

## The Outcomes of Root Canal Treatment Undertaken by Dental Students in Kulliyah of Dentistry, IIUM: Tooth Survival

Musliana Mustafa<sup>1\*</sup>, Muhamad Sharifuddin Mat Daud<sup>1</sup>, Mohamad Shafiq Mohd Ibrahim<sup>2</sup>

1. Department of Restorative Dentistry, Kulliyah of Dentistry, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia.

2. Department of Dental Public Health, Kulliyah of Dentistry, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia.

### Abstract

It is not known whether or not root canal treatment provided by undergraduate dental students in the Kulliyah of Dentistry (KOD), International Islamic University Malaysia (IIUM) is successful; therefore, the need to investigate the outcome of treatment is indispensable. This study was conducted at the KOD, IIUM from 11th July 2018 until 12th June 2019. Follow up visits were conducted at least 6 months after the completion of root canal treatment. A total of 175 root canal treated teeth from 143 patients aged between 17 and 71 years old were still present during the follow up visits. Information on the extraction of root canal treated teeth, including reasons for extraction was obtained from the patients or patient's records. Treatment was considered failed when the tooth was extracted due to fracture or persistent intraradicular infection. The results show that survival rate of root canal treated teeth was 98.9% over an observation period of at least 42 months. Two root canal treated teeth were extracted due to tooth fracture. Root canal treatment provided by undergraduate dental students in the Kulliyah of Dentistry was effective, with minimal percentage of failure.

Clinical article (J Int Dent Med Res 2021; 14(3): 1260-1264)

**Keywords:** Tooth survival; root canal treatment; outcomes; survival rate; prognostic indicators.

**Received date:** 15 March 2021

**Accept date:** 23 May 2021

### Introduction

The outcome of root canal treatment has been reported in many studies. Some studies have highlighted periapical healing<sup>1-6</sup> while others reported the survival of root canal treated teeth, determined by the tooth retention.<sup>4, 5, 7-20</sup>

The data reported in literatures shows a wide variation in percentage of tooth survival ranging from 36%<sup>9</sup> to above 60%<sup>8, 10, 12, 13</sup> over an observation period of 2 years<sup>12</sup> to 10 years.<sup>10, 12</sup> An epidemiological study<sup>8</sup> carried out in the United States over an 8-year period showed 97% tooth survival in 1 462 936 teeth of 1 126 288 patients. The results from a systematic review observed survival rate of approximately 81% in the root canal treated teeth that were restored with crowns after 10 years follow up in

comparison to the root canal treated teeth without crowns.<sup>10</sup> Another systematic review showed survival rate ranging between 86% and 93% over an observation period of 2 to 10 years.<sup>12</sup> The survival data reported in the previous studies show large differences that could be attributed to the study characteristics such as study design, follow up period and sample size.

The survival data of a root canal treated teeth is based on various levels of evidence. Therefore, a robust conclusion pertaining to the long-term survival of the tooth is difficult to make, although in recent years a 10-year observation period has been reported in some studies.<sup>5, 20</sup> Due to the various factors dictating the survival of root canal treated teeth, the preoperative prognosis of a root canal treated teeth should be made with great caution.

The prognostic indicators determining survival of root canal treated teeth have been reported by previous researchers.<sup>13</sup> These include the influence of preoperative, intraoperative and post-operative factors that in certain situations are difficult to control. However,

#### \*Corresponding author:

Musliana Mustafa  
Kulliyah of Dentistry, International Islamic University Malaysia,  
Jalan Sultan Ahmad Shah, Bandar Indera Mahkota,  
25200 Kuantan, Pahang, Malaysia.  
E-mail: [muslianamustaffa@iium.edu.my](mailto:muslianamustaffa@iium.edu.my), [drmusliana@gmail.com](mailto:drmusliana@gmail.com)

this information can be used to help inform patients of possible treatment benefits, risks and outcomes,<sup>21</sup> so that the clinicians and patients have a general understanding of the factors influencing the survival of root canal treated teeth.

It is not known whether or not root canal treatment undertaken by undergraduate dental students in the Kulliyah of Dentistry (KOD), International Islamic University Malaysia (IIUM) is successful, therefore, the need to investigate the outcome of treatment is indispensable. This is important to determine the success of root canal treatment that is provided to patients. Moreover, the limitations encountered during treatment could be identified early and hence could be improved in future clinical practice.

Based on the discussion above, the objective of this study was to assess the survival rate of root canal treated teeth provided by undergraduate dental students and to identify the prognostic indicators determining survival.

### Materials and methods

This study received ethical approval from the International Islamic University Malaysia Research Ethics Committee (IREC 2018-039).

This was a retrospective study assessing the survival of root canal treated teeth. The study was conducted at the Kulliyah of Dentistry, IIUM from 11<sup>th</sup> July 2018 until 12<sup>th</sup> June 2019. The samples were selected based on the inclusion and exclusion criteria as follows. Inclusion criteria included primary root canal treatment undertaken by undergraduate dental students in KOD, IIUM, with at least 6 months follow up. The exclusion criteria included periodontically involved root canal treated teeth, secondary root canal treatment, incomplete root canal treatment and the extracted root canal treated teeth due to orthodontic treatment. All included samples were treated between 31<sup>st</sup> March 2015 and 28<sup>th</sup> March 2019.

Sample size calculation was done using Raosoft sample size calculator involving a total number of 151 teeth. Initially, patient records were retrieved from the database or clinical logbooks of the undergraduate dental students. Potential patients for review were contacted by phone and invited for the follow up visits. The explanation regarding the study was done by the researchers and patients who agreed to

participate in the study was required to sign a consent form.

During the follow up visit, the pain and other relevant history was asked, the clinical examination was conducted and the periapical radiographic images for assessment of the periapical status was taken. The primary outcomes were clinical and radiographic evidence of absence of apical periodontitis or periapical healing of the tooth. The secondary outcome was tooth survival.

A total of 175 root canal treated teeth from 143 patients were reviewed, the age of patients ranged between 17 and 71 years old (mean: 39 years old). Information on the extraction of root canal treated teeth including the reasons for extraction was obtained from the patients or patient's records. Teeth extracted due to the fracture or persistent intraradicular infection and teeth required root canal retreatment or periapical surgery were considered failed treatment.

Statistical analysis was performed using IBM SPSS version 25. The overall longevity of root canal treated teeth was analyzed using Kaplan-Meier statistics.

### Results

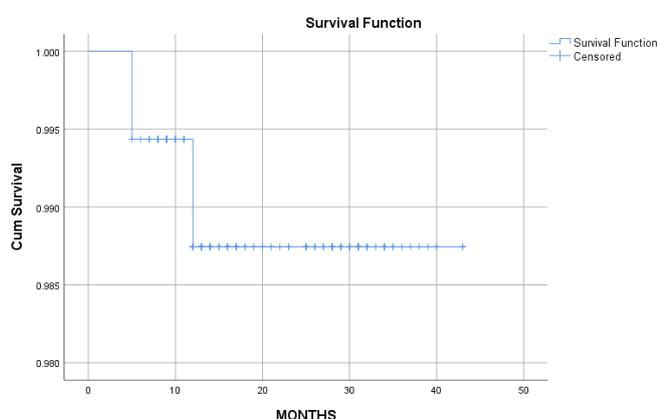
In total, 196 teeth from 161 patients underwent root canal treatment by undergraduate dental students between 31<sup>st</sup> March 2015 and 28<sup>th</sup> March 2019. A total of 16 root canal treated teeth (8.2%) from 15 patients were affected by localized periodontitis (at least one site with probing pocket depth of at least 4 mm), 1 root canal treated tooth from 1 patient was extracted for orthodontic reason and 2 root canal treated teeth from 2 patients were extracted without specific reasons. A total of 177 root canal treated teeth from 143 patients; 83 females (58%) and 60 males (42%) were included in the analysis. Of these, 1 root canal treated tooth from 1 patient was extracted due to tooth fracture about 5 months after completion of the root canal treatment and another 1 root canal treated tooth from 1 patient was extracted after 12 months. The age of patient during root canal treatment ranged between 17 and 71 years old (mean: 39 years old). Tooth type, observation period and post-operative status of the root canal treated teeth are presented in Table 1 and 2 respectively.

Tooth type	Number of root canal treated teeth (n = 175)	Percentage (%)	Observation period			
			6 to 12 months	1 to 2 years	2 to 3 years	3 to 4 years
Incisors	51	29.1	7	22	18	4
Canine	6	3.8	0	4	2	0
Premolars	65	37.1	14	29	18	4
Molars	53	30.3	15	22	13	3

**Table 1.** Tooth type and the observation period.

Tooth type	Coronal restoration			Abutment of prosthesis		Number of the adjacent tooth			Terminal tooth	
	Adhesive Restoration	Amalgam restoration	Cast restoration	Removable	Fixed	0	1	2	Yes	No
Incisors	35	0	15	0	1	0	9	42	0	51
Canine	5	1	0	0	0	2	2	2	1	5
Premolars	43	1	19	0	2	1	14	50	5	60
Molars	42	0	10	0	1	0	19	34	11	42

**Table 2.** Post-operative status.



**Figure 1.** Kaplan-Meier survival analysis of root canal treated teeth.

Kaplan-Meier survival analysis showed tooth loss from month 5 post-treatment, meanwhile, the probability of tooth survival until month 12 is 98.7%. The average tooth survival was 42 months [95% CI (41.99 - 43.16)].

### Discussion

The survival rate of root canal treated teeth undertaken by various operators has been evaluated in previous studies such as by the undergraduate dental students,<sup>19</sup> endodontic postgraduate students,<sup>5, 7, 13, 16</sup> a combination of undergraduate and postgraduate dental students,<sup>22</sup> dental practitioners<sup>11, 14, 15, 20, 23, 24</sup> and a combination of dental practitioners and endodontic specialists.<sup>8</sup> However, the survival of root canal treated teeth undertaken by undergraduate dental students is less frequently evaluated, perhaps due to a larger focus on the technical quality of root canal treatment.<sup>25-35</sup>

The follow up visit conducted in the present study was from 6 months to 4 years post-

treatment, although longer observation periods have also been reported in the past, including 8 years,<sup>16, 19</sup> and 10 years.<sup>5, 7, 11, 20</sup>

The survival rate of root canal treated teeth in the present study was 98.9% over an observation period of at least 42 months. One root canal treated tooth was extracted due to fracture within 5 months and another one root canal treated tooth was extracted 12 months after the completion of root canal treatment. In a previous study, the survival rate of root canal treated teeth was 79.5% over an observation period of 8 years<sup>19</sup> whereas in another study, the survival rate of root canal treated teeth was 72.7% over an observation period of at least 3 years.<sup>22</sup> The findings reported in the former study<sup>19</sup> could be attributed to the longer observation period, in which the failure rate would have likely increased over time<sup>36</sup> and the findings in the latter study<sup>22</sup> could be associated with a lack of proper post-operative restoration and some of the root canal treatments was carried out by the less experienced practitioners.

Comparison of the survival rates of root canal treated teeth undertaken by undergraduate dental students in the present study against the same treatment done by dental practitioners showed 74%,<sup>23</sup> 80%,<sup>14</sup> 81.7%,<sup>20</sup> and 93%<sup>11</sup> survival rate in the latter over an observation period of 10 years. In other studies spanning less than 10 years observation period, 90% survival rate was reported after 5 to 6 years<sup>15</sup> and 97.1% survival rate was reported after 8 years.<sup>8</sup> Although the majority of studies reported of the survival rate, one study reported annual failure rate, which was 1.9% over a 10-year observation period.<sup>24</sup> The reported survival data showed that the root canal treatment provided was of high quality considering the experience of the dental practitioners and endodontic specialists. However, due to the longer observation period, the failure rate would have likely increased, explaining the survival data reported by the previous researchers.<sup>14, 20, 23</sup>

It was not possible to determine the prognostic indicators determining the survival of root canal treated teeth owing to the limited number of failures within the observation period. Perhaps, a longer follow up duration of more than 4 years could better assess the status of failure. Meanwhile, previously reported data show that there are 13 prognostic indicators for the survival of root canal treated teeth, such as history of

diabetes, systemic steroid therapy, narrow but deep periodontal probing depth, preoperative pain, sinus discharged, preoperative iatrogenic perforation (for root canal retreatment cases), intraoperative iatrogenic perforation, patency at apical terminus, extrusion of root fillings, presence of cast restoration, presence of cast post and core, proximal contacts with both mesial and distal adjacent teeth and terminal location of the tooth.<sup>13</sup> These prognostic indicators could dictate the prognosis of the root canal treated teeth and can be used in patient informed consent prior to root canal treatment. However, due to insufficient data in the present study, the prognostic indicators determining the survival of root canal treated teeth could not be determined.

The present study was limited by insufficient historical data, leading to retrospective analysis, as well as different observation periods, complicating standard comparison. The prognostic factors indicating tooth survival could not be identified due to the limited number of root canal treated teeth that were extracted within the observation period. Based on the findings, root canal treatment provided by undergraduate dental students in the KOD, IIUM followed a predictable approach with good short-term prognosis. Multiple factors could influence the survival of root canal treated teeth, however, in the present study it was not possible to address these factors owing to a retrospective nature of the study. Future research selecting the appropriate cases over a standard observation period can be performed to overcome this limitation.

## Conclusions

Within the limitations of the present study, the survival of root canal treated teeth undertaken by undergraduate dental students in KOD, IIUM showed 98.9% over an observation period of at least 42 months, with a minimal percentage of failure.

A longer observation period is needed to assess the survival rate of the root canal treated teeth so that factors contributing to treatment failure could provide insights on the precautions that needs to be addressed when providing root canal treatment to patients.

## Acknowledgements

This research was supported by the Research Initiative Grant Scheme 2017 from the International Islamic University Malaysia (RIGS17-090-0665).

## Declaration of Interest

The authors report no conflict of interest.

## References

1. Friedman S, Abitbol S, Lawrence HP. Treatment outcome in endodontics: the Toronto Study. Phase 1: Initial Treatment. *J Endod* 2003;29(12):787-793.
2. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala KJ. 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;40(12):921-939.
3. Ng YL, Mann V, Gulabivala K. A prospective study of the factors affecting outcomes of nonsurgical root canal treatment: part 1: periapical health. *Int Endod J* 2011;44(7):583-609.
4. Lee A, Cheung G, Wong M. Long-term outcome of primary non-surgical root canal treatment. *Clin Oral Investig* 2012;16(6):1607-1617.
5. Fernández R, Cardona JA, Cadavid D, Álvarez LG, Restrepo FA. Survival of endodontically treated roots/teeth based on periapical health and retention: a 10-year retrospective cohort study. *J Endod* 2017;43(12):2001-2008.
6. Stenhagen S, Skeie H, Bårdsen A, Laegreid T. Influence of the coronal restoration on the outcome of endodontically treated teeth. *Acta Odontol Scand* 2020;78(2):81-86.
7. Dammaschke T, Steven D, Kaup M, Ott KHR. Long-term survival of root-canal-treated teeth: a retrospective study over 10 years. *J Endod* 2003;29(10):638-643.
8. Salehrabi R, Rotstein I. Endodontic treatment outcomes in a large patient population in the USA: an epidemiological study. *J Endod* 2004;30(12):846-50.
9. Nagasiri R, Chitmongkolsuk S. Long-term survival of endodontically treated molars without crown coverage: a retrospective cohort study. *J Prosthet Dent* 2005;93(2):164-170.
10. Stavropoulou A, Koidis PT. A systematic review of single crowns on endodontically treated teeth. *J Dent* 2007;35(10):761-767.
11. Fonzar F, Fonzar A, Buttolo P, Worthington HV, Esposito M. The prognosis of root canal therapy: a 10-year retrospective cohort study on 411 patients with 1175 endodontically treated teeth. *Eur J Oral Implantol* 2009;2(3):201-208.
12. Ng YL, Mann V, Gulabivala K. Tooth survival following non-surgical root canal treatment: a systematic review of the literature. *Int Endod J* 2010;43(3):171-189.
13. Ng YL, Mann V, Gulabivala K. A prospective study of the factors affecting outcomes of non-surgical root canal treatment: part 2: tooth survival. *Int Endod J* 2011;44(7):610-625.
14. Borén DL, Jonasson P, Kvist T. Long-term survival of endodontically treated teeth at a public dental specialist clinic. *J Endod* 2015;41(2):176-181.
15. Fransson H, Dawson VS, Frisk F, et al. Survival of root-filled teeth in the Swedish adult population. *J Endod* 2016;42(2):216-220.
16. Pratt I, Aminoshariae A, Montagnese TA, Williams KA, Khalighinejad N, Mickel A. Eight-year retrospective study of the critical time lapse between root canal completion and crown placement: its influence on the survival of endodontically treated teeth. *J Endod* 2016;42(11):1598-1603.
17. Almasri M. Assessment of extracting molars and premolars after root canal treatment: A retrospective study. *Saudi Dent J* 2019;31(4):487-491.

18. 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(8):1040-1049.
19. Sadaf D. Survival Rates of Endodontically Treated Teeth After Placement of Definitive Coronal Restoration: 8-Year Retrospective Study. *Therapeutics Clinical Risk Management* 2020;16:125-131.
20. Kebke S, Fransson H, Brundin M, Mota de Almeida FJ. Tooth survival following root canal treatment by general dental practitioners in a Swedish county- a 10-year follow-up study of a historical cohort. *Int Endod J* 2021;54(1):5-14.
21. Hülsmann M, Schinkel I. Influence of several factors on the success or failure of removal of fractured instruments from the root canal. *Dent Traumatol* 1999;15(6):252-258.
22. Chatzopoulos GS, Koidou VP, Lunos S, Wolff LF. Implant and root canal treatment: Survival rates and factors associated with treatment outcome. *J Dent* 2018;71:61-66.
23. Lumley P, Lucarotti P, Burke F. Ten-year outcome of root fillings in the General Dental Services in England and Wales. *Int Endod J* 2008;41(7):577-585.
24. Skupien JA, Opdam N, Winnen R, et al. A practice-based study on the survival of restored endodontically treated teeth. *J Endod* 2013;39(11):1335-1340.
25. Rafeek RN, Smith WA, Mankee MS, Coldero LG. Radiographic evaluation of the technical quality of root canal fillings performed by dental students. *Aust Endod J* 2012;38(2):64-69.
26. Vukadinov T, Blažić L, Kantardžić I, Lainović T. Technical quality of root fillings performed by undergraduate students: a radiographic study. *The Scientific World Journal* 2014;2014.
27. Akbar I, Alam F, Raza M. Radiographic technical quality of root canal fillings performed by undergraduate dental students. *Pakistan Oral & Dental Journal* 2017;37(2):355-360.
28. Eskandarloo A, Karkehabadi H, Hashemi SZH, Ahmadi M, Hendi SS. Radiographic quality of root canal obturation performed by fifth year students of hamadan dental school. *Iran Endod J.* 2017;12(2):236-241.
29. Rapo H, Oikarinen-Juusola K, Laitala M, Pesonen P, Anttonen V. Outcomes of endodontic treatments performed by dental students-A follow-up study. *J Dent Oral Biol.* 2017;2(6):1046.
30. Fayyaz A, Ehsan S, Waseem RF. Radiographic evaluation of endodontic treatment performed by undergraduate students and interns. *J Pak Dent Assoc* 2018;27(3):115-119.
31. Fong W, Heidarifar O, Killough S, Lappin M, El Karim I. An audit on technical quality of root fillings performed by undergraduate students. *Int Endod J* 2018;51:e197-e203.
32. Suttagul K, Asawaworarit W. Quality Assessment of Root Canal Treatment Performed by Dental Students at Western University, Thailand. *J Int Dent Med Res* 2018;11(1):21-26.
33. Aksoy F, Aydin U. Evaluation of the quality of root canal treatment performed by undergraduate dental students. *Ann Med Res* 2019;26(6):1108-1111.
34. Ribeiro DM, Henckel MD, Mello FW, Felipe MCS, Felipe WT. Radiographic analysis the obturation's quality in root canal treatment performed by a South Brazilian sample of undergraduate students. *RGO-Rev Gaúch Odontol* 2019;67:e20190040.
35. Suttagul K, Asawaworarit W. Quality Assessment of Root Canal Treatment Performed by Dental Students at Western University, Thailand. *J Int Dent Med Res.* 2018;11(1):21-26.
36. Cheung GS. Survival of first-time nonsurgical root canal treatment performed in a dental teaching hospital. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002;93(5):596-604.