Original Article

Impact of the quality of coronal restoration and root canal filling on the periapical health in adult syrian subpopulation

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Abstract

Background: The purpose of this study was to determine the status of periapical tissues of endodontically treated teeth according to coronal restorations and root canal fillings separately and in concomitant in adult Syrian subpopulation. **Methods:** 784 endodontically treated teeth from two hundred randomly selected Syrian adult patients were radiographically evaluated. According to predetermined criteria, the quality of coronal restorations and root canal filling of each tooth was scored as adequate or inadequate. The status of periapical tissues was also classified as healthy or diseased. Results were analyzed using Chi-squared test. **Results:** Adequate coronal restorations were determined in 58.54% of cases which was accompanied with less periapical pathosis than that in teeth with inadequate restorations ($P < 0.01$). 14% of teeth were restored by posts which showed no significant impact on the periapical tissues health. 18.5% of endodontic treatments were evaluated as adequate with less number of periapical radiolucencies than that of inadequate root canal fillings ($P < 0.01$). Absence of periapical pathosis was 96.6% in cases with both adequate coronal restorations and root canals fillings. The rate was 88.5% in cases with only adequate root canals fillings, and about 70% in cases with only adequate coronal restorations. When the treatment was inadequate in both coronal and root canals fillings, success rate was only observed in 48.8%. **Conclusion:** The most important factor with regard to the periradicular tissue health is the quality of root canal filling without neglecting the influence of coronal restoration (regardless of its type). There is a high prevalence rate of periapical pathosis in Syrian subpopulation due to poor dental practice.

Key words: Coronal restoration, periapical tissue, root canal filling

INTRODUCTION

The main goal of endodontic treatment is the complete apical and coronal seal of root canal system to prevent the bacterial leakage and percolation[1] Many studies have confirmed the importance of coronal leakage as a possible cause of failure of root canal treatment (RCT). Malone and Donelly[2] considered coronal restoration as it replaces missing tooth structure, protects remaining tooth from fracture, and prevents canals recontamination as the first protective barrier for the periapical tissues after RCT.

Torabinejad *et al.*,[3] confirmed the results of Swanson and Madison 1978[4] that root canal treatment failure could be assumed to the delayed final restoration placement or when the temporary filling partially or completely lost. Hence, a great attention should be paid for the immediate placement of coronal restoration. Some studies suggested the placement of a barrier made of different materials on the root canal orifices for complete coronal seal.[5,6] This barrier is indicated even in cases with post retained restorations.[7]

In 1995, Ray & Trope[8] published a radiographic study about the correlation between the periapical pathosis and endodontically treated teeth. Their results indicated that the adequacy of the coronal restoration is more important than the quality of the root canal filling. They also showed that the periapical pathosis related clearly to the quality of coronal restoration and not to the root canal filling. Kirkevang *et al.*[9] gained

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similar results. On the contrary, many studies, showed the adequacy of root canal filling is the most important preventive measure for the periapical tissues (although there was no negligence on the coronal restoration importance).[10,11] Moreover, Ricucci and Bergenholtz[12] reported that exposure of root canal fillings to the saliva (teeth with missing coronal restorations) was not necessarily associated with apical pathosis in cases with adequate endodontic treatment.

Many epidemiological studies from different countries: Brazil,[11] France,[13] Turkey,[14] Belgium[15] and Australia[16] gave conflicting results about the impact of the final coronal restoration on the status of periapical tissues. Gillen *et al*. 2011[17] and Pak *et al*. 2012[18] made a comprehensive review to studies related to this subject and couldn't resolve this controversy.

The aim of this study was to assess the influence of the quality of coronal restorations and root canal treatment (separately and in concomitant) on the periapical status of endodontically treated teeth from an adult Syrian subpopulation.

METHODS

We randomly selected panoramic x-rays for patients attended dental school of Damascus University who fulfill the selection criteria: Patient's age was set to be minimum of 19 years old, they had neither received any dental treatment for more than one year, nor had previously visited dental school clinics (selected patients are private clinic patients). Panoramic x-rays with any distortion especially in anterior region had been excluded. Our sample contained 200 high qualities panoramic X-rays which had been examined under good illumination and magnification by two endodontists with minimum 5 years experience individually. In cases when disagreement occurred, 25 years experience endodontist made the decision. The number of examines teeth in panoramic x-rays (except third molars) were 5331 teeth, 784 teeth (361 teeth for males and 423 teeth for females) received endodontic treatments (there was a radioopaque material in the root canals or pulp chambers).

We recorded the type of the final fillings as following:
Type of coronal restoration

- No filling in 39 teeth (5%)
- Filling in 320 teeth (42.1%)
- Prefabricated post & filling in 26 teeth (3.3%)
- Crown in 304 teeth (38.8%)
- Post & crown in 85 teeth (10.8%) .

The quality of the final restorations and root canal fillings had been classified as: Adequate or inadequate according to Tronstad *et al*. 2000[10] as follows:

Adequate coronal restoration: Restoration appears intact radiographically.

Inadequate coronal restoration: Final restoration appears radiographically with overhang, open margin, recurrent caries, temporary filling or no filling.

Adequate root canal filling: All canals obturated with dense fillings ending about 2 mm shorter than the radiographic apex.

Inadequate root canal filling: Root canal fillings end more than 2 mm shorter than the radiographic apex or grossly overfilled. Root canal fillings with voids, unfilled canals, and/or poor condensation.

Periapical status was assessed by periapical index (PAI) proposed by Ørstavik *et al*. 1986,[19] who scored the periapical area of the radiographic images as follows:

1. Normal periapical structures.
2. Small changes in bone structure.
3. Changes in the bone structure with little mineral loss.
4. Periodontitis with well-defined radiolucent area.
5. Severe periodontitis with exacerbating features.

According to this index we classified periapical tissue as: Normal or healthy periapex: Absence of radiographic evidence of diseased periapical tissues. This coincides with first and second scores.

Diseased periapex: Radiographic evidence of diseased periapical tissues. This coincides with third, fourth and fifth score of Ørstavik *et al*. index. The worst score of all canals was taken to represent the PAI score for multicanal teeth.

SPSS software was used for statistical analysis (SPSS Inc, Chicago, IL). Differences between groups were examined using Chi-square test.

RESULTS

Out of 784 endodontically treated teeth, the Mandibular molars were the most frequent treated teeth. Mandibular anterior teeth were the least frequency. 459 cases (58.54%) had been classified as having adequate coronal restoration, and 325 (41.46%) cases as having inadequate one [Table 1].

In the 459 teeth with adequate final restoration, the status of periapical tissues was healthy in 353 teeth (76.9%) and diseased in 106 teeth (23.1%). In the 325 teeth with inadequate coronal restoration, the status of periapical tissues was healthy in 169 teeth (52%) and diseased in 156 teeth (48%) [Table 2].

Chi-squared test was used to evaluate the major differences in the status of periapical tissues according to the adequacy of final coronal restoration as illustrated in Table 3.

Statistical analysis revealed that the healthiness of periapical tissues affected by quality of coronal $P < 0.01$ [Table 4].

The study showed that 72% of the cases with final restoration absence accompanied with a clear radiographic radiolucency. Teeth with prefabricated post and filling or cast post and crown accompanied with periapical pathosis (38.5% and 31.8%) respectively. Overall, the post presented in 111 cases (14.1%), 74 cases accompanied with healthy periapical tissues and 37 cases with diseased tissues. There were no significant differences compared to other types of restorations.

Endodontic treatments had been evaluated as adequate in 145 teeth (18.5%), and inadequate in 639 teeth (81.5%). When we compared the status of periapical tissues according to the adequacy of root canals fillings we noticed that 95.2% of the teeth were with adequate root canal fillings, and about 60.1% of the inadequate endodontically treated teeth were with healthy periapical tissues (score one and two Ørstavik *et al*. index). Periradicualr disease (PAI >2) had been found in 262 teeth (33.4%). 7 cases of there were with adequate treatment and 255 cases were inadequate [Table 5].

The difference in the number of teeth with healthy periapical tissues and adequate root canal filling were significant when compared to teeth with inadequate root canal filling. ($P < 0.001$).

The impact of the adequacy of the coronal restoration and root canal filling on the status of periapical tissues had been studied (separately and in concomitant). The studied teeth had been classified to four groups [Table 6].

In this study the status of periapical tissue were healthy in 96.6% of cases when both final coronal restoration and root canal filling were adequate. But the status of periapical tissues was healthy in 88.5% when only the root canal fillings were adequate and 70% when only the coronal restoration was adequate. The status of periapical tissue was healthy in only 48.8% of cases when both the endodontic treatment and the final restoration were inadequate [Table 7].

For cases with both adequate restorations and adequate root canal filling, the success rate was 96.6%. Healthy periapex was observed in 88.5% of the teeth with adequate root canal filling and inadequate restoration. The statistical difference was not significant between the two groups [Table 8]. when only the final restoration was adequate (root canal treatment inadequate) The success rate was 70%($P = 0.04$). The difference when both the final restoration and the root canal filling were inadequate was significant when compared to the other three groups.

Table 1: Illustrate the type of the teeth in the study and the adequacy of the final coronal restoration

Type of the teeth	No. (%)		
	Adequate coronal restoration	Inadequate coronal restoration	Sum
Maxillary anterior teeth	97 (77)	29 (23)	126 (100)
Mandibular anterior teeth	9 (34.6)	17 (65.4)	26 (100)
Maxillary premolars	91 (59.5)	62 (40.5)	153 (100)
Mandibular premolars	70 (65.4)	37 (34.6)	107 (100)
Maxillary molars	71 (45.2)	86 (54.8)	157 (100)
Mandibular molars	121 (56.3)	94 (43.7)	215 (100)
Total	325 (41.5)	459 (58.5)	

Table 2: Illustrate the status of periapical tissues according to the adequacy of final coronal restoration

The status of periapical tissues	No. (%)		
	Adequate coronal restoration	Inadequate coronal restoration	Sum
Healthy tissues	353 (76.9)	169 (52)	522 (66.58)
Peiapical periodontitis	106 (23.1)	156 (48)	262 (33.42)
Total	459 (100)	325 (100)	

Table 3: Evaluation of the major differences between studied groups

Studied variable	Coronal restoration adequacy	No.	Mean rank	U value	*P* value	Significant diff.?
Periapical index (PAI)	Adequate coronal restoration	459	337.29	49247.5	0.000**	Yes
	Inadequate coronal restoration	325	470.47			
	Total	784				

**: Significant at (P<0.01)

Table 4: The effect of coronal restoration type on the status of periapical tissues

Periapical status	No. (%)				
	No filling	Filling	Prefabricated post+filling	Crown	Post+Crown
Healthy periapex	11 (28.2)	244 (73.9)	16 (61.5)	193 (63.5)	58 (68.2)
Apical periodontitis	28 (71.8)	86 (26.1)	10 (38.5)	111 (36.5)	27 (31.8)
Total	39 (100)	330 (100)	26 (100)	304 (100)	85 (100)

Table 5: The status of periapical tissues according to the adequacy of the root canal filling

Periapical status	No. (%)		
	Adequate endodontic treatment	Inadequate endodontic treatment	All teeth
Healthy periapex	138 (95.2)	384 (60.1)	522 (66.6)
Apical periodontitis	7 (4.8)	255 (39.9)	262 (33.4)
Total	145 (100)	639 (100)	784 (100)

Table 6: Classification of teeth according to the adequacy of the final restoration and root canal filling

Type of the treatment	No.(%)
Both the final restoration and root canal filling are adequate	119 (15.2)
The final restoration is inadequate while the root canal filling is adequate	26 (3.3)
The final restoration is adequate while the root canal filling is inadequate	340 (43.4)
Both the final restoration and the root canal filling are inadequate	299 (38.1)
Total	784 (100)

Table 7: The effect of endodontic treatment and the final coronal restoration on the status of periapex

The status of periapex	No. (%)			
	Both the coronal restoration and the root canal filling are adequate	The coronal restoration is inadequate+ the root canal filling is adequate	The coronal restoration is adequate+ the root canal filling is inadequate	Both the coronal restoration and the root canal filling are adequate
Healthy periapex	115 (96.6)	23 (88.5)	238 (70)	146 (48.8)
Diseased periapex	4 (3.4)	3 (11.5)	102 (30)	153 (51.2)
Total	119 (100)	26 (100)	340 (100)	299 (100)

DISCUSSION

This epidemiological study used x-rays to evaluate the presence of periapical radiolucencies, the quality of the root canal fillings and restorations with all limits of the 2 dimensional images. One of this study disadvantages is the inability to collect detailed information about the endodontic treatment: When it was done? if the periapical pathosis is pre or post treatment disease? whether the periapical periodontitis is healing or expanding**?** in fact, radiographic image represents a snapshot of a continuous process of a dynamic disease. According to the study of Petersson *et al*. (1991).[20] The number of healed lesions equals the number of developed ones after 10 years of follow up, indicating the reliability of epidemological studies for recording the long-term success of endodontic treatments. This type of studies gave us valuable information about the level and development of dental practice in different periods, the common endodontic errors and the prevalence of periapical pathosis in subpopulations.[21,22] To overcome the disadvantages of this type of studies, the sample was expanded and radiographs had been evaluated by using good illumination and magnification. All panoramic x-rays in this study were taken in dental school clinics of Damascus University. Many studies did not find significant differences between periapical and panoramic x-rays in evaluation of periapical pathosis.

One of the most important questions is whether the study represents the Syrian subpopulation? To come up to an answer we should mention that dental school clinics of Damascus university is one of the biggest dental clinics in Damascus that offers consultations and treatments to so many people from Damascus and its province.

The criteria of sample selection was: The patient should have received his previous treatment outside dental school clinics (by general practice dentists), did not receive any dental treatment for at least one year of attendance to give a chance for any radiographic radiolucency to be healed by that time. According to Ørstavik D (1996)[23] 89% of lesions would heal after one year of endodontic therapy.

The number of endodontically treated teeth was 784 teeth (half of them were upper and lower molars). The prevalence of periapical lesions was about 33.42%, 58.5% of the coronal restorations were evaluated as adequate with different type of restorations, while 5% of the sample lost its restorations. The incidence of apical periodontitis associated with Adequate coronal restorations was lower with significant difference than inadequate ones. This is comparable to other studies results.[13,14]

Table 8: Evaluation of the significant differences between studied groups

Group A	Group B	No.	Chi-Square	d.f.	*P* value (2 tailed)	Significant diff. ?
Adequate in both endodontic treatment and coronal restoration	Adequate in endodontic treatment only	145	3.105	1	0.078	No
	Adequate in coronal restoration only	459	35.219	1	0.000**	Yes
	Inadequate in both endodontic treatment andcoronal restoration	418	82.962	1	0.000**	Yes
Adequate in endodontic treatment only	Adequate in coronal restoration only	366	4.024	1	0.045*	Yes
	Inadequate in both endodontic treatment andcoronal restoration	325	15.053	1	0.000**	Yes
Adequate in coronal restoration only	Inadequate in both endodontic treatment andcoronal restoration	639	29.733	1	0.000**	Yes

*: Significant at (P<0.05), **: Significant at (P<0.01)

The effect of the type of the coronal restorations on the status of periapical tissues was not crucial. In 111 cases out of 784 cases, the final restoration included canal post (with coronal filling or full crown). Some studies indicated that the presence of canal posts accompanied with higher percentage of periapical pathosis due to leakage during post space preparation or infrequent irrigation or weakening the remaining gutta percha.[14,24,25] Our findings revealed no relationship between the post and the outcome of the treatment. other studies gave similar results.[26,27]

Root canal filling was adequate in 18.5% of cases which is so low when compared to other studies that consider root canal therapy as predictable treatment.[28] In this study, the correlation between periapical pathosis and inadequate root canal treatment was highly significant, other studies confirmed these results.[13,29]

When each factor (root canal filling or coronal restoration) was evaluated separately, it had a significant influence on periapical health; in fact, these two factors are un separated. To evaluate which factor had the greater impact on outcome, we statistically analyzed the results of combination of these two factors.

Success rate (the presence of healthy periapex) scored in 96.6% of cases with adequacy of both factors and decreased to 88.5% in cases with adequate root canal fillings and inadequate coronal restorations but with non-significant difference (it means that root canal treatment exert greater impact on outcome). In cases with adequate coronal restorations and inadequate root canal fillings success rate was recorded in 70%, which again indicates the importance of root canal filling in the success of the endodontic treatment. The worst results were obtained when both factors are inadequate which accompanied with lower successful results and high significant difference compared to all studied groups. That indicates the importance of a complete treatment (adequate root canal filling and placement of adequate final coronal restoration).

CONCLUSION

Overall results indicate that the factor that plays the key role in the success of a treatment is the quality of root canal filling without neglecting the effect of the coronal restoration. The prevalence of periapical lesion in Syrian subpopulation is high which indicate poor dental practice. Thus, considerable efforts should be spent to improve the level of endodontic treatment and promote periradicular health.

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