

The outcome of single-visit nonsurgical retreatment and patients' perception of retreatment: a retrospective cohort study with 1-year follow-up

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ABSTRACT

Aim: To evaluate the outcome of single visit nonsurgical retreatment by clinical examination and PAI (Periapical Index) and, patients' feedback regarding the nonsurgical retreatment after 1 year.

Material and Method: 115 patients who previously had nonsurgical retreatment were recalled after 1 year and after dropouts, 84 patients were examined clinically and radiographical examinations were completed pre-and postoperatively using Periapical Index. Patients were also asked if they would still choose nonsurgical retreatment for teeth with previously failed root canal treatment.

Results: The healing rate after 1 year was 88%. The tooth type did not influence the outcome ($p=0.756$). While the failure rate was lower in males (3.3%) than in females (16.7%), gender did not affect the outcome ($p=0.088$). 97.6% of patients had a positive approach to nonsurgical retreatment. There was a statistically significant relationship between treatment outcome and patients' feedback ($p=0.013$). There is a statistically significant positive correlation between postoperative VAS (Visual Analogue Scale) pain score and postoperative PAI score ($p=0.002$).

Conclusion: Single-visit nonsurgical retreatment is a viable option for teeth where certain periapical diseases such as symptomatic apical abscess are excluded. Patients, who experienced successful nonsurgical retreatment, are eager to preserve their tooth with failed primary root canal treatment when nonsurgical retreatment option is available.

Keywords: Nonsurgical retreatment, periapical index, root canal treatment

INTRODUCTION

In the case of post-treatment disease, previously root canal-treated teeth require either nonsurgical retreatment or surgical intervention (1). To retain masticatory function and to avoid further destruction of surrounding tissues and possible acute exacerbation, nonsurgical retreatment of teeth with failed post-treatment should be the first option when it is deemed as a viable option. According to the consensus report of the ESE (European Society of Endodontology), nonsurgical retreatment is indicated for teeth with inadequate root canal filling and apical periodontitis and/or symptoms (2).

During endodontic nonsurgical retreatment, clinical steps are repair of perforations, locating the previously missed root canals, shaping and disinfection of the entire canal system, and obturation respectively (1). Although cleaning, shaping, and disinfection do not differ from primary root

canal treatment, locating and treating the missed portions of root canal anatomy, removing separated instruments, and bypassing the ledges can be very challenging. However, the complete healing rates of nonsurgical retreatment range from 74%-98% (3).

The outcome of root canal treatment should be monitored at least after 1 year and subsequently as required to assess the healing process. European Society of Endodontology (ESE) classifies 'favorable outcome' when pain, swelling, sinus tract, and, loss of function are absent and normal periodontal ligament space around the root is radiologically indicated (2). Progression or resolution of periapical inflammation can be evaluated by observing bone density changes from periapical radiographs. Periapical index (PAI) consists of a 5-point scale ranging from 'healthy' to 'severe periodontitis with exacerbating features'. The PAI is based on reference radiographs of teeth with verified histological diagnoses (4,5).

It is consistently shown that patients are satisfied with root canal therapy (6,7). Studies focusing on patients' perception after root canal treatment are limited to primary root canal treatment and patient-centered outcome assessment via questionnaires can provide insight into the perception and expectations of patients about retreatment. Thus, the present study aimed to evaluate the outcome of single visit nonsurgical retreatment by clinical examination and PAI and, patients' feedback regarding the nonsurgical retreatment after 1 year. The null hypothesis was as follows: there is a statistically significant relationship between treatment outcome and patients' feedback.

MATERIAL AND METHOD

This retrospective study was carried out with the permission of Karabük University Non-interventional Clinical Research Ethics Committee (Date: 13.04.2022, Decision No: 2022/910). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

According to a power analysis (G*Power Version 3.0.10, Kiel University, Germany) (F tests, effect size $f = 0.45$, α error probability = 0.05, $1-\beta$ error probability = 0.85), the minimal established sample size was 77. Amongst the referred patients with post-treatment disease, 115 patients were undergone for single visit nonsurgical endodontic retreatment after clinical and radiographic examination in the Department of Endodontics. Exclusion criteria were as follows:

- a. Teeth with mobility over grade 2
- b. Teeth with symptomatic apical abscess
- c. Teeth with root fracture
- d. Teeth with a preoperative probing depth of ≥ 5 mm,
- e. Internally or externally resorbed tooth
- f. Immature teeth
- g. Non-restorable teeth
- h. In cases where exudate drainage present

All clinical procedures were completed by the same endodontist with 4 years of experience (Y.Ö) after recording age, gender, medical and dental history, symptoms, obtaining preoperative periapical radiographs, and informed consent form. After caries removal and access cavity preparation, previous obturation material was removed using Hedström hand files and ProTaper D1, D2, and D3 files (Dentsply Maillefer, Ballaigues, Switzerland) under rubber-dam isolation. Apical patency was established with #8-10 hand files and working length was determined with Gold Reciproc Motor (VDW GmbH, Munich, Germany). Root canal shaping was completed using Dia-X from D1 to D5 files (Diadent Group International, Europe) and 2 mL of 2.5% sodium

hypochlorite was used between each file. Final irrigation was completed using 2.5% NaOCl, 17% EDTA and obturated with gutta-perchas (Dentsply Maillefer) using cold-lateral compaction technique with AH Plus root canal sealer (Dentsply Maillefer). All teeth were restored at the same visit using resin composite (Kerr, Orange, CA, USA) and postoperative periapical radiographs were obtained. Severely damaged teeth were subsequently referred for indirect coronal restorations.

All patients were recalled for follow-up after 1 year. Amongst all the cases treated ($n=115$), 31 patients (27%) did not attend the follow-up visits due to number of reasons including relocation, unwillingness to attend, and being unable to reach. 84 patients, since all patients, received nonsurgical retreatment only once, and therefore 84 teeth were examined clinically and radiographically by two independent examiners after obtaining informed consent. During the clinical examination, the absence/presence of spontaneous pain, sinus tract, sensitivity to percussion, and palpation were recorded. The presence of postoperative pain was evaluated with the help of a 10-point Visual Analogue Scale (VAS). Afterward, patients were asked if they would still choose retreatment over a surgical intervention when they are given multiple treatment options for another failed primary root canal treatment, and answers were also recorded.

Two independent observers who were supposed to perform radiographic examination went through a calibration procedure using PAI on another 100 digital periapical images of teeth with different periapical status (8, 9). Two calibrated examiners interpreted and scored independently the images and the scores that were agreed upon were used. A third examiner's opinion was asked in case of disagreement.

For the assessment of pre-and post-operative periapical tissues and indicators of healing; 5-point PAI was used. Periapical radiographs were obtained and saved for radiographic evaluation. The highest score of the multiple teeth was recorded. Only teeth with PAI ≤ 2 scores and shows no signs or symptoms were assigned as "healed", teeth scored PAI ≥ 3 , and presence of clinical signs or symptoms were accepted as 'unhealed'.

Cohen Kappa analysis was used to evaluate the inter-observer agreement. Pearson Chi-square and Fisher's exact test were used to analyze categorical data according to treatment outcome. Mann Whitney U test was used to compare postoperative pain and PAI scores. The relationship between postoperative pain and postoperative PAI score was analyzed with Spearman's correlation. Analysis results were presented as frequency and percentage for categorical data, and median (min-max) for quantitative data. The significance level was set as $p < 0.05$.

RESULTS

Interobserver kappa value was calculated as 0.86 and showed reliability in terms of periapical status assessment. Descriptive analysis of the demographic, preoperative, postoperative parameters and patients' perception of retreatment is presented in **Table 1**. The healing rate after 1 year was 88%. The highest rate of failure was observed in mandibular anterior teeth (25%). However, the tooth type did not influence the outcome (p=0.756). While the failure rate was lower in males (3.3%) than in females (16.7%), gender also did not affect the outcome (p=0.088). Amongst all the cases that were clinically examined, the rate of loss of function was 4.8%, the rate of postoperative tenderness to percussion rate was 6%, the rate of postoperative palpation rate was 2.4%, and the rate of postoperative sinus tract was 3.6%. The rate of those who had a positive approach to nonsurgical retreatment was 97.6%. While the failure rate was 9.8% amongst those who had a positive approach, all the patients with failed retreatment had a negative approach (100%) and there was a statistically significant relationship between treatment outcome and patients' feedback (p=0.013).

| | Healed (n=74) | Failure (n=10) | Total (n=84) | P |
|------------------------------------------------------------------------|---------------|----------------|--------------|------------------------------|
| Tooth | | | | 0.756 ² |
| Maxillary anterior | 14 (93.3) | 1 (6.7) | 15 (17.9) | |
| Maxillary molar | 18 (85.7) | 3 (14.3) | 21 (25) | |
| Maxillary premolar | 6 (100) | 0 (0) | 6 (7.1) | |
| Mandibular anterior | 3 (75) | 1 (25) | 4 (4.8) | |
| Mandibular molar | 25 (89.3) | 3 (10.7) | 28 (33.3) | |
| Mandibular premolar | 8 (80) | 2 (20) | 10 (11.9) | |
| Gender | | | | 0.088 ¹ |
| Female | 45 (83.3) | 9 (16.7) | 54 (64.3) | |
| Male | 29 (96.7) | 1 (3.3) | 30 (35.7) | |
| Loss of function | | | | 0.005¹ |
| No | 74 (91.3) | 7 (8.6) | 81 (96.4) | |
| Yes | 0 (0) | 3 (100) | 3 (3.6) | |
| Postoperative tenderness to percussion | | | | <0.001¹ |
| No | 74 (93.7) | 5 (6.3) | 79 (94) | |
| Yes | 0 (0) | 5 (100) | 5 (6) | |
| Postoperative tenderness to palpation | | | | 0.013¹ |
| No | 74 (90.2) | 8 (9.8) | 82 (97.6) | |
| Yes | 0 (0) | 2 (100) | 2 (2.4) | |
| Postoperative sinus track | | | | 0.001¹ |
| No | 74 (91.4) | 7 (8.6) | 81 (96.4) | |
| Yes | 0 (0) | 3 (100) | 3 (3.6) | |
| “Would you choose nonsurgical retreatment over surgical intervention?” | | | | 0.013¹ |
| Yes | 74 (90.2) | 8 (9.8) | 82 (97.6) | |
| No | 0 (0) | 2 (100) | 2 (2.4) | |

¹Fisher's exact test; ²Pearson Chi Square, Statistically significant relationships are indicated with bold typeface

Comparison of postoperative pain, pre and postoperative PAI scores according to treatment outcome is presented in **Table 2**. While the median VAS pain value was 0 in healed cases, the median VAS score was 2 in failed cases, and the difference between them was statistically significant (p<0.001). The median preoperative PAI score was 4 in both healed and failed cases and there was no statistical difference between them (p=0.830). While the median value of the postoperative PAI score was 2 in healed cases, it was 3 in failed cases, and there was a statistical difference (p<0.001). There is a statistically significant positive correlation between postoperative VAS pain score and postoperative PAI score (p=0.002). It was observed that, as the pain increases, the PAI score also increases.

| | Treatment outcome | | Total | P* |
|--------------------------|-------------------|---------|---------|------------------|
| | Healed | Failure | | |
| Postoperative pain (VAS) | 0 (0-0) | 2 (0-6) | 0 (0-6) | <0.001 |
| Preoperative PAI score | 4 (2-5) | 4 (3-5) | 4 (2-5) | 0.830 |
| Postoperative PAI score | 2 (1-2) | 3 (2-4) | 2 (1-4) | <0.001 |

*Mann Whitney U test, Median (Min-Max)

DISCUSSION

Due to the reduced total treatment time and microleakage risk between appointments, single visit root canal treatment is favorable when it is indicated (10). Moreover, it was observed that intracanal medication with calcium hydroxide for weeks had no advantage over single visit root canal treatment in terms of periapical healing and overall treatment outcome (11). On the other hand, the influence of the number of treatment visits on nonsurgical retreatment has not been concluded due to consistent study results. While Van Nieuwenhuysen et al. (12) reported improved outcomes with multiple visits, the study of Farzaneh et al. (10) showed no significant difference. Although it was shown that active exudate drainage had no influence on the outcome of retreatment, teeth with active exudate drainage were excluded due to the potential postoperative complications after single-visit retreatment (13).

A high recall rate might lead to a less likelihood of inclusion of failed cases and therefore a biased and overestimated outcome of treatment results (14). While our recall rate was 73% and higher than some previous studies, it might be due to the fact that 1-year follow-up results in fewer dropouts than studies that have a longer follow-up period (10,15,16).

88% healing rate in the present study is close to the previous studies with a similar study design namely 85% and %90 (17,18). It could be regarded as the major

limitation of our study that 1-year follow-up might only reflect the short-term results of single-visit nonsurgical retreatment. Additionally, since the cases with a 3 PAI score were considered as “failure” despite reducing in lesion size and uncertain cases added to the failed cases, it might be speculated that a longer follow-up study could have been in a higher rate of healing. However, a recent study revealed that the outcome of root canal retreatment at 1 year is significantly correlated with survival at 4 years (19). Therefore, despite the lack of long-term follow-up results, we believe our study might contribute to the literature, considering that there are still few studies about the outcome of single-visit nonsurgical retreatment.

Results on the significance of tooth type in the outcome of nonsurgical retreatment have been inconsistent in the literature (20). In the present study, tooth type had no influence on healing rate and these results are similar to some previous studies, on the other hand opposing results identifying tooth type as an outcome predictor have been reported and lower healing rates in molars was attributed to the complexity of molar root canal anatomy (17, 21, 22). In accordance with previous studies, gender and preoperative PAI scores did not influence the outcome of nonsurgical retreatment in our study (13, 21).

Failure in root canal treatment is often associated with insufficient disinfection during the initial treatment, coronal leakage, foreign body reaction, true cyst, and vertical root fracture (23, 24). In the present study, previously formed ledges that could not be bypassed, previously separated instruments that could not be removed, and missed root canals due to the lack of use of a dental operating microscope might directly or indirectly lead to the failed cases. Unlike some of the previous studies, teeth with separated instruments were included in our study, since nonsurgical retreatment is a rational option for certain cases with separated instruments (13, 15). We believe studies including cases with previous procedural complications might reflect more realistic outcomes of nonsurgical retreatment cases.

Cone-beam computed tomography (CBCT) is proven to be helpful when it comes to identifying the missed root canals before nonsurgical retreatment (25). CBCT is also shown to detect periapical lesions significantly more precisely (26). Therefore, the lack of CBCT technology during the treatment period might have contributed to a possible underestimation of the numbers of the root canals and a likely overestimation of the healing rate.

The outcome of the nonsurgical retreatment is dramatically influenced by the operator’s educational background and clinical experience (27). Due to the

demanding nature of nonsurgical retreatment, it might also be argued that the healing rate and retreatment satisfaction rate could have been lower with retreatments performed by undergraduate students.

Not the quality of dental care, but how the patient perceives the dental care can be assessed, and in general, patients are satisfied with the outcome of root canal treatment (28, 29). A recent study showed that patients who underwent nonsurgical retreatment reported significant time loss from work but lower physical and psycho-social disability during the recovery phase in comparison to apical surgery (30). 97.6% of patients in the present study mentioned that they would still choose nonsurgical root canal treatment over surgical intervention. Unsurprisingly, all the patients dissatisfied with retreatment were failed cases. The null hypothesis is, therefore, accepted. However, 9.8% of the patients with failed retreatment had still a positive perception of retreatment. Cost is indicated to be the most important dissatisfaction factor with root canal treatment by patients (31). However, since all the patients were treated in a public hospital and the dental care was free of charge, we believe this fact partly contributed to the overwhelming positive perception of the patients.

CONCLUSION

Within the limitations of the present study, it could be concluded that regardless of tooth type and gender, single-visit nonsurgical retreatment is a viable option for teeth where certain periapical diseases such as symptomatic apical abscess are excluded. Patients, who experienced successful nonsurgical retreatment, are eager to preserve their tooth with failed primary root canal treatment when nonsurgical retreatment option is available.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Karabük University Non-interventional Clinical Research Ethics Committee (Date: 13.04.2022, Decision No: 2022/910).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Roda RS, Gettleman Bradley H, Johnson Scott C. Nonsurgical retreatment. *Pathways Pulp* 2020; 1189-369.
2. European Society of Endodontics. Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *Int Endod J* 2006; 39: 921-30.
3. Friedman S, Mor C. The success of endodontic therapy--healing and functionality. *J Calif Dent Assoc* 2004; 32: 493-503.
4. Orstavik D, Kerekes K, Eriksen HM. The periapical index: a scoring system for radiographic assessment of apical periodontitis. *Endod Dent Traumatol* 1986; 2: 20-34.
5. Rueda-Ibarra V, Jiménez-Valdés BI, García-García HE, et al. Using the Periapical Index to evaluate the healing of periapical lesions after root canal treatment. *Giornale Italiano di Endodonzia* 2020; 34.
6. Gatten DL, Riedy CA, Hong SK, Johnson JD, Cohenca N. Quality of life of endodontically treated versus implant treated patients: a University-based qualitative research study. *J Endod* 2011; 37: 903-9.
7. Torabinejad M, Salha W, Lozada JL, Hung YL, Garbacea A. Degree of patient pain, complications, and satisfaction after root canal treatment or a single implant: a preliminary prospective investigation. *J Endod* 2014; 40: 1940-5.
8. Reit C. The influence of observer calibration on radiographic periapical diagnosis. *Int Endod J* 1987; 20: 75-81.
9. Sebring D, Kvist T, Buhlin K, Jonasson P, EndoReCo, Lund H. Calibration improves observer reliability in detecting periapical pathology on panoramic radiographs. *Acta Odontol Scand* 2021; 79: 554-61.
10. Farzaneh M, Abitbol S, Friedman S. Treatment outcome in endodontics: the Toronto study. Phases I and II: Orthograde retreatment. *J Endod* 2004; 30: 627-33.
11. Ørstavik D. Apical periodontitis: microbial infection and host responses. *Essent Endod* 2019: 1-10.
12. Van Nieuwenhuysen JP, Aouar M, D'Hoore W. Retreatment or radiographic monitoring in endodontics. *Int Endod J* 1994; 27: 75-81.
13. Serefoglu B, Micoogullari Kurt S, Kandemir Demirci G, Kaval ME, Caliskan MK. A prospective cohort study evaluating the outcome of root canal retreatment in symptomatic mandibular first molars with periapical lesions. *Int Endod J* 2021; 54: 2173-83.
14. Friedman S. Considerations and concepts of case selection in the management of post-treatment endodontic disease (treatment failure). *Endod Topics* 2002; 1: 54-78.
15. Yigit-Ozer S. Non-surgical root canal retreatment: A retrospective outcome study. *Meandros Med Dent J* 2020; 21: 67-72.
16. de Chevigny C, Dao TT, Basrani BR, et al. Treatment outcome in endodontics: the Toronto study--phases 3 and 4: orthograde retreatment. *J Endod* 2008; 34: 131-7.
17. Eyuboglu TF, Olcay K, Ozcan M. A clinical study on single-visit root canal retreatments on consecutive 173 patients: frequency of periapical complications and clinical success rate. *Clin Oral Investig* 2017; 21: 1761-8.
18. Pirani C, Friedman S, Gatto MR, et al. Survival and periapical health after root canal treatment with carrier-based root fillings: five-year retrospective assessment. *Int Endod J* 2018; 51: e178-e88.
19. Al-Nuaimi N, Ciapryna S, Chia M, Patel S, Mannocci F. A prospective study on the effect of coronal tooth structure loss on the 4-year clinical survival of root canal retreated teeth and retrospective validation of the Dental Practicality Index. *Int Endod J* 2020; 53: 1040-9.
20. Ng YL, Mann V, Gulabivala K. Outcome of secondary root canal treatment: a systematic review of the literature. *Int Endod J* 2008; 41: 1026-46.
21. Zhang M-M, Fang G-F, Chen X-T, Liang Y-H. Four-year outcome of nonsurgical root canal retreatment using cone-beam computed tomography: a prospective cohort study. *J Endod* 2021; 47: 382-90.
22. Pirani C, Iacono F, Gatto MR, et al. Outcome of secondary root canal treatment filled with Thermafil: a 5-year follow-up of retrospective cohort study. *Clin Oral Investig* 2018; 22: 1363-73.
23. Nair PN. Pathogenesis of apical periodontitis and the causes of endodontic failures. *Crit Rev Oral Biol Med* 2004; 15: 348-81.
24. Nair PN, Sjogren U, Figdor D, Sundqvist G. Persistent periapical radiolucencies of root-filled human teeth, failed endodontic treatments, and periapical scars. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1999; 87: 617-27.
25. Karabucak B, Bunes A, Chehoud C, Kohli MR, Setzer F. Prevalence of apical periodontitis in endodontically treated premolars and molars with untreated canal: a cone-beam computed tomography study. *J Endod* 2016; 42: 538-41.
26. Davies A, Patel S, Foschi F, Andiappan M, Mitchell PJ, Mannocci F. The detection of periapical pathoses using digital periapical radiography and cone beam computed tomography in endodontically retreated teeth-part 2: a 1 year post-treatment follow-up. *Int Endod J* 2016; 49: 623-35.
27. Torabinejad M, Corr R, Handysides R, Shabahang S. Outcomes of nonsurgical retreatment and endodontic surgery: a systematic review. *J Endod* 2009; 35: 930-7.
28. Wigsten E, Al Hajj A, Jonasson P, EndoReCo, Kvist T. Patient satisfaction with root canal treatment and outcomes in the Swedish public dental health service. A prospective cohort study. *Int Endod J* 2021; 54: 1462-72.
29. Hamasha AA, Hatiwsh A. Quality of life and satisfaction of patients after nonsurgical primary root canal treatment provided by undergraduate students, graduate students and endodontic specialists. *Int Endod J* 2013; 46: 1131-9.
30. Khoo ST, Lopez V, Ode W, Yu VSH, Lui JN. Psycho-social perspectives of nonsurgical versus surgical endodontic interventions in persistent endodontic disease. *Int Endod J* 2022; 55: 467-79.
31. Dugas NN, Lawrence HP, Teplitsky P, Friedman S. Quality of life and satisfaction outcomes of endodontic treatment. *J Endod* 2002; 28: 819-27.