Radiographic periapical healing associated with root treated teeth accessed through existing crowns: a historical controlled cohort study

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ABSTRACT

Objectives: The aim of this study was to determine the periapical healing rate and complications arising from non-surgical root canal treatment (NSRCT) conducted through the existing and retained restoration, compared to that conducted after removal of restoration (direct or indirect) with subsequent placement of a new crown.

Materials and Methods. Two-hundred-and-forty-five teeth met the inclusion criteria and were followed-up for 2 years. One-hundred-and-six teeth had NSRCT completed through existing cast restorations, and 57 and 82 had the existing crowns and direct restorations removed (respectively) and received a new crown after NSRCT. Periapical healing was assessed radiographically using strict (complete healing) and loose (complete and incomplete healing) criteria. Multivariable logistic regression models were used to investigate the effect of prior restoration removal on periapical healing following NSRCT, adjusting for potential confounding ($p<0.05$).

Results. There was no significant ($p>0.05$) difference in the periapical healing rates amongst teeth accessed through existing crowns (72%, 90%) versus those where crowns (79%, 93%) or direct restorations (77%, 90%) were removed for NSRCT. The findings were adjusted for the significant influencing factor: size of pre-operative radiolucency ($p<0.05$). Of the 109 teeth that were initially accessed through existing crowns, 9 (8%) displayed porcelain fracture or crown de-cementation.

Conclusion. Performing root canal treatment through an existing full coverage restoration did not compromise periapical healing and was associated with a low incidence of associated complications.

Clinical Relevance: Crown removal before NSRCT is not mandatory for periapical healing but requires a judicious pre-assessment of current and future marginal and restorative integrity.

Key-words: outcome; periapical healing; endodontic access; crown; quality of restoration

INTRODUCTION

Non-surgical Root canal treatment (NSRCT) aims to prevent or treat apical periodontitis [1] with the ultimate post-operative goal of normal periradicular tissue architecture. A range of pre-operative, intra-operative and post-operative prognostic factors influence periapical healing [2]. Of these, the quality of the post-treatment restoration has a decisive influence on long-term periapical healing, presumably through aiding control of the treated root canal system environment [3]. A well-designed, fabricated and delivered crown after NSRCT may also reduce uncontrolled mechanical stresses and the risk of catastrophic tooth structure failure [4] and thus improve the long-term survival of the tooth-full coverage restoration assembly.

It is estimated that millions of conventional crowns or fixed partial dentures (FPD) are placed every year [5,6], with or without prior root canal treatment. The placement of such restorations requires sufficient tooth structure sacrifice to create space for an adequate bulk of restorative material for optimal strength, contour and aesthetics. In a proportion of teeth with vital pulps, this may lead to severe and irreversible pulpal injury [7,8], and the consequent need for root canal treatment [9,10]. The proportion of restored teeth requiring root canal treatment may be related to the type of restoration and extent of occlusal support it provides. For example, 3% of teeth prepared for single crowns needed root canal treatment (at an average of 6 years post-operatively), compared to 11% of fixed partial denture abutments (at an average of 8 years post-operatively), and 10-23% of teeth supporting extensive fixed partial dentures [8,11]. Root canal treatment, in the form of revision, may also be required on crowned and previously root-treated teeth with persistent or new periapical disease [2,12].

The dentist confronted with the prospect of managing pulpal or periapical disease on crowned teeth, faces the dilemma of whether to first remove the crown for safer access or to cut an access through it [13]. The conscientious dentist will be compelled to weigh several arguments for or against each approach, in the process of deciding.

Forceful prosthetic crown removal would risk damage to the tooth and crown, whilst cutting the crown off would commit the patient to the expense of a new restoration, albeit with tooth-structure saving. Access through a prosthetic crown, meanwhile, may risk rendering the core and crown unstable through unintentional weakening of carefully placed retention features [14]. It may also lead to loss of orientation by the operator, leading to a mal-aligned access cavity with unnecessary dentine removal, coupled with the ignominy of difficulty in locating the canals [15].

The argument for removal of crown or FPD prior to root canal treatment was given a decisive edge by the notion and evidence that pulp necrosis may be preceded by an underlying cause (leakage, caries or cracks) that merits prior correction [16]. Added to this is the need to assess remaining tooth structure to determine future predictable restorability. The counter-argument is that such a draconian policy is prone to unnecessary sacrifice of sound restorations and increased time and financial cost for the patient. With or without agonising about such difficult decisions, dentists and patients frequently choose to keep an existing extra-coronal restoration due to the cost of a replacement. A survey found that many Endodontists and General Dentists routinely access through existing crowns [17], however, there is a lack of published data on the influence of accessing through existing crowns *versus* prior crown removal on the subsequent periapical healing and restorative complications.

The primary aim of this study was to radiographically determine the 2-year periapical healing associated with NSRCT completed through full coverage restorations in teeth with pre-operative periapical radiolucencies compared to those that had the existing restorations first removed (cuspal coverage and direct restorations) and subsequently restored with new full coverage restorations.

The null hypothesis was that there was no significant difference in periapical healing between teeth that had NSRCT completed through a pre-existing full coverage restoration, compared to teeth that received root canal treatment after restoration removal, coupled with subsequent placement of a new crown.

A secondary aim was to determine the complication rate (porcelain fracture and de-cementation) of accessing *through* existing extra-coronal restorations for up to 2 years later.

MATERIALS AND METHODS

Patient and tooth selection

Clinical records and radiographs of consecutive patients referred for NSRCT to manage periapical disease, and completed by a single operator (LF) at a Specialist Endodontic practice based in Poole, Dorset, United Kingdom, between July 2014 and December 2016, were identified. Only patients who had attended annual reviews of periapical healing for two years post-NSRCT were included [2,18] but those with complete healing at one-year were not subjected to further review.

The selected root-treated teeth were divided into those where NSRCT had been performed by accessing existing crowns, as well as those where existing restorations (direct or indirect) were first removed to allow completion of NSRCT plus placement of an immediate core and then subsequent restoration with a new full coverage crown. Direct restorations commonly encountered and removed before NSRCT included amalgam and a variety of tooth-coloured plastic filling materials (resin-based, glass-ionomer-based, variety of interim restorative material). Indirect restorations were either full-ceramic, full-metal or porcelain-bonded-to-metal crowns.

Patients with a medical history of diabetes or corticosteroids were excluded. Teeth were excluded, if they had one or more of the following variables, that were identified as potential confounding factors:

1. radiographs of inadequate quality;
2. history of previous surgical treatment;
3. periodontal defects deeper than 5 mm [19];
4. coronal cracks extending into the pulp chamber [20];
5. pre- or intra-operative treatment mishaps (missed canals, perforations, separated instruments) [21];
6. absence of patency at the canal terminus [2];
7. root fillings other than gutta-percha; or
8. root fillings with voids or not extending within 2 mm of the radiographic apex [22].

Data collection

The following demographic and clinical data were extracted from the clinical notes: sex, age, tooth type, size of periapical lesion, presence of sinus tract and primary or secondary nature of root canal treatment (pre-operative), permanent core material (intra-operative), function as FPD abutment, cast restoration material and quality of coronal restoration (post-operative).

Clinical procedure

All patients were treated under local anaesthesia and rubber dam isolation. A dental operating microscope (Global Surgical Corporation, St Louis, MO) was used during the entire procedure. Existing large plastic restorations (amalgam or composite restorations) in the line of the access cavity were removed before NSRCT and any remaining restoration parts were removed before post-operative build-up. The decision to either keep or remove an existing cast cuspal-coverage restoration was reached in conjunction with the patient through informed consent. In general, patients were advised to have the crown removed if there was a poor marginal fit or tooth restorability was suspected to be questionable. However, in cases of suboptimal marginal adaptation but with an absence of gross marginal discrepancy and obvious caries, the patient made the final decision after being informed of the potential impact on treatment outcome. When accessing through a cuspal coverage restoration, a ball-ended diamond bur (Endo Access FG 2, Maillefer, Ballaigues, Switzerland) was used to remove porcelain and a tungsten carbide fissure bur (Jet Carbide FG 246, Kerr, Orange, CA, USA) to cut through metal with appropriate orientation, under water irrigation. Once in the pulp chamber the access was refined with an ultrasonic tip

(Start-X 3, Maillefer, Ballaigues, Switzerland) and the walls explored to determine the presence and size of restorations, caries and cracks. Following access, working length measurements were determined with a #10 or larger ReadySteel file (Dentsply Sirona, Ballaigues, Switzerland) using an electronic apex locator (EAL) (Root ZX II; J Morita, Irvine, CA) and the root canals were prepared with a reciprocating system (Wave One/Wave One Gold, Dentsply Sirona, Ballaigues, Switzerland). The EAL '0 reading' was taken as the apical limit of the preparation. A periapical radiograph was taken when apex locator readings were not stable or were discrepant with pre-operative radiographic estimated lengths. Master apical file size determination was based on triangulation of several factors: initial radiographically estimated canal size, evidence of debris on apical file-flutes during instrumentation and tactile feedback of apical file fit. The minimum apical preparation size was that of the Primary file of the reciprocating system (#25). Root canal filling materials were removed by using a combination of size 2 Gates-Glidden drills, hedstrom files or reciprocating instruments with or without the use of chloroform. The root canals were irrigated with 3% sodium hypochlorite (Teepol products, Orpington, UK) heated with a baby bottle warmer (Philips Avent, Philips, Guilford, UK) and a final rinse with 20% citric acid (Cerkamed, Stalowa Wola, Poland) delivered *via* a 27-G open-ended notched needle (Sherwood Medical, St. Louis, MO, USA). Both irrigant solutions were agitated manually with a matched gutta-percha cone, sonically (Endoactivator, Dentsply Sirona, Ballaigues, Switzerland), ultrasonically (Irrisafe, Acteon, Merignac, France) or by a combination of these. The canals were dried with matched paper points and obturated with matched gutta-percha cones (Dentsply Sirona, Ballaigues, Switzerland) and AH Plus Sealer (Dentsply Sirona, Ballaigues, Switzerland) using a Schilder's warm vertical compaction technique. The tooth was then restored with dual-cure resin composite (Core-X, Dentsply Sirona, Ballaigues, Switzerland), glass ionomer cement (Fuji IX, GC America Inc., Alsip, IL, USA) or silver amalgam (Dispersalloy, Dentsply Sirona, Ballaigues, Switzerland). Intermediate Restorative Material (Dentsply Sirona, Ballaigues, Switzerland) orifice plugs were placed in conjunction with glass-ionomer cement and amalgam restorations. In general, accessed full-ceramic crowns were repaired with composite resin, whereas full-metal and porcelain-bonded-to-metal crowns were restored with either of the used core materials. Patients were referred back to the general dental practitioner after root canal treatment for the provision of cusp coverage restorations.

Radiographic examination

All periapical radiographs were taken with a paralleling technique using a positioning device (XCP holder; Rinn, Elgin, IL, USA). Conventional radiography with dental X-ray film (Insight; Eastman Kodak, Rochester, NY, USA) developed in an automated processing machine (Velopex Intra XE; Medivance Instruments, London, UK) was used for cases completed before March 2016. Digital radiography with an intraoral sensor (Planmeca ProScanner, Planmeca, Helsinki, Finland) was used for cases completed from March 2016 onwards. Conventional radiographs were placed on a light box and photographed in a standard manner using a DSLR camera in close-up default setting (Canon EOS 1100D, Canon Ltd, Uxbridge, UK) with a macro lens (Tamron AF 90mm f/2.8 Di SP A/M 1:1, Tamron Europe, Cologne, Germany) positioned in a horizontal camera mount (Alzo

Digital, Bethel, CT, USA). The images were then imported into the digital imaging software (Planmeca Romexis, Planmeca, Helsinki, Finland) and calibrated.

Radiographic evaluation of healing

An independent assessor (JR) examined the radiographs on a computer screen (iMac, Apple, Cupertino, CA, USA) in a dimly-lit room. A second observer (SM) assessed 30% of the sample to account for variation in radiographic assessment [2]. Examiners were able to visualize all radiographs of each case at the same time and could adjust brightness and contrast on the digital system software. The clinical crown was masked for radiographic periapical assessment. Both assessors were pre-calibrated by examining reference radiographs of the four categories of periapical healing outcomes:

1. *complete healing*, in the absence of apical abnormalities;
2. *incomplete healing*, when the pre-operative lesion had reduced in size without restitution of a normal periodontal ligament space;
3. *uncertain*, when it was not possible to make a decision on the progression of the periapical lesion;
4. *failure*, in case of persistent or worsening periapical radiolucency.

Radiographically-determined "success" was based on strict (only complete healing) or loose (both complete and incomplete periapical healing accepted as successful outcomes) criteria [2]. If a tooth had been extracted or had received further treatment because of endodontic problems, it was judged a failure. Multi-rooted teeth were assessed according to the root with the largest periapical radiolucency.

Evaluation of post-operative quality of the final restoration

Clinical examination of the restoration's marginal adaptation was carried out with a DG16/23 explorer (Hu-Friedy, Frankfurt Am Main, Germany) at a 90° angle to the restoration margin. The quality of the final extra-coronal restoration was dichotomized into: (i) *poor quality*; if there were clinical signs of recurrent caries, overhangs or a catch was detected with the explorer when run across the tooth/restoration interface, and radiographically if there were visible overhangs or gaps at the restoration margin; or (ii) *good quality;* if marginal fit was judged satisfactory both clinically and radiographically.

Statistical methods

Kappa scores were calculated to establish radiographic intra- and inter observer agreements.

The Cohen's kappa coefficient was calculated to assess both inter- and intra-observer reliability in determination of radiographic healing outcome. Good agreement was taken as >0.8, substantial as 0.61-0.8, and moderate 0.4-0.6 [23].

Multivariable Generalised Linear Models were used to investigate the effect of removal *versus* access through retained existing crowns on the periapical healing rate following root canal treatment, after accounting for the potential confounding.

RESULTS

A total of 536 teeth in 511 patients were identified to be associated with periapical radiolucencies. The number of patients attending their scheduled review appointments was 429 (84%; 454 teeth). Sixteen patients (16 teeth) were excluded because of their medical history and 6 (6 teeth) because the teeth had been extracted for non-endodontic or unknown reasons. A further 187 teeth were excluded for a range of other reasons as shown in Table 1. The final cohort comprised of 245 teeth in 236 patients after the inclusion and exclusion criteria had been applied.

A total of 109 teeth were initially accessed through crowns or FPDs, of which 9 (8%) displayed subsequent complications: 3 teeth had their crowns removed before NSRCT completion due to de-cementation (n=1) or porcelain fracture (n=2), leaving an actual sample in this group of 106 teeth. A total of 7 molars and 2 premolars (8%) exhibited porcelain fracture (n=8) or de-cementation (n=1) after crown access. Porcelain repairs were conducted for 6 crowns together with the access restoration, with the use of dual-cure resin composite (without porcelain etch and silane), and were still present at the last follow-up visit.

Of the remaining 139 teeth, 57 had existing crowns and 82 had direct restorations removed for NSRCT, and were subsequently restored with a new full coverage restoration. The characteristics of the final cohort stratified by pre-NSRCT restorative status are presented in Table 2. There were significant differences ($p<0.05$) in the distribution of sex, age, number of retreatment cases, choice of core material and function as fixed-prosthesis abutment between the treatment groups (Table 2).

For determination of periapical healing, intra-observer agreement was good (kappa 0.831; 95% confidence interval [CI]: 0.689-0.972) and inter-observer agreement was substantial (kappa 0.717; 95% CI: 0.511-0.924)

The strict and loose periapical healing outcomes were 79%, 93% (respectively) for teeth that had crowns removed and 77%, 90% (respectively) for direct restorations removed prior to root canal treatment. The respective values were 72%, 90% for teeth in which it was performed through the pre-existing crown without its removal.

Multivariable Generalised Linear Models accounting for each demographic or tooth-related factor (Table 2) revealed that the odds of periapical healing were not significantly ($p<0.05$) different whether the NSRCT was performed with or without prior restoration removal, regardless of choice of radiographic criteria. Age, sex, tooth type, previous NSRCT, presence of sinus tract, core and crown restorative material, quality of the final coverage restoration and tooth functioning as abutment did not show any significant ($p<0.05$) association with periapical healing. Larger pre-operative periapical radiolucencies significantly ($p=0.01$) reduced the odds of periapical healing judged by strict criteria (OR = 0.9; 95% CI: 0.8, 0.9) but not by loose criteria ($p>0.05$).

DISCUSSION

The aim of this retrospective cohort study was to compare the periapical healing rate of teeth receiving NSRCT with or without prior crown removal; removed restorations were replaced with a new crown after root canal treatment. In an effort to minimize bias due to potential confounding effects, variables that were likely to influence treatment outcome were identified as criteria for exclusion or were accounted for in the statistical analysis.

The healing rate of the studied cohort was in line with previous studies [2,24] and the recall rate was higher than other similar reports [2,25,26]**.** The 2-

year follow-up protocol had been adopted as a routine by the operator based on the fact that most teeth heal within this time range [2,18]**.**

A prospective case series had previously found that clinical examination and periapical radiographs were inadequate to detect caries, cracks and marginal breakdown, which in a majority of cases were only detected after restoration removal [16]**.** One school of thought proposes that marginal integrity is all-important for predictable periapical healing following root canal treatment [16]. It consequently deprecates treatment through existing crowns, with or without suspect margins, because it deems it impossible to judge internal flaws in adaptation. However, the present study found that accessing through pre-existing restorations did not confer a significant negative impact on radiographically observed periapical healing in such cases. Despite the clinical division of presenting restoration margins into the binary categories of good or poor quality, they exhibited a wide spectrum of marginal goodness-of-fit. It is likely that externally evident marginal discrepancies may not necessarily represent complete lack of internal adaptation. Clinically significant “leakage” would require continuous channels of communication from the oral environment to the root-filling and thence to the periapex [27,28]. The fact that all teeth in this study were restored with a definitive core immediately after root canal treatment may have “blocked” the continuity of any such channels to the root-filling. The long-term durability of such “blocking” still needs to be tested through longer follow-up than the two years adopted [29].

The quality of crown margin adaptation, as determined through a binary measure in this study was not found to affect periapical healing. This is in contrast with other longitudinal studies [22,30], which have found that the quality of the post-operative coronal restoration is one of the strongest predictors of periapical healing after NSRCT, along with the pre-operative presence of an apical radiolucency and the quality and apical extent of the root filling. Clinical measurement of marginal quality is notoriously difficult and variability in the definition, assessment and standardisation of such criteria may explain differences between studies. In this clinical investigation a large proportion (42%) of the coronal restorations were assessed as inadequate, which may imply a stricter than usual assessment of the quality of the restoration and inclusion of marginally “suboptimal”, yet clinically acceptable restorations, as “inadequate”.

Regardless of the material used, the restorative imperative is to achieve the best adaptation to the cavity wall to exclude microleakage. There is always a microscopic gap at the restoration/tooth interface, clinically undetectable by the finest dental probe tip (40µm), allowing penetration of fluids and bacteria from the oral cavity [31,32]. Such leakage can be associated with numerous clinical consequences, including post-restoration dentine sensitivity, marginal staining of teeth or restorative material, restorative material degradation, dentine softening, frank caries, pulpal and periapical inflammation, and failure of root canal treatment [33,34]. Although differences may be apparent in the frequency of such problems between various restorative materials [32,34], the probability and predictability of the depth of leakage penetration into the marginal interface lacks clarity [35].

In the absence of sophisticated diagnostic tools to determine marginal integrity quality that could meaningfully be correlated with clinically significant leakage, the default approach relies on gross measures detectable by the human eye, tactile feel of discrepancy with a probe or some form of magnification.

One of the main reasons for removing crowns or restorations prior to root canal (re)treatment is to assess the tooth's structural integrity and to inform the restored tooth's survival prognosis [36]. Although, this study's primary goal was not to examine tooth survival, it was noted that 5 of the 6 teeth excluded due to extraction had undergone root canal treatment through existing restorations. Retrospective examination of these cases revealed four to be FPD abutments, one of which had fractured, another had developed a large carious lesion and the others were of unknown aetiology. These findings highlight the importance of pre-operative restorability assessment and the need for further research on the survival of teeth accessed through existing restorations.

In the absence of firm scientific data, clinically pragmatic protocols may serve to aid decision-making on when to remove an existing restoration and when to retain it, rather than the punitive threshold of removing *all restorations* from teeth that require root canal treatment. Recently, well-designed, fabricated and placed restorations exhibiting little outward evidence of marginal deficiency or leakage (discolouration, caries or sensitivity), may be assumed to have good internal adaptation. The length of service of the restoration without a history of decementation or without signs of marginal leakage may also be given the benefit of the doubt, regardless of the visual judgement about marginal adaptation. Having cut the access cavity through a prosthetic crown, the internal interfaces between the restoration and tooth structure may be explored with an instrument such as an *American Pattern probe* for signs of leakage to the pulp chamber, to decide on crown removal at this early stage. Restorations with obvious marginal gaps, coupled with discolouration, caries and history of decementation lie at the opposite end of the spectrum, where the restoration may be better removed at the outset.

A number of *in-vitro* studies have investigated the impact of endodontic access cavities on crowns. Some investigated the fracture resistance of crowns after access [37-40], some evaluated crown damage upon endodontic access preparation [37,41] and others, loss of crown retention [14,42,43]**.** A reduced crown retention [14,37,42] and fracture resistance [39,40] was generally reported, albeit with restitution of original values after restoration [14,38-40]. The latter results could explain the low number of complications in the present study (8%), with only 3 of 109 requiring replacement. The present study results are in contrast with those of two clinical studies with longer recall times which reported complications in 21% of the crowns after an average of 4.48 years [44] and crown survival rates of 82.7%, 71.5%, 67.3%, and 48.8% after 2, 5, 7, and 10 years, respectively [45].

The size of the pre-operative lesion was found to affect periapical healing, consistent with previous findings [2,25].

CONCLUSION

The provision of root canal treatment through an existing crown or FPD abutment did not reduce the probability of periapical healing. The pre-operative size of the periapical radiolucency affected its subsequent healing rate. The occurrence of complications upon accessing through crown restorations was low 2 years after the treatment.

Compliance with ethical standards

Conflict of interest: The authors deny any conflicts of interest.

Ethical approval: This non-intervention retrospective cohort study did not require research ethics committee review according to the United Kingdom Health Research Authority (http://www.hra-decisiontools.org.uk/research/). This study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed consent: This study did not use identifiable details of patients and treatment data used was gathered anonymously.

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Table 1 Reasons for exclusion of teeth

	Number of teeth
Inadequate image quality	4
Periodontal disease >5 mm	17
Coronal cracks into pulp chamber	18
NSRCT mishaps	17
Absence of apical patency	16
Root filling other than gutta-percha	4
Suboptimal post-operative root filling	4
Absence of cuspal coverage	107
Total	**187**

Table 2 Demographic and tooth-related characteristics by the treatment groups

	Crown retained	Crown removed	Restoration removed	P value
	106 teeth	**57 teeth**	**82 teeth**	
Sex				
Females (%)	60 (56.6%)	36 (63.2%)	33 (40.2%)	0.02
Males (%)	46 (43.4%)	21 (36.8%)	49 (59.8%)	
Age (years)	60±12	59±11	55±14	0.02
Tooth type (%)				
Maxillary				
Incisors/canines	7 (6.6%)	9 (15.8%)	0 (0%)	0.03
Premolars	15 (14.2%)	6 (10.5%)	10 (12.2%)	
Molars	35 (33.0%)	13 (22.8%)	27 (32.9%)	
Mandibular				
Incisors/canines	3 (2.8%)	3 (5.3%)	0 (0%)	
Premolars	6 (5.7%)	2 (3.5%)	5 (6.1%)	
Molars	40 (37.7%)	24 (42.1%)	40 (48.8%)	
Size of pre-operative periapical radiolucency (mm)	5.7±2.8 mm	6.5±3.0 mm	5.7±2.8 mm	0.2
Presence of pre-operative sinus tract (%)	32 (30.2%)	17 (29.8%)	14 (17.1%)	0.09
Previous treatment (%)	31 (29.3%)	37 (64.9%)	28 (34.2%)	<0.0001
Quality of final coverage restoration				
Good	62 (58.5%)	35 (61.4%)	48 (58.5%)	0.9
Poor	44 (41.5%)	22 (38.6%)	34 (41.5%)	
Crown material				
Porcelain bonded crown	75 (70.7%)	42 (73.7%)	50 (61%)	0.8
Full metal crown	13 (12.3%)	5 (8.8%)	22 (27%)	
Full ceramic crown	18 (17.0%)	10 (17.5%)	10 (12%)	
Post-RCT core material				
GIC	35 (33.0%)	3 (5.3%)	24 (29.3%)	<0.0001
Amalgam	20 (18.9%)	2 (3.5%)	6 (7.3%)	
Composite	51 (48.1%)	52 (91.2%)	52 (63.4%)	
Function as abutment at review	18 (17.0%)	3 (5.3%)	3 (3.7%)	0.004