers of other RES = 8, EMS = 12 articles have been assessed exactly. RES = 5 and EMS = 8 publications should be ignored at this phase as the mentioned papers could not met the inclusion criteria. Eventually, three papers were included in RES group and four studies in EMS group [16-22]. The papers met our review inclusion criteria (Figure 1). Tables 1 and 2 showed individual studies in this meta-analysis.

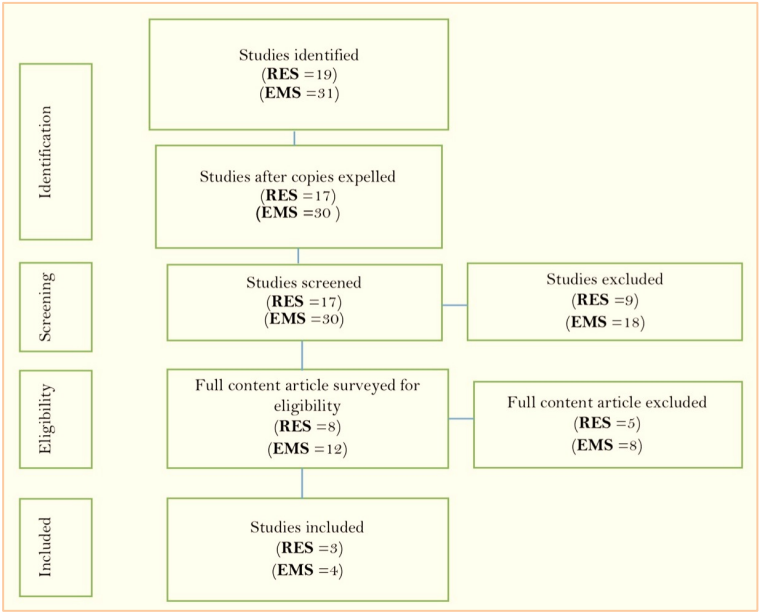


Figure 1. Study attrition diagram.

The sample size of the EMS group has been 283 cases with the success level of 93.05% (95% CI: -1.873–77.916), and in RES group, the sample size was n=456 with a success rate of 80.16 (95% CI: 13.905–

282.849). Figures 2 and 3 are the representation of the weights and levels of success in the forest plots. The analysis showed success for the EMS had been 1.16 times the success probability for RES.

Table 1. Resin-based endodontic surgery selected articles.

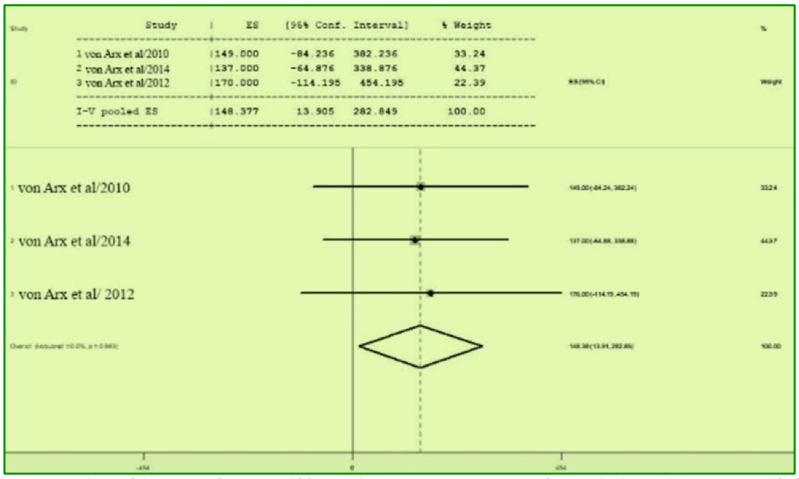
Study	Design	Follow-Up (Months)	Sample Size	Success Rate (N)	Success Rate (%)
von Arx et al. [16]	PRC	119	149	119	79.9
von Arx et al. [18]	PRC	60	137	103	75.3%
von Arx et al. [20]	PRC	60	170	145	85.3

PRC: Prospective Nonrandomized Clinical Study.

Table 2. Endodontic microsurgery selected articles.

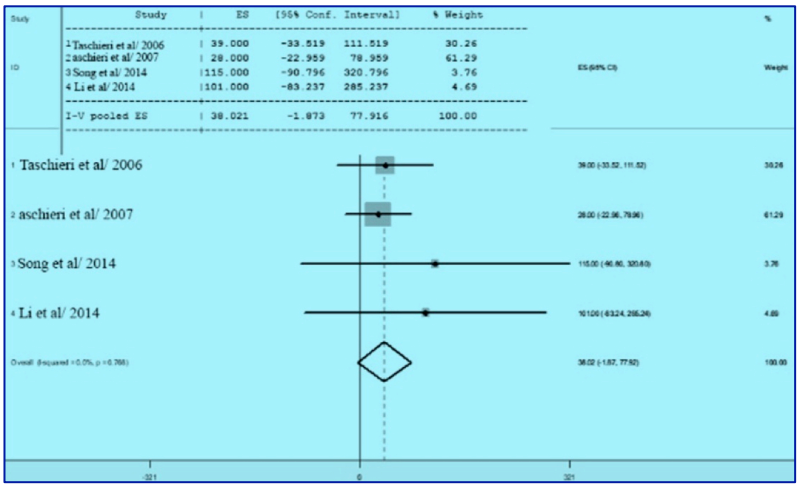
Study	Design	Follow-Up (Months)	Sample Size	Success Rate (N)	Success Rate (%)
Taschieri et al. [17]	RCT	12	39	37	94.9
Aschieri et al. [19]	PC	12	28	26	92.9
Song et al. [21]	RC	96	115	105	91.3
Li et al. [22)	RC	24	101	94	93.1

RCT: Nonrandomized Clinical Trial; PC: Prospective Case Study; RC: Retrospective Case Study.



Heterogeneity chi-squared=0.03 (df = 2) p=0.983; I-squared (variations in ES could be attributed to heterogeneity) = 0.0%; Testing ES=0: z=2.16, p=0.031.

Figure 2. Forest plots showed success rates in RES group.



Heterogeneity chi-squared=1.14 (df=3); p=0.768; I-squared (variations in the ES could be attributed to heterogeneity)=0.0%; Testing ES=0: z=1.87, p=0.062

Figure 3. The forest plots showed success rates in EMS group.

Discussion

In the present meta-analysis and systematic review, we compare the rates of success of RES and EMS. According to our findings, the success rate for EMS has been 1.16 times the probable success for RES.

Although the RES search contains only three articles compared to four articles in EMS group, the size of the sample and research quality have been compared to each different. Results of this study are consistent with another systematic research [2], in which the RES group has been composed of just three articles as compared to eleven investigations in the EMS group. The results showed that the success for the EMS had been 2.55 times the probable success for RES [2].

Studies demonstrated that the root-end sealing of the mandibular molars with the dentine-bonded resin composites would be encouraging and give 92% full healings in the cases explored between six months and twelve years post-operatively. Authors such as Rud et al. [23] and Jensen et al. showed [24] that dentin-bonded resin composite exploited over the whole, partially concave resection surfaces would be a foreseeable apical sealant described by the increased success rates. A research was developed by von Arx et al. [16] involving 353 consecutive cases with the endodontic lesions restricted to periapical areas. Notably, the root-end cavities have been procured with the sonic micro-tips, and MTA has been used to fill them (n=178); the result showed that the EMS approaches, in which MTA is the root filling substance, had a statistically significant performance with a 91.3% positive outcomes as compared to RES [16]. This study supplied the exceptional to be had documents on the possibility of successfulness for RES (80.16 %) and updated probable successfulness for EMS (93.05%).

Conclusion

Analyses revealed that using the micro-surgical procedures superiorly achieved predictable higher levels of success for the root-end surgery than the conventional procedures; therefore, it has been confirmed that probable successfulness for EMS considerably enhanced compared to probable successfulness for RES.

Authors' Contributions

GJ	https://orcid.org/0000-0002-5527-9817	Methodology, Writing - Original Draft and Writing - Review and Editing.
SJ	https://orcid.org/0000-0003-3803-1235	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing and Visualization.
NN	https://orcid.org/0000-0002-6365-6619	Formal Analysis, Writing - Original Draft and Writing - Review and Editing.
FK	https://orcid.org/0000-0003-3706-9389	Writing - Original Draft and Writing - Review and Editing.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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