Assessment of Health of Periapical Tissues and Quality of Root Canal Treatment in a Given Population: A Retrospective Study

Ravi Nagpal¹, Mahima Goel², Sravan Kumar Madderla³, Ashish Kumar⁴, Alka Arora⁵, Devendra Chaudhary⁶

Contributors:
1Reader, Department of Conservative Dentistry and Endodotics, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar, Rajasthan, India; 2Senior Lecturer, Department of Oral and Maxillofacial Surgery, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar, Rajasthan, India; 3Post-graduate Student, Department of Conservative Dentistry and Endodotics, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar, Rajasthan, India; 4Senior Lecturer, Department of Conservative Dentistry and Endodotics, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar, Rajasthan, India; 5Professor and Head, Department of Conservative Dentistry and Endodontics, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar, Rajasthan, India; 6Postgraduate Student, Department of Conservative Dentistry and Endodontics, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar, Rajasthan, India.

Correspondence:
Dr. Nagpal R. Department of Conservative Dentistry and Endodotics, Maharaja Ganga Singh Dental College and Research Centre, Sri Ganganagar, Rajasthan, India. Email: dhirk160@gmail.com

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Abstract:
Background: Inflammation of the periapical tissues is caused by persistent microbial infection in the root canal of the tooth affected by disease process. Primarily being asymptomatic, this inflammation is frequently detected on routine radiographic investigations. Literature revealed numerous studies highlighting the prevalence of periapical lesions in association with root filled teeth.

Materials and Methods: Evaluation of a total of 750 teeth of 400 patients was done to assess the periapical health and quality of root canal treatment (RCT) done with the help of intraoral periapical radiographs and clinical sign and symptoms. De Moor et al. criteria were used for the assessment of the quality of root canal therapy.

Results: Among the endodontic treated tooth, a significant amount of cases showed periapical or periodontal pathologies ($P > 0.005$). About 75.5% of teeth showed inadequate RCT in the form of radiographically short or overextended apical fillings. Out of all the cases of endodontically treated teeth, 71.5% of the cases showed associated pathologies in the periapical regions with only 28.5% cases showing adequate periapical health.

Conclusion: The present study provides epidemiological data about periapical health and the mechanical quality of endodontic therapy. Results showed a high incidence of periapical pathologies and a significantly high number of inadequately root canal treated teeth. Hence, we emphasize on the need to improve the standard and quality of the endodontic treatment to satisfactory level in order to reduce the incidence of the periapical pathologies.

Key Words: Apical periodontitis, endodontic pathologies, periapical lesions, root canal treatment

Introduction
The relationship between the pulp and the periodontium is very intimate since the time of their development. There is establishment of a direct vascular connection between the pulpal tissue and the periodontium via apical and accessory foramen as development of the two tissue progresses. Endodontic pathologies usually lead to inflammatory changes in the periapical tissues leading to apical periodontitis. Recent researches and treatment protocols give special consideration to the treatment options and procedures to be followed after the completion of root canal treatment (RCT) and its effect on the RCT treated tooth. Such treatment procedures may provide a direct pathway for the micro-organisms and their by-products to the periapical area and bone tissue in the vicinity of these areas. Assessment of such protocols forms important part in determining the prognosis and success of RCT procedures.

Different studies quoted in the literature are mostly the institutional bases studies being carried in ideal environment under ideal conditions. Results of these studies are very high due to the fact that most of these studies are carried by well-trained dental practitioners. Hence, results of such studies highlight ideal results rather than results that would be obtained in actual conditions in routine general practices. Regular and periodic follow-up, both clinically and radiographically, is required for the evaluation of the quality and success of the endodontic treatment. Adequate healing is characterized clinically by the absence of sign and symptoms and radiographically by intact periodontal ligament space. On the other side, treatment failure is characterized by persistence of apical periodontitis. Reduction in the periapical radiolucency is regarded as healing phase of the lesion. Furthermore, the presence of post-treatment apical periodontitis is considered as the RCT failure. Evidence of the past literature shows that the quality of the dental treatment, especially the endodontic treatment is much less than the ideal treatment protocol. The success rate of the treatment, irrespective of any given population group and area or location of study, is approximately one-half. As the quality of the endodontic
treatment decreases, there is an increase in the incidences of periapical lesions, especially the apical periodontitis. Hence, improving the quality of the RCT will also improve the apical health of the patient.  

Therefore, we carried this retrospective study to assess the impact of quality of root canal therapy on the health of periapical tissues.

Materials and Methods

A total 400 patients were selected for the study. Patients included for the study were the new cases reporting to the dental clinics for routine dental problems; more specifically for root canal problems. Patients aged between 20 and 60 years with an average age being 42 years. Evaluation of the periodontal and periapical health was done with the help of intraoral periapical radiographs and orthopantomographs. A total of 750 teeth were evaluated for whom the RCT was carried out. The evaluation included assessment of periodontal status and periapical health of 1500 roots of all the selected teeth. All the radiographs were assessed by a registered radiologist using an illumination box.

For analysis of radiographs, assessment of various parameters was done which included evaluation of the quality of endodontic treatment, periapical and periodontal health using criteria based on De Moor et al. (Table 1).

All the results were analyzed using SPSS software. Chi-square test was used for studying the variables and \( P < 0.005 \) was considered to be as significant.

Results

We evaluated treatment quality and periapical health in a total of 1500 roots of 400 patients for our study. Out of 750 teeth, 411 were maxillary teeth and 339 were mandibular (\( P < 0.005 \)) (Table 2). Regarding the type of teeth, molar were the most common teeth reported for treatment in the clinic (\( P > 0.005 \)) (Table 3). The evaluation of periapical status was done and is presented in Table 4. A total of 31% cases treated with root canal showed healthy periapical and periodontal status. A significant amount of cases showed periapical or periodontal problems in endodontic treated tooth (\( P > 0.005 \)). While assessing the relationship between the quality of RCT and the periapical health, we found that 76.5% of teeth showed incomplete RCT inform of short of apex radiographically or overextended beyond the apical foramen. While on the other hand, 23.5% teeth received ideal RCT treatment. Table 4 highlights the relationship between RCT fillings and periapical health.

Also to evaluate the quality of RCT, we assessed radiographically the amount and smoothness of taper present. We found that 38% teeth had ideal taper while 62% teeth had inadequate taper (Table 5). These were a significant relation seen in between quality of taper and periodontal and periapical health (\( P > 0.005 \)). For the assessment of the quality of the RCT, we

<table>
<thead>
<tr>
<th>Quality of RCT</th>
<th>Criteria</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of the root canal fillings</td>
<td>Adequate</td>
<td>Root filling ending &lt;2 mm from the radiographic apex</td>
</tr>
<tr>
<td>Density of the root canal fillings</td>
<td>Adequate</td>
<td>No voids present in the root fillings or between root fillings and the root canal walls</td>
</tr>
<tr>
<td>Taper of the root canal fillings</td>
<td>Adequate</td>
<td>Consistent taper from the apex to the coronal part</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dental arch</th>
<th>Total teeth (%)</th>
<th>Number of periapical pathologies</th>
<th>Healthy periapical area</th>
<th>Chi-square test P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxilla</td>
<td>411 (54.8)</td>
<td>350</td>
<td>61</td>
<td>0.024 (n.s)</td>
</tr>
<tr>
<td>Mandible</td>
<td>339 (45.2)</td>
<td>246</td>
<td>93</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of teeth</th>
<th>Total teeth (%)</th>
<th>Number of periapical pathologies</th>
<th>Healthy periapical area</th>
<th>Chi-square test P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molars</td>
<td>382 (50.9)</td>
<td>321</td>
<td>61</td>
<td>0.0002 (s)</td>
</tr>
<tr>
<td>Premolars</td>
<td>110 (14.6)</td>
<td>79</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Canines</td>
<td>151 (20.1)</td>
<td>115</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Incisors</td>
<td>107 (14.4)</td>
<td>81</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RCT quality</th>
<th>Total teeth</th>
<th>Number of periapical pathologies</th>
<th>Healthy periapical area</th>
<th>Chi-square test P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate</td>
<td>210</td>
<td>111</td>
<td>99</td>
<td>0.00028 (s)</td>
</tr>
<tr>
<td>Inadequate</td>
<td>540</td>
<td>485</td>
<td>55</td>
<td></td>
</tr>
</tbody>
</table>

PDL: Periodontal ligament, RCT: Root canal treatment
also assessed the density of the fillings and noted that 61% of the cases had inadequate density (Table 6). A combination of adequate length of RCT fillings, density and taper, was considered for evaluating the quality of RCT.

Considering all the three parameters together, we found that only 15% of the cases showed ideal or adequate RCT fillings. On comparing, the quality of endodontic treatment and the periapical and periodontal health, statistically significant correlation was seen showing the prevalence of periapical alterations and improper RCT ($P > 0.005$).

Discussion
In teeth affected by carious process, the treatment protocol involves cleaning and shaping of root canal process and filling it till apex with a biocompatible filling material. The process is known as RCT. The main aim of RCT is to eliminate pathogenic bacteria and their by-products from pulp space and from periapical tissues. Under ideal conditions, RCT has a very high success rate, approximately 90%. However, a comparatively low success rate of RCT has been reported by different authors in different studies in the literature. For adequate RCT procedure, care must be taken to completely clean and shape the root canal and obturating it till the apex to prevent re-infection. Failure of RCT can occur due to inadequate performance of protocol at any stage of the treatment.

In our study, we evaluated the periapical status and quality of RCT in 400 patients reporting from year 2009 to 2012. Evaluation was done by analyzing clinical sign and symptoms and by assessing the changes occurring in radiographs. Superimposed and poor quality radiographs were excluded from the study. On comparing the various teeth, we found that molars were predominantly involved in treatment process followed by premolar ($P > 0.005$). Also when compared between both the arches, maxillary teeth were more affected by pathologic processes ($P < 0.005$).

More failure cases reported in maxillary arch may be due to fact that more morphological variations are seen in maxillary teeth as compared to mandibular teeth. Our results were in correlation with the results obtained by Tarim Ertas et al. who reported similar variation in both the arches. On assessing, the quality of RCT by De Moor et al. criterion, 76.5% cases showed inadequate RCT in the form of incompletely filled root or overextended root. Furthermore, we found that 71.5% cases of RCT treated teeth show prevalence of pathologies associated in periapical regions with only 28.5% RCT treated cases show adequate periapical health. Such a higher number of patients reporting with periapical infection was also seen in studies of De Moor et al., Weiger et al. and Tarim Ertas et al. and may be due to the fact that quality of RCT done affects the quality and health of periapical tissues.

Root length filling was used as one of the criteria to evaluate the quality of RCT. Our results showed that out of all the teeth included in the study, the majority of them ($n = 540$) had inadequate (under filled or overfilled) root canal. Furthermore, the prevalence of periapical pathologies was significantly higher in inadequate group ($P < 0.005$). Similar studies have been reported in the past which show high prevalence of periapical pathologies in cases where root canal was not adequately filled. Saunders et al. and Boltacz-Rzepkowska and Pawlicka includes 2 mm of the apex radiographically as within normal limits.

For assessment of the quality of RCT, two more parameters were taken into consideration in the present study. It included quality of taper present and the density of the filling material in the root canal. Both the parameters showed a significant number of inadequate cases and significantly higher prevalence of periapical pathologies ($P < 0.005$) (Tables 5 and 6). Literature revealed very controversial results regarding the use of material density parameter for the assessment of the quality of RCT. Some studies considered this factor as an important parameter for determining the prognosis of treatment while others considers it as an independent variable for determining the outcome of endodontic therapy. Therefore, the results of our study showed that quality of RCT do alter the periapical and periodontal health and each step of the RCT must be performed very carefully with great efficacy to improve the prognosis of disease.

Conclusion
The results of this study demonstrate a high prevalence of periapical pathologies in endodontic treated teeth in the given population due to inadequately performed treatment procedures. Many root canal procedures performed by practitioners is technically unsatisfactory and subsequent efforts must be taken to improve the standard and outcome of the treatment.

### Table 5: RCT quality of treated teeth according to taper of prepared and filled canal.

<table>
<thead>
<tr>
<th>RCT quality</th>
<th>Total teeth</th>
<th>Number of periapical pathologies</th>
<th>Healthy periapical area</th>
<th>Chi-square test $P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taper</td>
<td></td>
<td></td>
<td></td>
<td>0.00013 ($s$)</td>
</tr>
<tr>
<td>Adequate</td>
<td>223</td>
<td>107</td>
<td>116</td>
<td></td>
</tr>
<tr>
<td>Inadequate</td>
<td>527</td>
<td>489</td>
<td>38</td>
<td></td>
</tr>
</tbody>
</table>

<sup>$s$: Significant, RCT: Root canal treatment</sup>

### Table 6: RCT quality of treated teeth according to density of RCT filling.

<table>
<thead>
<tr>
<th>RCT quality</th>
<th>Total teeth</th>
<th>Number of periapical pathologies</th>
<th>Healthy periapical area</th>
<th>Chi-square test $P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density of RCT filling</td>
<td></td>
<td></td>
<td></td>
<td>0.00031 ($s$)</td>
</tr>
<tr>
<td>Adequate</td>
<td>286</td>
<td>192</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Inadequate</td>
<td>464</td>
<td>404</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

<sup>$s$: Significant, RCT: Root canal treatment</sup>
References


