The title page

Differences in root canal retreatment method among General practitioner, General practitioner joining continuing dental education, and Endodontist in Thailand

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The Abstract

Objective The proper treatment for failed root canal treated tooth should be considered by knowledge and related factors. Thai general dental practitioners (GP) should have comprehensive knowledge and competency about this topic. Therefore, this study aimed 1) to investigate the competency about evaluating success and failure after root canal treatment and 2) to compare proper treatment for failed root canal treated teeth among general dental
practitioners (GP), GPs who have ever joined continuing education about root canal retreatment (CE) and endodontists (ENDO).

**Materials and methods** Dentists who had Thai dental license and graduated from dental school in Thailand were participants. They answered all questions in web-based questionnaire which included 3 parts: A) demographic data B) case scenarios for evaluating the success and failure of root canal treated tooth C) case scenarios for considering proper treatment plan of failed root canal treated tooth and factors influencing the plan. Part A data were used to classify group. The differences of part B and C data among groups were statistically analysed by One-Way ANOVA and Chi-square test respectively (p < 0.05).

**Results** The questionnaire was responded by 387 Thai dentists including 226 GP, 52 CE and 109 ENDO. There was no significant difference in evaluating the success and failure of root canal treated tooth among groups (p = 0.103), whereas there were 4/7 scenarios in part c which had statistically significant differences between GP and ENDO.

**Conclusions** GP, CE and ENDO had similarly competency to evaluate the success and failure of root canal treatment. However, in some cases, GP and CE chose the treatment for failed root canal treated tooth unlike ENDO.

**Keyword:** Competency, Continuing education, Endodontist, General dental practitioner, Root canal retreatment

**The main manuscript**

**Introduction**

Although primary root canal treatment has high success rate (70-90%)(1), there was failed cases about 13.18% (2). When the tooth was diagnosed as failed root canal treated tooth, there are several options for treatment such as non-surgical root canal
retreatment, surgical retreatment and tooth removal. The treatment plan of dentists may be different due to their knowledge and experience. It is not easy to consider about the definitive root canal retreatment plan. The dentists must know how to evaluate success of root canal treatment, the factors which related to the failure and the considerable factors for retreatment plan. The retreatment topic is one of the Thai general dental practitioner (GP) competency from Thai Dental Council (TDC) and Competency Assessment and Accreditation 2014 (CDA)(3) and it is one of the topics in the national dental license examination(3). As quote in the Thailand national dental license examination manual that “dentists must have ability to evaluate root canal treatment outcome and properly manage patient who have problems after root canal treatment”(3). These imply that Thai dentists must have the competencies for evaluating healing after root canal treatment and they should manage the patient who has failed root canal treated teeth to receive proper retreatment. A previous study about root canal retreatment strategies of Australian dentists showed that GP significantly suggested extraction and tooth replacement with an implant more than other treatment options even if the tooth could be managed by contemporary endodontic techniques(4).

At the present, Thailand has about 13,000 dentists graduated from several institutions(5). They may have different understanding about treatment for failed root canal treated teeth which may due to their dental graduated program or continuing education after graduation. It is interesting to know what the root canal retreatment strategies in Thai general dentists are and their decisions are similar to those of endodontist or not. Therefore, this study aimed 1) to investigate the competency about evaluating success and failure after root canal treatment and 2) to compare proper treatment for failed root canal treated teeth among general dental practitioners (GP),
GPs who have ever joined continuing education about root canal retreatment (CE) and endodontic specialists (ENDO) who had well understanding and experience about endodontic retreatment.

**Materials and methods**

The protocol of this study was approved by the Human Ethics Committee, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand (protocol number: HREC-DCU 2019-084). All participants in this study were Thai dentists who had the Thai dental national license. They were classified into 3 groups including GP, CE and ENDO.

A questionnaire was made in form of web-based questionnaire (google form) including 3 parts: A) demographic data: age, graduation year, specialty and passed continuing education about root canal retreatment, B) 4 case scenarios for evaluating the success and failure of root canal treated tooth, and C) 7 case scenarios for choosing proper treatment for failed root canal treated teeth and considerable factors influencing the decision. The case scenario questions were created by an endodontic lecturer who had experience in endodontic for 15 years. The characteristics of cases in part B and C were shown in Table 1. In part B and C, the participants chose the best answer from multiple choices including Part B: success, failure and questionable and Part C: follow-up, root canal retreatment, endodontic surgery and extraction, whereas considerable factors could be chosen up to 4 choices. The questionnaire draft was trial tested by the 6th year undergraduate dental students and 5 endodontic instructors of the faculty of dentistry, Chulalongkorn University, Thailand for evaluating understanding and clearly correcting the questions. The intra-rater reliability was analysed with the data from endodontic instructors and presented as Kappa in each instructors which are
in range of 0.621 - 0.864 (moderate to almost perfect agreement). The validity was analyzed in part B and C by index of Item-Objective Congruence (IOC) with 0.5 confidence. The IOC values of part B and C were 0.75 and 0.54.

After questionnaire correction, the link of the questionnaire was shared to Thai dentists via social networks such as Facebook and Line in January-Mid-February 2020.

Data analysis

The education data was used to classify the groups. For part B, when the participants answered correctly, they would get 1 score/case. The differences of scores among groups in part B was statistically analysed by One-Way ANOVA and Bonferroni Post Hoc test. For part C, Chi-square test was used to analyze the difference of answers. Statistical analysis was calculated using IBM® SPSS® 22.0 (IBM Corporation, New York, USA). The level of significance was p < 0.05. The considerable factors influencing the decision were analyzed by descriptive analysis.

Results

The questionnaire was responded by 388 Thai dentists. A participant was excluded due to the data cannot be classified into group and then the 387 dentists were classified into 3 groups including 228 GPs, 50 CEs and 109 ENDOs. The summary data of age, graduation year and specialty were shown as Table 2.

From part B, the mean and standard deviation of scores in GP, CE and ENDO were 2.71±0.83, 2.81±0.68 and 2.91±0.82 respectively. There was no significant difference in evaluating the success and failure of root canal treated tooth among groups (p = 0.103).
The results of proper treatment plan and the first 3 of considerable factors were shown as Figure 1 and 2, respectively. There were statistically significantly differences found in case 1, 2, 4 and 5.

**Discussion**

This research was conducted due to curiosity to evaluate the competency of Thai GPs in terms of assessment the success of previous endodontic treatment and selection of proper retreatment method and to compare with CE who might have more knowledge about endodontic retreatment and ENDO who were professional in endodontic treatment. There were a few previous studies which investigated competency or knowledge for dental treatment planning\(^{(4, 6-9)}\). The specialty and experience of dentists strongly influenced their treatment plan of failed root canal treated tooth so endodontists had the most compatible agreement\(^{(4, 8)}\). Besides specialty training program, continuing education program that consists of lectures, discussions and hands-on training could improve GP’s knowledge and skill\(^{(9)}\). There was no study to evaluate decision making for treatment plan in Thai dentist. They may have different understanding about treatment for failed root canal treated teeth which may due to their dental graduated program or continuing education after graduation.

The assessment of treatment result after root canal treatment is one of the competencies of Thai dentists\(^{(3)}\). It was basic knowledge that the dentists use to decide which tooth must have retreatment. This study found that most participants in all groups got 3 points (max = 4) and there was no statistically significant difference between groups. It implied that dentists in Thailand had good competency in evaluating success and failure root canal treatment. The wrong answers were the most in fourth case, it might be that the participants missed to focus on the success from
root canal treatment but they also considered the defects of other features such as the condition of restoration. Consequently, many participants evaluated this case as uncertain.

In part C, the result showed the differences between groups in some cases. The answers of ENDO were in the same way excepted the fifth case which ENDO chose conventional retreatment (48.6%) and follow up (49.5%) almost equally. The critical point of this case was the period of gutta percha contamination. From many previous studies which had different experimental leakage methods, there were several contaminated periods that demonstrated root canal reinfection. Thereby, endodontists might have a different knowledge about this topic. On the other hand, most GPs and CEs considered that retreatment was not necessary before making new restoration because they did not give importance to the leakage of root canal filling, but they focused on the absence of sign and symptom and quality of root canal filling as shown in Figure 2.

In the second and fourth cases, GP and CE chose treatment unlike ENDO. The main points of both cases were poor quality of root canal filling and new extensive restoration. The follow up/retreatment proportions of GP and CE were significantly more than that of ENDO. Conversely, the first 2 factors influencing decision making of all groups were similar so the majority of dentists in all groups had considerable principle similarly. In the first case, the GP had high proportion of extraction when compare with others. Although all groups considered sign and symptom of tooth, GP usually focused on restorability after root canal treatment and crown root ratio more than ENDO. It might be this reason why GP chose extraction more than other groups. In the third, sixth and seventh cases, the proportion of treatment didn’t have
statistically significant difference between groups because these scenarios weren’t complex, and the first 3 factors of all groups were in the same way.

The trend of decision-making for root canal treated tooth was different in GP and ENDO which correlated with Dechouniotis et al. study which found that GP chose more retreatment options than ENDO\textsuperscript{(8)}. This related to their endodontic training and experiences. In Australia, many GPs planned tooth removal and replacement with implant in the case scenarios which could be treated by endodontic procedures\textsuperscript{(4)}. Conversely, Thai GPs attempted keeping the tooth more than extraction. Although some studies found that the continuing education develop the ability of dentists\textsuperscript{(9)}, our study could not prove that continuing education affected dentist’s decision or not because there were small number of CE participants.

Most treatment proportions and mainly influencing factors of GP and CE were alike. In complicated cases which need the advanced endodontic knowledge, the selected treatments of GP and CE were more various than those of ENDO. To summarize, the results showed that Thai dental GPs had a competency in evaluating success and failure of root canal treated teeth, but they could select the proper treatments for failed root canal treated teeth moderately. Therefore, we recommended dental school instructors to emphasize this point and use more case-based studies about the treatment plan and considerable factors for various failed root canal treated tooth. However, due to limitation of time, the questionnaire was responded from only 387 dentists which is only 2.98% of Thai dentist\textsuperscript{(5)}. Although web-based questionnaire is fast and easy for data collection, it may not suitable for old-age dentists who are not familiar with online questionnaire. Due to ethical reasons, the researchers could not collect person-identifying information, so repeating answer could not be
The future study should be adjusted the questions to be higher validity and collect a large number of participants.

**Conclusions**

GP and CE had good competency to evaluate the success of root canal treatment approximate to ENDO. However, in some cases, the selected treatments for failed root canal treated teeth of GP and CE did not like those of ENDO.

**Acknowledgment**

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**References**


3. คู่มือการสอบเพื่อขอเข้ารับใบประกอบวิชาชีพทันตกรรม พ.ศ. 2557 [internet]. 2014 [cited 12 April 2020]. Available from: http://cda.or.th/download/downloadFiles.php?file=MH4xOTc1OX5pbWFhZords8OZC80MTQ5NS9tYW51YwMDE0Xzk0Ml8xNjlfODQ3LnBkZg==.


Table 1 The characteristics of case scenarios in part C (choosing proper treatment for failed root canal treated teeth and considerable factors influencing the decision)

<table>
<thead>
<tr>
<th>Case</th>
<th>Tooth</th>
<th>Years after RCT</th>
<th>Clinical (only abnormal)</th>
<th>Radiographic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>-</td>
<td>Labial pus fistula, Lingual severe attrition and resin composite filling, distal pocket depth 5 mm</td>
<td>Loose gutta percha, periapical lesion 7x7 mm</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>2</td>
<td>OM poor amalgam filling with leakage</td>
<td>Radiolucent area in pulp chamber, Short and small root canal filling, periapical lesion 6x6 mm</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>1</td>
<td>Discolored tooth, composite resin at occlusal surface in good condition</td>
<td>Root canal filling in good condition, widening PDL space</td>
</tr>
<tr>
<td>4</td>
<td>37</td>
<td>1</td>
<td>Partial composite resin and tooth fracture, pain when chewing food</td>
<td>Short and loose root canal filling, reduced periapical lesion size</td>
</tr>
<tr>
<td>5</td>
<td>46</td>
<td>-</td>
<td>Severe tooth structure loss and gutta percha exposed for 2 months then refilled with composite resin and observed 6 months</td>
<td>Root canal filling in good condition, lesion at furcation, normal periapical area</td>
</tr>
<tr>
<td>6</td>
<td>46</td>
<td>-</td>
<td>Secondary caries under metal crown 3 mm, pain to percussion, first degree mobility, pocket 4 mm at distal</td>
<td>Caries at cervical third of distal root, periapical lesion 4x5 mm (mesial) and 3x3 mm (distal), lesion at furcation</td>
</tr>
<tr>
<td>7</td>
<td>21</td>
<td>2</td>
<td>Bridge (12-21) in good condition, pus fistula was presented at labial side</td>
<td>Good root canal filling and fiber post 2/3 root length, periapical lesion 4x5 mm</td>
</tr>
</tbody>
</table>
Table 2: Summary data from Part A in questionnaire.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group</th>
<th>GP (n)</th>
<th>CE (n)</th>
<th>ENDO (n)</th>
<th>Total [n (%)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24-30</td>
<td>70</td>
<td>15</td>
<td>37</td>
<td>122 (31.53%)</td>
</tr>
<tr>
<td></td>
<td>31-40</td>
<td>109</td>
<td>20</td>
<td>43</td>
<td>172 (44.44%)</td>
</tr>
<tr>
<td></td>
<td>41-50</td>
<td>35</td>
<td>8</td>
<td>18</td>
<td>61 (15.76%)</td>
</tr>
<tr>
<td></td>
<td>51-60</td>
<td>12</td>
<td>6</td>
<td>10</td>
<td>28 (7.24%)</td>
</tr>
<tr>
<td></td>
<td>&gt;60</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4 (1.03%)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>228</td>
<td>50</td>
<td>109</td>
<td>387 (100%)</td>
</tr>
<tr>
<td>Graduation year</td>
<td>&lt;2014</td>
<td>160</td>
<td>74</td>
<td>35</td>
<td>269 (69.51%)</td>
</tr>
<tr>
<td></td>
<td>≥2014*</td>
<td>68</td>
<td>35</td>
<td>15</td>
<td>118 (30.49%)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>228</td>
<td>109</td>
<td>50</td>
<td>387 (100%)</td>
</tr>
<tr>
<td>Specialty</td>
<td>Orthodontics</td>
<td>26</td>
<td>1</td>
<td>3</td>
<td>30 (16.57%)</td>
</tr>
<tr>
<td></td>
<td>Prosthodontics</td>
<td>29</td>
<td>7</td>
<td>0</td>
<td>36 (19.89%)</td>
</tr>
<tr>
<td></td>
<td>Pediatric dentistry</td>
<td>14</td>
<td>1</td>
<td>0</td>
<td>15 (8.29%)</td>
</tr>
<tr>
<td></td>
<td>Restorative</td>
<td>11</td>
<td>1</td>
<td>3</td>
<td>15 (8.29%)</td>
</tr>
<tr>
<td></td>
<td>Periodontics</td>
<td>10</td>
<td>4</td>
<td>0</td>
<td>14 (7.74%)</td>
</tr>
<tr>
<td></td>
<td>Oral &amp; maxillofacial surgery</td>
<td>30</td>
<td>5</td>
<td>0</td>
<td>33 (19.33%)</td>
</tr>
<tr>
<td></td>
<td>Advanced general practice</td>
<td>12</td>
<td>10</td>
<td>1</td>
<td>23 (12.71%)</td>
</tr>
<tr>
<td></td>
<td>Others#</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>13 (7.18%)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>144</td>
<td>30</td>
<td>7</td>
<td>181 (100%)</td>
</tr>
</tbody>
</table>

*The year that Thai dental council started using the present version of Thailand national dental license examination

#included oral medicine, community dentistry, geriatric dentistry, occlusion and dento-maxillofacial radiology.
Figure 1: The results and differences of proper treatment plan for failed root canal treated teeth among groups.

* indicated the statistically significant difference from Bonferroni Post Hoc test (p <0.05).
Figure 2. The first 3 of considerable factors that participants used to choose proper treatment for failed root canal treated teeth.