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Survival of root filled cracked teeth in a tertiary institution

L. Tan[1], N. N. Chen[1], C. Y. Poon[1] & H. B. Wong[2]

[1]Department of Restorative Dentistry, National Dental Centre, Singapore; and [2]Biostatistic Department, Clinical Trial and Epidemiology Research Unit, Singapore

Abstract

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Aim To assess the survival rate of root filled cracked teeth over a 2-year period in a tertiary institute.

Methodology Forty-nine patients who had root canal treatment completed on their cracked teeth at the National Dental Centre (Singapore) were recalled for a 2-year review. Collected review data included presence of periodontal pocketing, sinus tract and swelling associated with the teeth. The date of extraction was noted if a tooth was missing at review. Pre-treatment data collected were number, extent and location of crack, presence of periodontal pocketing, patients' age and gender, location of cracked teeth, type of teeth and presence of terminal cracked tooth.

Results Fifty teeth in 49 patients were included. The Kaplan–Meier estimate of 2-year survival rate was 85.5% (95% confidence interval: 75.5–95.5). Cracked teeth which were the terminal teeth in the dental arch (RR = 4.9, 95% CI: 1.2–2.0, $P = 0.04$), teeth with pre-root filling periodontal pocketing (RR = 4.9, 95% CI: 1.2–2.0, $P = 0.04$) and teeth with multiple cracks (RR = ∞, 95% CI: 1.9–∞, $P = 0.01$) were more likely to be extracted.

Conclusions Within the limitations of this study, multiple cracks, terminal teeth and pre-root filling pocketing were significant prognostic factors for the survival of root filled cracked teeth.

Keywords: cracked teeth, endodontic treatment, prognosis, survival.

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Introduction

Cracked teeth have been defined as teeth with cracklines present in the vertical (occlusal–cervical) plane over a period of time (Rivera & Williamson 2003). These teeth have always presented a restorative dilemma for dentists as their prognosis is unpredictable. Many review papers have discussed the diagnosis and management of cracked teeth (Ailor 2000, Zimet & Endo 2000, Lynch & McConnell 2002, Geurtsen *et al.* 2003). Initial signs of cracked teeth include diffuse pain, an uncomfortable sensation while chewing and sensitivity to cold and sweet drinks (Homewood 1998, Ailor 2000, Brynjulfsen *et al.* 2002, Lynch & McConnell 2002).

The recommended management of these teeth includes cuspal protection with cast restorations and root canal treatment (RCT) if the pulp becomes irreversibly inflamed (Ehrmann & Tyas 1990, Ailor 2000). The clinical decision to treat and restore such teeth involves discussion with patients on the prognosis, cost and treatment time. This decision-making process, however, has been empirical as there are, so far, no clinical studies to assess the treatment outcome of such teeth. Thus, it was the aim of this study to assess the survival rate of root filled cracked teeth over a 2-year period in a tertiary institute.

Materials and methods

Forty-nine patients who had root canal treatment completed on their cracked teeth, at the National

Correspondence: Dr Lisa Tan, 5, Second Hospital Avenue, 168938 Singapore (Tel.: 065 9828 7892; fax: 065 6733 1903; e-mail: lstana@singnet.com.sg).

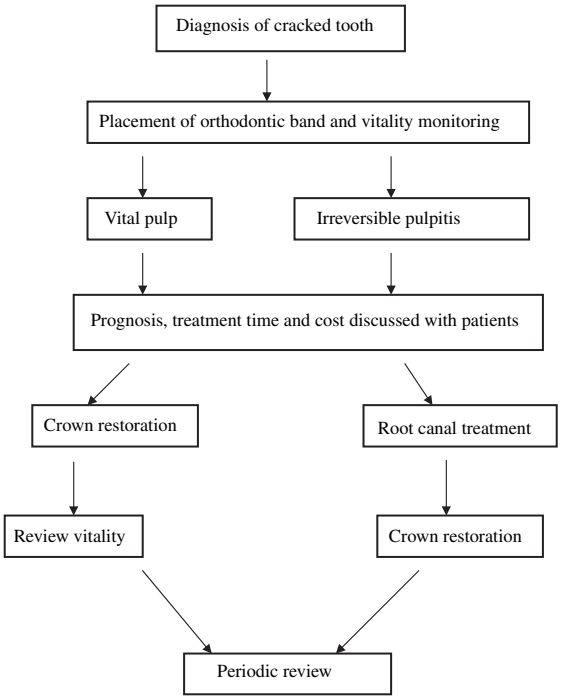

Figure 1 Protocol for management of cracked teeth at National Dental Centre (Singapore).

Dental Centre (Singapore) from November 1999 to June 2001, were recalled for a 2-year review by four endodontists.

These cracked teeth had been managed by following the treatment protocol for cracked teeth at the Centre. This protocol is summarized in Fig. 1. Root canal treatment was performed by four endodontists at the Centre. The teeth were isolated with rubber dam and 1% sodium hypochlorite solution was used as an irrigant during the treatment. The root canals were filled with gutta-percha and Roth's 801 sealer (Roth International, Chicago, IL, USA). During root canal treatment, the number (single or multiple), location (mesial, distal, buccal or palatal/lingual) and extent of crack-lines (coronal or radicular) were charted by the endodontists. Crack-lines which had extended beyond the orifices of the root canals were classified as radicular cracks. If they were confined within the wall of the pulp chamber, they were classified as coronal cracks. The extent of the longest crack was considered if multiple cracks were present. Magnification under microscope and methylene blue staining were used to investigate the cracks.

The teeth were restored with full-coverage crowns when they became asymptomatic after root canal treatment. However, there were some patients who did not wish to have crown restorations. In these cases, the teeth were restored with amalgam cores and were protected by orthodontic bands. Cracks were left *in-situ* during treatment and there was no attempt to eliminate them. The teeth were also not taken out of occlusion as they were protected by crowns or orthodontic bands.

During the review visit, the presence of sinus tracts, swelling and periodontal pocketing associated with the cracked teeth were noted. Periodontal pocketing was considered to be present if the periodontal probing was >3 mm. If the tooth was missing at review, the date of extraction was recorded.

General and pre-treatment data of these patients and their cracked teeth were collected from their clinical records. These included: (i) race and gender, (ii) type of tooth (molar or premolar), (iii) location of the tooth (maxillary or mandibular), (iv) number of cracks (single or multiple), (v) extent of crack (coronal or radicular), (vi) location of crack (mesial, distal, buccal or palatal/lingual), and (vii) presence of periodontal pocketing associated with the cracked teeth. Cracked teeth which were also the most posterior teeth in the dental arch (terminal teeth) were also noted.

All statistical analyses of the data were carried out using SPSS (version 11.5; SPSS® Base 11.5, Chicago, IL USA). A tooth was considered as 'survived' if the tooth was present at the time of review. The 2-year survival rate of root filled cracked teeth was estimated using Kaplan–Meier method. Associations between tooth survival status and explanatory variables were assessed using Fisher's exact tests or Mann–Whitney *U*-test. The relative risk with 95% CI was calculated

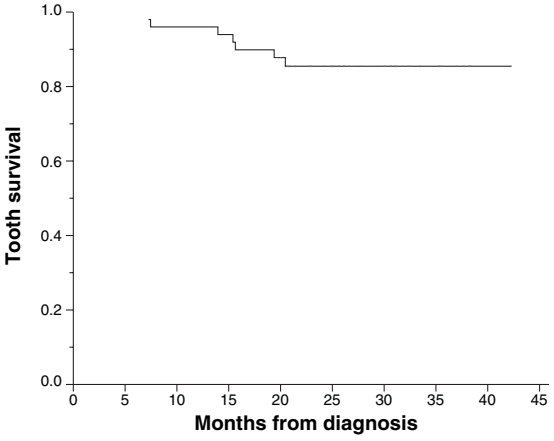

Figure 2 Tooth survival curve.

using Miettinen–Nurminen method (Miettinen & Nurminen 1985). Adjusted analysis was not performed because the sample size was small. Statistical significance was set at $P < 0.05$.

Results

The mean age of 49 patients was 44.7 years (SD: 10.9) and median age was 42.5 years (range: 23.7–73.7). Fifty root filled cracked teeth were included. Of these, 24 teeth were located in the maxilla and 26 teeth were located in the mandible. Forty-seven teeth were molars and three teeth were premolars.

At review, 40 teeth (80%) were asymptomatic and seven teeth (14%) had been extracted prior to review. Three teeth (6%) presented with an associated swelling at review. These teeth were not extracted as the swellings could be eliminated after treatment.

For all teeth, the minimum follow-up time was 7.3 months, and the maximum follow-up time was 42.3 months. The Kaplan–Meier tooth survival curve is shown in Fig. 2. It indicates a 2-year survival rate of 85.5% (95% CI: 75.5–95.5).

Table 1 shows the association between the tooth survival and explanatory variables. The results show that cracked teeth which were also terminal teeth in

Table 1 Association between tooth survival status and explanatory variables

Factor	Proportion extracted (%)	Relative risk	95% confidence interval[a]	*P*-value[b]
Race				
Chinese	7/42 (16)	1.0	–	0.58[c]
Indian	0/5	0.0	0.0–3.1	
Others	0/3	0.0	0.0–4.2	
Gender				
Female	4/30 (13)	1.0	–	1.0
Male	3/20 (15)	1.1	0.3–4.1	
Arch				
Mandible	3/26 (12)	1.0	–	0.70
Maxilla	4/24 (17)	1.4	0.4–5.4	
Tooth type				
Molar	6/47 (13)	1.0	–	0.37
Premolar	1/3 (33)	2.6	0.4–9.5	
Terminal abutment				
No	2/33 (6)	1.0	–	0.04
Yes	5/17 (29)	4.9	1.2–20	
Location of cracks				
Mesial				
No	3/26 (12)	1.0	–	0.70
Yes	4/24 (17)	1.4	0.4–5.4	
Distal				
No	0/17	1.0	–	0.08
Yes	7/33 (21)	∞	1.1–∞	
Buccal				
No	6/42 (14)	1.0	–	1.00
Yes	1/8 (13)	0.9	0.1–4.3	
Palatal or lingual				
No	4/35 (11)	1.0	–	0.66
Yes	3/15 (20)	1.8	0.5–6.2	
Multiplicity of cracks				
Single	0/24	1.00	–	0.01
Multiple	7/25 (28)	∞	1.9–∞	
Extension of cracks				
Within crown	5/37 (14)	1.0	–	0.25
Radicular extension	2/6 (33)	2.5	0.6–8.2	
Pre-treatment pocketing				
Absent	2/33 (6)	1.0	–	0.04
Present	5/17 (29)	4.9	1.2–20	

[a]Miettinen-Nurminen method.
[b]Fisher exact test.
[c]Fisher exact test comparing Chinese versus other.

the dental arch (RR = 4.9, 95% CI: 1.2–2.0, $P = 0.04$), teeth with pre-treatment periodontal pocketing (RR = 4.9, 95% CI: 1.2–2.0, $P = 0.04$) and teeth with multiple cracks (RR = ∞, 95% CI: 1.9–∞, $P = 0.01$) were more likely to be extracted. In this study, the age (median age: extracted 40.9 vs. survived 45.3, $P = 0.956$), the gender and race of patients, the location and type of tooth, the extent and location of crack did not significantly affect the survival of cracked teeth.

Discussion

This study showed that root filled cracked teeth had a 2-year survival rate of 85.5%. There are, so far, no reports on the survival rate of these teeth in the literature. Alley *et al.* (2004) reported that the 5-year survival rate of root filled teeth performed by endodontists was 98.1%. Cracked teeth are usually deemed to have poorer prognosis. Thus, the survival rate of 85.5% for cracked teeth could be considered as reasonable.

Terminal teeth had been defined as the most posterior teeth in the dental arch. It has been shown that terminal teeth in the dental arch are constantly subjected to the maximum occlusal forces compared with the more anterior teeth (Hattori *et al.* 2003). Multivariate analysis also indicated that the terminal abutment was one of the significant factors affecting the survival of teeth (Palmqvist & Sőderfeldt 1994).

All pre-treatment periodontal pockets associated with cracked teeth were isolated pockets; the patients did not have periodontal disease. They were probably caused by fine cracks that had propagated over a period of time, thus affecting the support of the periodontium (Gutmann & Rakusin 1994). These periodontal pockets then act as pathways for further infection, resulting in the loss of teeth.

In this study, however, the radicular extension of cracks was not a significant prognostic factor for the survival of cracked teeth. The sample size in this study was small; the relationship between the radicular extension of cracks and survival of teeth may be better evaluated by future studies using larger sample size.

When multiple cracks are present, teeth will be weaker structurally than those with a single crack. As crack-lines propagate, some may communicate and result in complete fracture (Gutmann & Rakusin 1994).

Although some of the variables in this retrospective study could not be controlled, it has indicated that root filled cracked teeth have a reasonable survival rate. Prospective studies are required to further evaluate the treatment outcome of cracked teeth.

Conclusion

Within the limitations of this study, the 2-year survival rate of root-filled cracked teeth was 85.5%. Multiple cracks, terminal teeth and pre-treatment pocketing were significant prognostic factors for survival of root filled cracked teeth.

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