JOURNAL OF COMPLEMENTARY MEDICINE RESEARCH, 2020
VOL 11, NO. 4
10.5455/jcmr.2020.11.04.08

RESEARCH ARTICLE

Open Access

Success Rate of Endodontic Treatment in Mandibular First Molar Performed in A Clinical Setup - A Retrospective Data on One Year Evaluation

Immadi Laxmi Sujith Kumar[1], Sindhu Ramesh[2*], Deepak.S[3]

[1]Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and technical Sciences , Saveetha University,Chennai, India
Email: 151906007.sdc@saveetha.com

[2]Professor, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and technical Sciences , Saveetha University, Chennai, India
Email: sindhuramesh@saveetha.com

[3]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and technical Sciences , Saveetha University, Chennai, India
Email: deepaks.sdc@saveetha.com

ABSTRACT

Conservation of a patient's natural teeth remains an important outcome in securing oral health. Endodontic treatments have been shown to successfully retain compromised teeth which are fractured, carious or traumatised. Outcomes of dental treatments as explained in the literature fall into four categories: success, survival with intervention, survival without intervention and failure. The success or failure in endodontic therapy is still problematic for the clinician. Improper mechanical debridement, persistence of bacteria in the canals and apex, poor obturation quality, over and under extension of the root canal obturating material, and coronal leakage are some of the commonly associated causes of failure. Despite the high success rate of endodontic treatment, failures do occur in a greater number of cases and most of the times can be attributed to the already stated causes. With an ever-increasing number of endodontic treatments being done each day, it has become difficult to avoid or minimize the most fundamental of reasons prominent to endodontic failure. A total of 1096 cases have been selected for the study with parameters like single visit root canal treatment, multi visit root canal treatment, and extractions. Data was collected from reviewing patient records and analysed the data between June 2019 and March 2020. In this study, we observed that root canal therapy has a success rate of 97.9% (1073 teeth) and 2.7% (23 teeth) failure in mandibular first molars (> 0.05). Within the limitations of the study, root canal therapy has a higher success rate but one cannot totally rely on one single factor that will decide the success of a treatment. More research is required with enhanced study designs before long term success rates can be correlated.

ARTICLE HISTORY

Received October 13, 2020
Accepted November 10, 2020
Published December 09, 2020

KEYWORDS

Endodontic success, failure rate, root canal therapy, mandibular molars, success rate

INTRODUCTION

Conservation of patient's natural teeth remains an important outcome in securing oral health. Endodontic management has been shown to strongly retain compromised teeth which were fractured, carious or traumatised.[1–3] However,

* **Contact**: Sindhu Ramesh, *Professor, Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and technical Sciences, Saveetha University, Chennai, India*
sindhuramesh@saveetha.com

modern developments in fixed partial dentures, implants provide greater choice for patients and clinicians and therefore the decision between a root canal therapy and fixed prosthesis is a commonly occurring dilemma in practice.[4,5]

Outcomes of dental treatment as described in the literature fall into one of the four categories: success, survival with intervention, survival without intervention and failure.[6] Most endodontic studies use the term success when defining treatment outcomes using clinical and radiographic criterion for the evaluation process. Recent studies pertaining to endodontic progress have adopted strict and lenient criterion when describing successful outcomes while complete radiographic healing and absence of any clinical signs and symptoms were characteristic of the strict category, reduction in size of radiolucency together with clinical normality defines the lenient criteria.[7–9] In contrast, most outcome studies of root canal therapy used success as the criteria. Thus the difference in methodologies and definition of outcome measures makes it difficult for the researchers. [10,11]

Regardless of the considerable number of hindrances inborn in fighting contamination in the root canal system, contemplates show a high achievement pace of endodontic treatment somewhere in the range of 85% and 95%. It is shown especially in cases where endodontic treatment is necessary in vital pulp, where the infection is confined to the pulp chamber.[12–14] Although endodontic treatment is an anticipated procedure with high success rates, failure can occur either through perpetual infection or through recontamination of the root canal system at some time after endodontic treatment.[15–17] Assessment of success or failure in endodontic therapy is still problematic for the clinician. The success rate in the literature varies from 70% to 97%. [18,19]

Seltzer et al., 1988 expressed that there is no clear definition of what constitutes success or failure in endodontic treatment. Many consider that the retention of a tooth without an associated sinus, swelling, pain or discomfort is a success, even though the radiographic appearance may not be satisfactory.[20,21] Others maintain that in addition to the absence of clinical signs or symptoms there must be evidence of complete bone repair, which would be demonstrated radiographically. Further confusion emanates from experimental work on bone which has shown that an average of 7.1% mineral bone loss must occur together with a loss of cortical plate for periapical lesion to present itself radiographically.[22,23] Since so much bone loss occur before visual differentiation is possible on a radiograph. It is probably that some teeth which are both clinically symptomless and normal radiographic appearance may, nonetheless, have either early or residual pathological change.

The usual factors which can be attributed to endodontic failure are:

- Persistence of bacteria (intra-canal and extra-canal)
- Inadequate filling of the canal (canals that are poorly cleaned and obturated)
- Overextensions of root filling materials
- Improper coronal seal (leakage)
- Untreated canals (both major and accessory)
- Iatrogenic procedural errors such as poor access cavity design
- Complications of instrumentation (ledges, perforations, or separated instruments).

Therefore, it is of interest to know the success of endodontic treatments performed. Previously our team had conducted numerous clinical trials and lab studies and in-vitro studies [24–39] over the past 5 years. We have shifted our focus to this retrospective analysis. The aim of present study is to assess the success rate of endodontic treatment.

MATERIAL AND METHODS

Study Design

Single centered retrospective study.

Ethical Approval

Approval for the project was obtained from the Institutional Review Board of Saveetha Institute of Medical and Technical Sciences, Chennai, India on Date 18/04/2020. SDC/SIHEC/2020/DIASDATA/0619-0320.

Eligibility Criteria

Inclusive criteria

Included patients of age group of 18 to 60 years, mandibular first molar

Exclusive criteria

Consisted of patients of age group more than 60 years, primary teeth, teeth other than mandibular first molars , teeth extracted other than root canal failure.

Data Extraction

This retrospective study was based on patient records collected by reviewing data from June 2019 to March 2020. Retrospective data was collected based on the root canal therapy done in the mandibular first molars. The final data was exported to excel and saved on a secure server for analysis. The case selection for the study is shown in (Flow chart 1).

Sample Size

A total of 8688 clinical cases were evaluated in which 4841 cases were multi visit root canal treatment and 3847 cases were single visit root canal treatment . After the exclusion and inclusion criteria a total of 1096 cases have been included in the study.

Groups

The root canal treatment of a tooth can be divided into two groups

Group A : Success

Group B : Failure

The mandibular molars are divided into

Group A : 36

Group B : 46

Visits for root canal treatment can be divided into

Group A : Multi visit

Group B : Single visit

Clinical Protocol

The clinical protocol for patients undergoing root canal procedures is to access the pulp status by pulp vitality tests, clinical and radiographic findings. After diagnostic procedures, access cavity preparation is made, cleaning and shaping of the root canal is done followed by oburation using sealer and coronal sealing given.

Study Outcome

Success rate is assessed based on clinical examination, the tooth either did or did not show symptoms such as pain, swelling, or tenderness to apical and gingival palpation or percussion. In the radiographic examination, filling was successful (1) if the periodontal ligament space was normal on the original diagnostic radiograph it remained unchanged, or (2) there was healing of a radiolucent area visible on the original preoperative radiograph and the periodontal ligament space had returned to normal or there was clear evidence of a reduction in size of the lesion.

STATISTICAL ANALYSIS

The data was imported from Excel for analysis and grouping of parameters was done. The parameters data was then copied into SPSS software and statistical analysis was done. Chi square test was used for statistical analysis. All analyses were performed using statistical software (SPSS inc., version 20, chicago, IL, USA) and p value less than 0.05 was considered statistically significant.

RESULTS & DISCUSSION

The failure of root canal treatment was taken into account by extraction performed in the same tooth. The frequency of patients who have undergone root canal treatment of mandibular molars across various age groups is shown in (Table 1). In this age group of 18-30 years showed higher percentage(43.5%).The frequency of root canal treatment of mandibular first molar amongst gender is shown in (Table 2). Males are higher in number for root canal treatment performed for mandibular first molar(58.8%). The frequency of multi visit and single visit root canal treatment of mandibular first molar is shown in (Table 3) with multi visit root canal treatment is the highest (65.9). Frequency of root canal treatment for right and left molars is shown in (Table 4). Frequency of success and failure is shown in (Table 5). In this study we observed that root cal therapy has a success rate of 97.9% (1073 teeth) and 2.7% (23 teeth) failure in mandibular molars. (P value >0.05). The multi visit root canal treatment showed a higher success rate has been performed greater in number than single visit. The association between success rate and visit of root canal treatment is shown in (Figure 1). The association between teeth number and success of root canal treatment is shown in (Figure 2).

The scientific technological advance in endodontics in recent years has been increasing the frequency of success of the treatment of root canals.[22,40,41] The absence of spontaneous and provoked painful symptomatology, hermetic sealing, dental element rehabilitated in masticatory function, and the repair of the apical and peripheral tissue are clinical criteria of success in endodontic therapy.[42–48] When failure shows, it is closely related to the persistence of microorganisms after endodontic obturation and infection due to lack of coronary sealing.[49–52] Endodontic treatment is not terminated with obturation of the root canal system. Clinical and radiographic control (preservation) is extremely important for the longevity of therapy, once any alteration is detected, endodontic treatment is indicated, as long as it is able to be performed.[53–56]

The results of the present study showed the annual failure rate of the root canal treatment was 2.1% and success rate was around 97.9%. So, this would justify that the reasons for extractions would be patient or operator or protocol based. The assessment criteria for the present study were in similar norms with the ESE guidelines.

The European Society of Endodontics recommends that radiographs of control ought to be taken for in any event 1 year after the endodontic treatment is finished and that ensuing radiographs are taken, if fundamental. In view of the difficulty of performing the histopathological analysis of the periapical lesion, clinical and radiographic reservation should be encouraged by the professional for the period of 2 to 4 years.[50,57] In the present study, only the extraction of the root canal treated tooth has been taken in consideration. The success of endodontic

treatment is closely related to the condition of pulp tissue. In the radical treatment of inflamed vital pulp, the infection when present is restricted to the pulp chamber and cervical third of the root canal system and the periradicular tissues are not infected. Thus, a high success rate is found for endodontic treatments with vital pulp when compared to the treatment of necrotic pulp and retreatment.[58–65]

In this study, success rate was higher for multivist root canal treatment , because of calcium hydroxide dressing, which eliminates the endodontic microflora. Age group of 18 to 30 years also showed higher success rate because of age factor which helps in defence against microorganisms and faster healing capacity. Coronal seal was found to significantly affect the outcome of endodontic treatment. When teeth were restored with coronal coverage, a higher success rate was shown as compared to those without coronal coverage,[66–71] the extraction of the endodontically treated teeth without coronal restorations was greater than those with crowns.[72–74]

Treatment given by specialists and the undergraduates both yielded higher achievement rates. This was justified by that, the undergraduates were increasingly cautious and followed protocols during treatment of progressively complex molars.[7,75,76] In the past studies it was expressed that specialists can make higher progress rates than those accomplished by undergraduate students.[77]

CONCLUSION

From the present study it can be concluded that the success rates of primary root canal treatment was around 97.9% in mandibular first molars with an annual failure rate of 2.1%. So in a clinical setup primary root canal treatment showed higher success rates.

Limitations

The limitations of this study was, it has a small sample size. Cannot be generalized to the whole population using this data. The period of evaluation was also very less.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

ACKNOWLEDGEMENT

With Sincere gratitude, we acknowledge the staff members of the department of Conservative Dentistry and Endodontics, Saveetha Dental College and study participants for their extended support towards the completion of research.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil

AUTHOR CONTRIBUTIONS

Immadi Laxmi Sujith Kumar carried out the retrospective study, participated in sequence alignment, statistical analysis and drafted the manuscript. Sindhu Ramesh conceived the study, participated in its design and provided the guidance to draft the manuscript. All authors read and approved the manuscript.

CONFLICT OF INTEREST

All authors stated no conflict of interest in the present study

REFERENCES

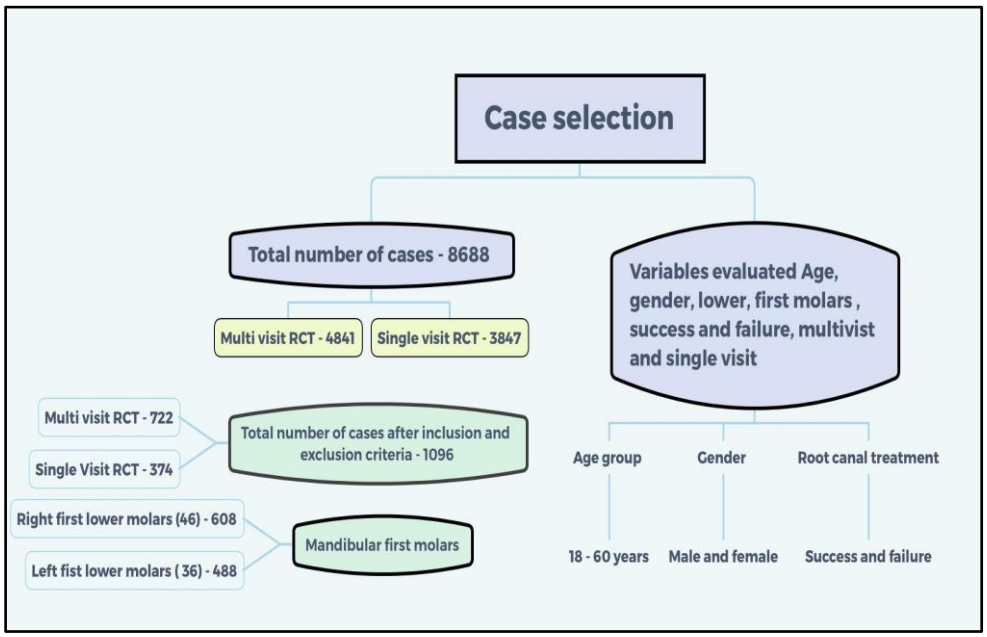
1. Mordohai N, Reshad M, Jivraj S, Chee W. Factors that affect individual tooth prognosis and choices in contemporary treatment planning. Br Dent J. 2007 Jan 27;202(2):63–72.
2. Rajakeerthi R, Ms N. Natural Product as the Storage medium for an avulsed tooth – A Systematic Review. Cumhuriyet Dental Journal. 2019 Jun 11;22(2):249–56.
3. Jose J, P. A, Subbaiyan H. Different Treatment Modalities followed by Dental Practitioners for Ellis Class 2 Fracture – A Questionnaire-based Survey. TODENTJ. 2020 Feb 18;14(1):59–65.
4. Torabinejad M, Anderson P, Bader J, Jackson Brown L, Chen LH, Goodacre CJ, et al. Outcomes of root canal treatment and restoration, implant-supported single crowns, fixed partial dentures, and extraction without replacement: A systematic review [Internet]. Vol. 98, The Journal of Prosthetic Dentistry. 2007. p. 285–311. Available from: http://dx.doi.org/10.1016/s0022-3913(07)60102-4
5. Rajendran R, Kunjusankaran RN, Sandhya R, Anilkumar A, Santhosh R, Patil SR. Comparative Evaluation of Remineralizing Potential of a Paste Containing Bioactive Glass and a Topical Cream Containing Casein Phosphopeptide-Amorphous Calcium Phosphate: An in Vitro Study. Pesqui Bras Odontopediatria Clin Integr. 2019;19(1):1–10.
6. Doyle SL, Hodges JS, Pesun IJ, Law AS, Bowles

WR. Retrospective cross sectional comparison of initial nonsurgical endodontic treatment and single-tooth implants. J Endod. 2006 Sep;32(9):822–7.
7. Friedman S, Abitbol S, Lawrence H. Treatment Outcome in Endodontics: The Toronto Study. Phase 1: Initial Treatment [Internet]. Vol. 29, Journal of Endodontics. 2003. p. 787–93. Available from: http://dx.doi.org/10.1097/00004770-200312000-00001
8. Ng Y-L, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature - part 1. Effects of study characteristics on probability of success. Int Endod J. 2007 Dec;40(12):921–39.
9. Ng Y-L, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature – Part 2. Influence of clinical factors [Internet]. Vol. 0, International Endodontic Journal. 2007. p. 071011095702005 – ??? Available from: http://dx.doi.org/10.1111/j.1365-2591.2007.01323.x
10. Hannahan JP, Eleazer PD. Comparison of success of implants versus endodontically treated teeth. J Endod. 2008 Nov;34(11):1302–5.
11. Hannahan JP, Eleazer PD. Comparision of success of implants versus endodontically treated teeth [Internet]. Vol. 17, Primary Dental Care. 2010. p. 44–44. Available from: http://dx.doi.org/10.1308/135576110790307618
12. Swartz DB, Skidmore AE, Griffin JA Jr. Twenty years of endodontic success and failure. J Endod. 1983 May;9(5):198–202.
13. Sjögren U, Hägglund B, Sundqvist G, Wing K. Factors affecting the long-term results of endodontic treatment [Internet]. Vol. 16, Journal of Endodontics. 1990. p. 498–504. Available from: http://dx.doi.org/10.1016/s0099-2399(07)80180-4
14. Smith CS, Setchell DJ, Harty FJ. Factors influencing the success of conventional root canal therapy--a five-year retrospective study. Int Endod J. 1993 Nov;26(6):321–33.
15. Salehrabi R, Rotstein I. Endodontic treatment outcomes in a large patient population in the USA: an epidemiological study. J Endod. 2004 Dec;30(12):846–50.
16. Siqueira JF, Rôças IN. Present status and future directions in endodontic microbiology [Internet]. Vol. 30, Endodontic Topics. 2014. p. 3–22. Available from: http://dx.doi.org/10.1111/etp.12060
17. Ramamoorthi S, Nivedhitha MS, Divyanand MJ. Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial. Aust Endod J. 2015 Aug;41(2):78–87.
18. Heling B, Tamshe A. Evaluation of the success of endodontically treated teeth [Internet]. Vol. 30, Oral Surgery, Oral Medicine, Oral Pathology. 1970. p. 533–6. Available from: http://dx.doi.org/10.1016/0030-4220(70)90171-4
19. Ashkenaz PJ. One-visit endodontics--a preliminary report. Dent Surv. 1979 Jan;55(1):62–7.
20. Seltzer S, Krasner P. Endodontology 2 Ed: Biologic considerations in endodontic procedures. Lea & Febiger; 1988. 566 p.
21. Ehrmann EH. Endodontology - Biologic Considerations in Endodontic Procedures: S. Seltzer [Internet]. Vol. 15, Australian Endodontic Newsletter. 2010. p. 14–5. Available from: http://dx.doi.org/10.1111/j.1747-4477.1990.tb00254.x
22. Hepworth MJ, Friedman S. Treatment outcome of surgical and non-surgical management of endodontic failures. J Can Dent Assoc. 1997 May;63(5):364–71.
23. Nandakumar M, Nasim I. Comparative evaluation of grape seed and cranberry extracts in preventing enamel erosion: An optical emission spectrometric analysis. J Conserv Dent. 2018 Sep;21(5):516–20.
24. Robert R, Justin Raj C, Krishnan S, Jerome Das S. Growth, theoretical and optical studies on potassium dihydrogen phosphate (KDP) single crystals by modified Sankaranarayanan–Ramasamy (mSR) method [Internet]. Vol. 405, Physica B: Condensed Matter. 2010. p. 20–4. Available from: http://dx.doi.org/10.1016/j.physb.2009.08.015
25. Sahu D, Kannan GM, Vijayaraghavan R. Size-dependent effect of zinc oxide on toxicity and inflammatory potential of human monocytes. J Toxicol Environ Health A. 2014;77(4):177–91.
26. Suresh P, Marimuthu K, Ranganathan S, Rajmohan T. Optimization of machining parameters in turning of Al-SiC-Gr hybrid metal matrix composites using grey-fuzzy algorithm [Internet]. Vol. 24, Transactions of Nonferrous Metals Society of China. 2014. p. 2805–14. Available from: http://dx.doi.org/10.1016/s1003-6326(14)63412-9
27. DeSouza SI, Rashmi MR, Vasanthi AP, Joseph SM, Rodrigues R. Mobile phones: the next step

towards healthcare delivery in rural India? PLoS One. 2014 Aug 18;9(8):e104895.
28. Sekhar CH, Narayanan V, Baig MF. Role of antimicrobials in third molar surgery: prospective, double blind,randomized, placebo-controlled clinical study. Br J Oral Maxillofac Surg. 2001 Apr;39(2):134–7.
29. Chellaswamy C, Ramesh R. Parameter extraction of solar cell models based on adaptive differential evolution algorithm [Internet]. Vol. 97, Renewable Energy. 2016. p. 823–37. Available from: http://dx.doi.org/10.1016/j.renene.2016.06.024
30. Danda AK, Muthusekhar MR, Narayanan V, Baig MF, Siddareddi A. Open versus closed treatment of unilateral subcondylar and condylar neck fractures: a prospective, randomized clinical study. J Oral Maxillofac Surg. 2010 Jun;68(6):1238–41.
31. Samuel MS, Bhattacharya J, Raj S, Santhanam N, Singh H, Pradeep Singh ND. Efficient removal of Chromium(VI) from aqueous solution using chitosan grafted graphene oxide (CS-GO) nanocomposite. Int J Biol Macromol. 2019 Jan;121:285–92.
32. Lakshmanan A, Bhaskar RS, Thomas PC, Satheesh Kumar R, Siva Kumar V, Jose MT. A red phosphor for nUV LED based on (Y,Gd)BO3:Eu3 [Internet]. Vol. 64, Materials Letters. 2010. p. 1809–12. Available from: http://dx.doi.org/10.1016/j.matlet.2010.05.034
33. Venu H, Subramani L, Dhana Raju V. Emission reduction in a DI diesel engine using exhaust gas recirculation (EGR) of palm biodiesel blended with TiO2 nano additives [Internet]. Vol. 140, Renewable Energy. 2019. p. 245–63. Available from: http://dx.doi.org/10.1016/j.renene.2019.03.078
34. Manimaran G, Pradeep kumar M, Venkatasamy R. Influence of cryogenic cooling on surface grinding of stainless steel 316 [Internet]. Vol. 59, Cryogenics. 2014. p. 76–83. Available from: http://dx.doi.org/10.1016/j.cryogenics.2013.11.005
35. Neelakantan P, Varughese AA, Sharma S, Subbarao CV, Zehnder M, De-Deus G. Continuous chelation irrigation improves the adhesion of epoxy resin-based root canal sealer to root dentine. Int Endod J. 2012 Dec;45(12):1097–102.
36. Babu MN, Naresh Babu M, Muthukrishnan N. Investigation on Surface Roughness in Abrasive Water-Jet Machining by the Response Surface Method [Internet]. Vol. 29, Materials and Manufacturing Processes. 2014. p. 1422–8. Available from: http://dx.doi.org/10.1080/10426914.2014.952020
37. Panda S, Doraiswamy J, Malaiappan S, Varghese SS, Del Fabbro M. Additive effect of autologous platelet concentrates in treatment of intrabony defects: a systematic review and meta-analysis. J Investig Clin Dent. 2016 Feb;7(1):13–26.
38. Adalarasan R, Santhanakumar M, Rajmohan M. Optimization of laser cutting parameters for Al6061/SiCp/Al2O3 composite using grey based response surface methodology (GRSM) [Internet]. Vol. 73, Measurement. 2015. p. 596–606. Available from: http://dx.doi.org/10.1016/j.measurement.2015.06.003
39. Rajeshkumar S, Kumar SV, Ramaiah A, Agarwal H, Lakshmi T, Roopan SM. Biosynthesis of zinc oxide nanoparticles usingMangifera indica leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells. Enzyme Microb Technol. 2018 Oct;117:91–5.
40. Kishen A, Peters OA, Zehnder M, Diogenes AR, Nair MK. Advances in endodontics: Potential applications in clinical practice. J Conserv Dent. 2016 May;19(3):199–206.
41. Gambarini G, Seracchiani M, D'Angelo M, Reda R, Testarelli L. Future Trends in Endodontics: From the Virtual Assessment of the Anatomy to the Computer-driven Approach. J Contemp Dent Pract. 2020 Jan 1;21(1):1.
42. Uraba S, Ebihara A, Komatsu K, Ohbayashi N, Okiji T. Ability of Cone-beam Computed Tomography to Detect Periapical Lesions That Were Not Detected by Periapical Radiography: A Retrospective Assessment According to Tooth Group. J Endod. 2016 Aug;42(8):1186–90.
43. Tanomaru JMG, Leonardo MR, Tanomaru Filho M, Bonetti Filho I, Silva LAB. Effect of different irrigation solutions and calcium hydroxide on bacterial LPS [Internet]. Vol. 36, International Endodontic Journal. 2003. p. 733–9. Available from: http://dx.doi.org/10.1046/j.1365-2591.2003.00717.x
44. Leonardo MR, Salgado AA, da Silva LA, Tanomaru Filho M. Apical and periapical repair of dogs' teeth with periapical lesions after endodontic treatment with different root canal sealers. Pesqui Odontol Bras. 2003 Jan;17(1):69–74.
45. Noor SSSE, Pradeep. Chlorhexidine: Its properties and effects. Intern Jour Contemp Microbiol. 2016;9(10):1755.
46. Teja KV, Ramesh S, Priya V. Regulation of matrix metalloproteinase-3 gene expression

in inflammation: A molecular study. J Conserv Dent. 2018 Nov;21(6):592–6.
47. Khirtika SG, Ramesh S. Comparative evaluation of dentinal cracks and detachments after instrumentation with hand and rotary files at various instrumentation lengths: An in vitro study. Journal of Advanced Pharmacy Education & Research| Jul-Sep. 2017;7(3).
48. Auswin MK, Ramesh S. Truss access new conservative approach on access opening of a lower molar: A case report. Journal of Advanced Pharmacy [Internet]. 2017; Available from: https://www.researchgate.net/profile/Sindhu_Ramesh2/publication/322919550_Truss_access_new_conservative_approach_on_access_opening_of_a_lower_molar_A_case_report/links/5b39e3f44585150d23ee1cd1/Truss-access-new-conservative-approach-on-access-opening-of-a-lower-molar-A-case-report.pdf
49. Tabassum S, Khan FR. Failure of endodontic treatment: The usual suspects [Internet]. Vol. 10, European Journal of Dentistry. 2016. p. 144–7. Available from: http://dx.doi.org/10.4103/1305-7456.175682
50. Demeter A, Bogdán S, Tóth Z, Nemes J. [Complex treatment of a large radicular cyst due to traumatic dental injury--a case report]. Fogorv Sz. 2014 Mar;107(1):29–33.
51. Ramanathan S, Solete P. Cone-beam Computed Tomography Evaluation of Root Canal Preparation using Various Rotary Instruments: An in vitro Study. J Contemp Dent Pract. 2015 Nov 1;16(11):869–72.
52. Siddique R, Sureshbabu NM, Somasundaram J, Jacob B, Selvam D. Qualitative and quantitative analysis of precipitate formation following interaction of chlorhexidine with sodium hypochlorite, neem, and tulsi. J Conserv Dent. 2019 Jan;22(1):40–7.
53. Travassos RMC, Caldas A de FJ, de Albuquerque DS. Cohort study of endodontic therapy success. Braz Dent J. 2003;14(2):109–13.
54. Cheung GSP. Survival of first-time nonsurgical root canal treatment performed in a dental teaching hospital [Internet]. Vol. 93, Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2002. p. 596–604. Available from: http://dx.doi.org/10.1067/moe.2002.120254
55. Friedman S. Prognosis of initial endodontic therapy [Internet]. Vol. 2, Endodontic Topics. 2002. p. 59–88. Available from: http://dx.doi.org/10.1034/j.1601-1546.2002.20105.x
56. Alley BS, Gray Kitchens G, Alley LW, Eleazer PD. A comparison of survival of teeth following endodontic treatment performed by general dentists or by specialists [Internet]. Vol. 98, Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2004. p. 115–8. Available from: http://dx.doi.org/10.1016/j.tripleo.2004.01.004
57. Torabinejad M, Kutsenko D, Machnick TK, Ismail A, Newton CW. Levels of evidence for the outcome of nonsurgical endodontic treatment. J Endod. 2005 Sep;31(9):637–46.
58. Ricucci D, Siqueira JF, Li Y, Tay FR. Vital pulp therapy: histopathology and histobacteriology-based guidelines to treat teeth with deep caries and pulp exposure [Internet]. Vol. 86, Journal of Dentistry. 2019. p. 41–52. Available from: http://dx.doi.org/10.1016/j.jdent.2019.05.022
59. Aguilar P, Linsuwanont P. Vital Pulp Therapy in Vital Permanent Teeth with Cariously Exposed Pulp: A Systematic Review [Internet]. Vol. 37, Journal of Endodontics. 2011. p. 581–7. Available from: http://dx.doi.org/10.1016/j.joen.2010.12.004
60. Lazarski M, Walkeriii W, Flores C, Schindler W, Hargreaves K. Epidemiological Evaluation of the Outcomes of Nonsurgical Root Canal Treatment in a Large Cohort of Insured Dental Patients [Internet]. Vol. 27, Journal of Endodontics. 2001. p. 791–6. Available from: http://dx.doi.org/10.1097/00004770-200112000-00021
61. Imura N, Pinheiro ET, Gomes BPFA, Zaia AA, Ferraz CCR, Souza-Filho FJ. The outcome of endodontic treatment: a retrospective study of 2000 cases performed by a specialist. J Endod. 2007 Nov;33(11):1278–82.
62. Kumar D, Antony SDP. Calcified Canal and Negotiation-A Review. J Adv Pharm Technol Res. 2018;11(8):3727.
63. Janani K, Palanivelu A, Sandhya R. Diagnostic accuracy of dental pulse oximeter with customized sensor holder, thermal test and electric pulp test for the evaluation of pulp vitality - An in vivo study. BDS [Internet]. 2020 Jan 31;23(1). Available from: https://bds.ict.unesp.br/index.php/cob/article/view/1805
64. Teja KV, Ramesh S. Shape optimal and clean more. Saudi Endodontic Journal. 2019 Sep 1;9(3):235.
65. Hussainy SN, Nasim I, Thomas T, Ranjan M. Clinical performance of resin-modified glass

ionomer cement, flowable composite, and polyacid-modified resin composite in noncarious cervical lesions: One-year follow-up. J Conserv Dent. 2018 Sep;21(5):510–5.
66. Nagasiri R, Chitmongkolsuk S. Long-term survival of endodontically treated molars without crown coverage: a retrospective cohort study. J Prosthet Dent. 2005 Feb;93(2):164–70.
67. Mclntyre FM. Long-term Survival of Endodontically Treated Molars Without Crown Coverage: A Retrospective Cohort Study [Internet]. Vol. 2006, Yearbook of Dentistry. 2006. p. 64–6. Available from: http://dx.doi.org/10.1016/s0084-3717(08)70057-6
68. Bin Hassan SA. [No title] [Internet]. [cited 2020 May 31]. Available from: https://www.researchgate.net/profile/Saeed_Bin_Hassan/publication/270904346_Restorations_and_Survivability_of_Endodontically_Treated_Teeth/links/54b986070cf24e50e93dc785/Restorations-and-Survivability-of-Endodontically-Treated-Teeth.pdf
69. Hatzikyriakos AH, Reisis GI, Tsingos N. A 3-year postoperative clinical evaluation of posts and cores beneath existing crowns. J Prosthet Dent. 1992 Apr;67(4):454–8.
70. Ravinthar K, Jayalakshmi. Recent Advancements in Laminates and Veneers in Dentistry. J Adv Pharm Technol Res. 2018;11(2):785.
71. Manohar MP, Sharma S. A survey of the knowledge, attitude, and awareness about the principal choice of intracanal medicaments among the general dental practitioners and nonendodontic specialists. Indian J Dent Res. 2018 Nov;29(6):716–20.
72. Caplan DJ, Weintraub JA. Factors related to loss of root canal filled teeth. J Public Health Dent. 1997 Winter;57(1):31–9.
73. Stavropoulou AF, Koidis PT. A systematic review of single crowns on endodontically treated teeth. J Dent. 2007 Oct;35(10):761–7.
74. Tikku A, Chandra A, Bharti R. Are full cast crowns mandatory after endodontic treatment in posterior teeth? [Internet]. Vol. 13, Journal of Conservative Dentistry. 2010. p. 246. Available from: http://dx.doi.org/10.4103/0972-0707.73382
75. Tanalp J, Güven EP, Oktay I. Evaluation of dental students' perception and self-confidence levels regarding endodontic treatment. Eur J Dent. 2013 Apr;7(2):218–24.
76. Awooda E, Mudathir M, Mahmoud S. Confidence level in performing endodontic treatment among final year undergraduate dental students from the University of Medical Science and Technology, Sudan (2014) [Internet]. Vol. 6, Saudi Endodontic Journal. 2016. p. 26. Available from: http://dx.doi.org/10.4103/1658-5984.172000
77. Luz D dos S, Ourique F de S, Scarparo RK, Vier-Pelisser FV, Morgental RD, Waltrick SBG, et al. Preparation time and perceptions of Brazilian specialists and dental students regarding simulated root canals for endodontic teaching: a preliminary study. J Dent Educ. 2015;79(1):56–63.



Flow Chart 1 : Case Selection for the Study

Table 1: Frequency of patients underwent root canal treatment of mandibular first molars across various age groups, which shows that 18-30 years group has undergone more number of root canal treatment (43.5%) and 51-60 years age group has undergone least number of root canal treatment(7.7%).

Age	Frequency	Percent	Valid Percent	Cumulative Percent
18-30 years	477	43.5	43.5	43.5
31-40 years	357	32.6	32.6	76.1
41-50 years	178	16.2	16.2	92.3
51-60 years	84	7.7	7.7	100.0
Total	1096	100.0	100.0	

Table 2: Frequency of root canal treatment of mandibular first molar amongst gender, which shows that males have undergone more number of root canal treatment (58.8%) than females (41.2%)

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	452	41.2	41.2	41.2
Male	644	58.8	58.8	100.0
Total	1096	100.0	100.0	

Table 3: Frequency of mutivist and single visit root canal treatment of mandibular first molar, which shows multi visit root canal treatment are more (65.9%) than single visit root canal treatment(34.1%)

Visit	Frequency	Percent	Valid Percent	Cumulative Percent
Multi visit root canal treatment	722	65.9	65.9	65.9
Single visit root canal treatment	374	34.1	34.1	100.0
Total	1096	100.0	100.0	

Table 4: Frequency of Root Canal Treatment done in Mandibular Right and Left Molar, which shows 46(mandibular right first molar) has undergone more number of root canal treatments (55.5%) than 36(mandibular left first molar) (44.5%).

Mandibular first molar	Frequency	Percent	Valid Percent	Cumulative Percent
36	488	44.5	44.5	44.5
46	608	55.5	55.5	100.0
Total	1096	100.0	100.0	

Table 5: Frequency of success and failure of root canal treatment, which shows the root canal has a success rate of 97.9% and failure of 2.1%

Root Canal treatment	Frequency	Percent	Valid Percent	Cumulative Percent
failure	23	2.1	2.1	2.1
success	1073	97.9	97.9	100.0
Total	1096	100.0	100.0	

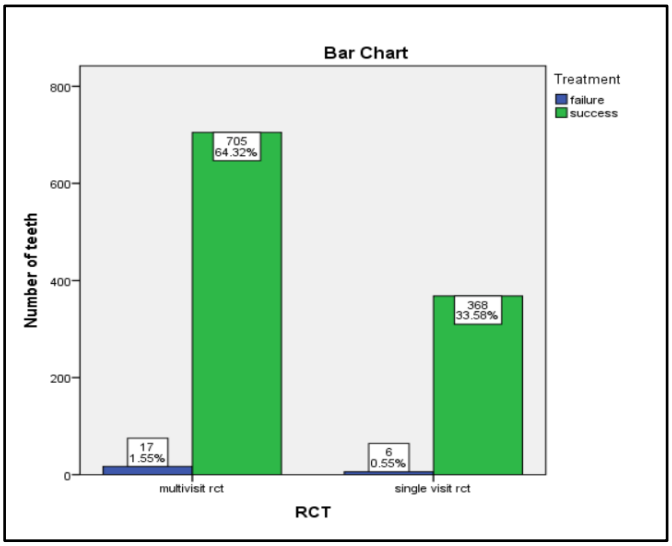


Figure 1: Bar chart showing association between success and failure for multi visit and single visit root canal treatment. X axis represents root canal treatment and y axis represents the number of teeth. Success (green), failure (red) where multi visit RCT showed higher success than single visit RCT. The association was analysed using Chi square test (0.025), p value - 0.509(>0.05) and was found there is no statistical significance.

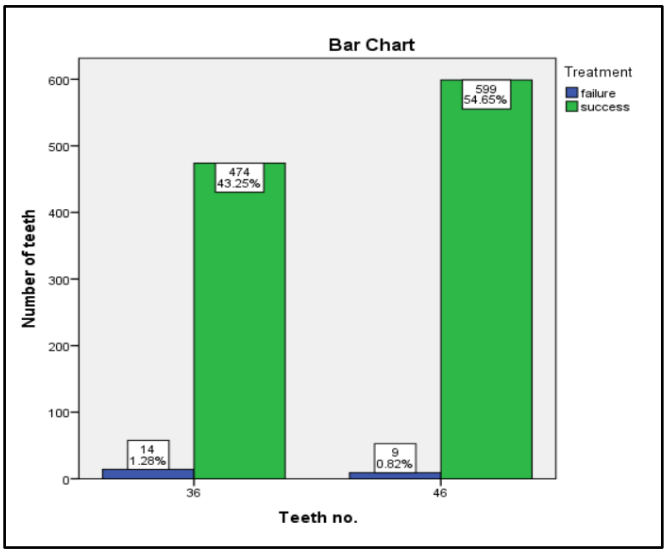


Figure 2: Bar chart showing association between success and failure for mandibular first molars. X axis represents teeth number and y axis represents the number of teeth. Success (green), failure (red) where 46 showed higher success than 36. The association was analysed using Chi square test (0.048), p value - 0.138(>0.05) and was found there is no statistical significance.