Clinical decision-making in complex endodontic cases between postgraduate students across dental specialties at a UK dental school: A pilot study

Abstract

Introduction: Treatment decisions for a heavily restored endodontically treated tooth vary amongst clinicians owing to multitude of factors. This phenomenon not only often poses dilemmas to clinicians of different clinical backgrounds, it also exerts a degree of treatment difficulty to the treating clinician. Previous studies indicated that specialty training and clinical experience significantly impacted clinical decision-making process.

Materials and Methods: Master of Science postgraduate students in endodontics, prosthodontics, periodontics, oral surgery and implantology participated in a questionnaire-based cross-sectional study. The dental specialties were further categorised into restorative and surgical dentistry. A multiple-choice questionnaire with three clinical cases was distributed to the students. Data were analysed for trends using descriptive statistics.

Results: There was a 44% response rate; the majority of respondents were from restorative dentistry specialties. Cases 1 and 2 were rated as moderate to high difficulty, Case 3 was predominantly rated as high difficulty with procedure predictability being the main factor affecting their clinical decision-making in three cases. Endodontic retreatment was selected as the preferred treatment in Cases 1 and 2 and periradicular surgery in Case 3. The students were fairly confident in managing Cases 1 and 2, but not in Case 3. Referral patterns were consistent in Cases 1 and 2 with endodontists being the first choice of referral except for Case 3 where 48% preferred to refer to oral surgeons and 35% choosing endodontists. Some indication of differences between specialties were noted throughout. Years in practice appeared to be related to the importance of predictability in Case 3 only.

Conclusion: Considerable inter-clinician variability was noted whereby specialty postgraduate training impacted on clinical decision-making. Overall, procedural predictability, technical difficulty, risk of damage to the tooth and patient preference were the most highly ranked factors affecting clinical

decision-making. Evidence-based treatment guidelines and dental curricula should be reviewed to enhance inter-clinician agreement in clinical decision-making, ultimately improving patient care.

Keywords: Clinical decision making; Dental education; Dental school; Dental specialties; Endodontics; Postgraduate students

Introduction

Clinical decision-making (CDM) is the consideration of the evidence base, clinical judgement and patient values to identify the optimal treatment modality for a specific patient.[1] However, treatment decisions vary amongst dental clinicians owing to different clinical backgrounds or specialties,[1] ability to appraise the existing literature and knowledge,[2] education and training, experience, attitudes and values of involved persons and economic resources.[3] Some clinicians may base their clinical decisions on personal values and experience without any objective analysis of the treatment outcomes.[4] It could also be argued that clinicians are not necessarily making evidence-based decisions in every clinical situation owing to barriers like information overload from new product brochures or company representatives or inappropriate application of scientific evidence to a particular patient.[5]

CDM has now become a collaborative process whereby both patient and clinician are mutually involved in a shared and parallel decision making process by which a consensus is reached.[6] While the patients' views on their treatment plans may not be feasible or based on sound knowledge, how a patient perceives his/her treatment can ultimately influence the CDM process of the clinician.[7] However, most patients in general have the tendency to opt for treatments that are consistent with the clinician's recommendations.[8]

Complex endodontic cases with evidence of post treatment disease are particularly challenging to manage. This is indicated by the presence of emergent, persistent or recurrent clinical symptoms together with non-resolving or enlarging periapical radiolucency.[4] Due to the lack of available guidelines in the management of symptomatic complex endodontic cases, dental professionals often have no concordance in the decision-making process, resulting in subjective and varied recommendations.[9]

A failed complex endodontic case entails a heavily restored, symptomatic endodontically treated tooth that requires further treatment. Failed heavily restored endodontically treated teeth often pose dilemmas to clinicians of different clinical backgrounds in primary and secondary care settings as there are several alternative treatment options available which sometimes may be more cost effective or less complicated to be considered by both patient and clinician.[10] Factors to take into consideration when planning for the treatment of a failed heavily restored endodontically treated tooth are listed in Table 1,[11, 12, 13] often resulting in a variety of treatment options based on individual circumstances of the patient. These treatment options are:

- non-surgical endodontic retreatment
- periradicular surgery
- extraction and replacement with fixed or removable prosthesis
- extraction and replacement with a single implant
- intentional replantation

A heavily restored, symptomatic endodontically treated tooth could pose a degree of treatment difficulty to the treating clinician.[14] This situation often leads a clinician into a predicament as to preserve the root-treated tooth with non-surgical endodontic retreatment, periradicular surgery or remove the offending tooth and restore the gap with different prostheses.[15] A prudent decision-making process is therefore pivotal in ensuring a safe and effective treatment outcome for the patient.

As previous studies indicated that specialty training and clinical experience significantly impacted CDM,[1, 4, 13, 15, 16, 17] it is important to understand how different specialties may approach a heavily-restored, symptomatic endodontically-treated tooth. This has implications for patient outcomes but also for postgraduate dental educators; increased understanding may contribute to adapting curricula to support clinicians in their CDM for complex clinical cases regardless of their specialty. Therapeutic decisions can be inconsistent even with clinical conditions being equal, which has been integral to the development of evidence-based dentistry/medicine.[18] A postgraduate student cohort was selected as the ideal sample based on their current hands-on experience, diverse clinical and demographic backgrounds.

The objectives of this study were:

- To recognise if inter-clinician variabilities exist in CDM of postgraduate students
- To identify factors which influence the CDM of postgraduate students

Materials and methods

Study design

This cross-sectional study was conducted at University of Central Lancashire between October 2018 and February 2019. Ethical approval was gained from the School of Dentistry ethics committee.

Study population

Eligible participants were students who started the part-time three-year MSc programmes in oral surgery, prosthodontics, endodontics, dental implantology and periodontics in year 2016, 2017 and 2018.

Recruitment

Recruitment took place between October 2018 and February 2019. Following a brief introduction to the study, invitation letters, information sheets, questionnaires and return envelopes were distributed to all students during joint teaching sessions by an independent member of staff. Participation was on a voluntary basis. A consent form was not used but participants were notified that consent would be implied by receipt of response, i.e. submission of the completed questionnaire. The participants who completed the questionnaire were required to place the document in the opaque envelopes provided and place the sealed envelopes in a designated collection box in the school office at the end of their lectures or clinics. The collection box was securely stored by a member of school office staff at the end of working day. No incentive was provided to the study participants.

Questionnaire development

The questionnaire comprised of three anonymised clinical cases (see Figures 1-3). All cases comprised of a radiograph and clinical information relevant to the research objectives and were obtained from the

authors' archive. Cases selected varied in terms of tooth location and complexity. A clinical diagnosis was included in each case scenario to prevent ambiguity.[19] Radiographs were the only supplemental material provided in line with previous studies where the authors adopted similar questionnaire method.[1, 13, 15]

The content of the questionnaire was developed by authors JL and SK by adapting themes used in previous studies.[1, 13, 15] It was piloted among a group of postgraduate dental students of different specialties at another UK dental school to identify any possible issues within the questionnaire prior to data collection. Feedback received from the pilot phase was used to refine the questionnaire, including the removal of ambiguous phrases, detailing of case information, and improving clarity. The reliability of the questionnaire was confirmed by a test-retest methodology, whereby substantial intra-rater agreement was achieved.

Questions

The questionnaire consisted of parts A and B. Part A involved general information and demographic details of the participant, including gender, programme of study, number of years practising clinical dentistry and type of practice. Part B consisted of three clinical cases, with five multiple-choice questions and relevant radiograph within each case. The questions were all identical in three cases to ensure standardisation. The participants were asked to:

1) Rate the level of difficulty/complexity of the cases (minimal, moderate, or high difficulty).
2) Rank the factors which would be taken into consideration in participant's clinical decision making based on importance (1 being most important, 5 being least important). The factors were tooth restorability, procedure predictability, technical difficulty, risk of iatrogenic root/tooth damage, patient preference, time required to complete treatment and finance/cost of treatment.
3) Rank the treatment options from each case based on the participant's judgement (1 being most preferred option, 5 being the least preferred option). The options were non-surgical endodontic retreatment, periradicular surgery, extraction and replacement with fixed prosthesis, extraction and replacement with removable prosthesis, extraction and replacement with a single implant, intentional replantation, no treatment, and 'other' options.

4) Identify their confidence level in managing the case successfully (confident, fairly confident, not confident or prefer to refer).

5) Choose the specialty the participant would refer to if he/she were to refer for further management (prosthodontics, oral surgery, endodontics, implantology, periodontics or no referral required).

Data management and analysis

To ensure anonymity, participant responses were assigned a code during data collection. Data analysis was undertaken in IBM® SPSS® Statistics Version 20.0 (IBM Corp). Non-responses or partially completed responses were classed as missing. Comparisons were carried out for individual specialties as well as based on Restorative Dentistry specialties (endodontics, periodontics and prosthodontics) and Surgical Dentistry (oral surgery and dental implantology; implantology was categorised as a surgical specialty owing to the requirement for meticulous surgical planning prior to surgical insertion of implant which subsequently allows diligent restorative planning to achieve the best desired outcome[20]).

A sample size calculation was not carried out. It was designed as a small-scale pilot study to explore CDM amongst postgraduate students using a questionnaire within a timeframe of the MSc programme. Owing to the anticipated smaller sample size and pilot nature of the study, data were analysed using descriptive statistics and crosstabulation to identify trends in the data with Fisher' Exact Test used to investigate potentially meaningful differences on the basis of demographic information.

Results

Of the 109 potential participants approached, 48 (44%) responded. The majority of the respondents (n=24; 50.0%) were postgraduate students enrolled in the periodontic and endodontic programmes and most (n=31, 64.6%) had been practising dentistry for less than ten years. The majority (n=30; 62.5%) were male and almost 50% worked in private practice (Table 2). Owing to small numbers, we report aggregated findings but highlight potential explanatory trends throughout.

In response to Question 1, Cases 1 and 2 were rated as moderate to high difficulty, whereas Case 3 tended to be rated as high difficulty. While responses for Case 2 tended to be consistent across

specialties, there was a tendency for the endodontic students to rate cases 1 and 3 as more difficult, with 72.7% (n=8) and 90.9% (n=10) of these students selecting the high difficulty option respectively. Fisher's Exact Test demonstrated that years of practice was unrelated to perceived difficulty or complexity of the cases (p=0.50).

With Question 2, the factors to be considered during CDM that were selected most frequently in Cases 1 and 3 were almost identical; procedure predictability (n=45, 93.8% and n=46, 95.9% respectively), technical difficulty (n=43, 89.6% for both scenarios) and risk of damage to the tooth or root (n=38, 79.2% for both scenarios). For Case 2, procedure predictability was again most frequently selected (n=46, 95.9%), followed by technical difficulty (n=44, 91.7%) and patient preference (n=36, 75.0%). For Case 3, Fisher's Exact test demonstrated a significant difference in terms of the ranking of treatment predictability and years in practice (p=0.045).

The primary treatment decision of postgraduate students assessed in Question 3 showed that more than 70% (n=24) of students from the restorative specialties opted for non-surgical root canal retreatment compared to just over half of the surgical postgraduate students in Case 1. (Proportions ranged from 81.8% (n=9) of endodontic students to 69.2% (n=9) of periodontic students, while for the oral surgery and implantology students the proportions were 50.0% (n=3) and 55.6% (n=5) respectively). Extraction and placement of relevant prostheses as a treatment option was chosen by only 12% (n=4) of the restorative group and 33.4% (n=5) of the surgical group. Periradicular surgery was selected as first choice of treatment by 9% (n=3) of students from the restorative specialties and 13% (n=2) of surgical specialty students (Figure 4).

Similarly in Case 2, almost 90% (n=29) of the respondents from restorative specialties prioritised the non-surgical root canal retreatment option whereas only 53.3% (n=8) of the surgical group agreed. The high proportion in the restorative group was mainly driven by the endodontic (100%, n=11) and periodontic (92.3%, n=12) students. The implantology students were the least likely to select this option with only 44.4% (n=4) agreeing, where a Fisher's Exact Test showed that this was statistically significantly different from the endodontic students (p=0.008). Only 6% (n=2) of the respondents from the restorative group chose extraction and placement of other prostheses for Case 2, in contrast with 26.7% (n=4) from surgical group. Interestingly, there were very small number of respondents from

restorative and surgical specialties who opted for periradicular surgery as their first choice of treatment (Figure 5).

The pattern of results was different for Case 3. Periradicular surgery was chosen as the first choice of treatment by 46% (n=15) and 40% (n=6) of the restorative and surgical specialties respectively. Extraction and placement of relevant prostheses were chosen by 33.4% (n=11) of the restorative students and 40% (n=6) of the surgical students, whereas non-surgical endodontic retreatment option was only chosen by 15% (n=5) and 20% (n=3) of restorative and surgical groups respectively. Additional options were suggested from the restorative group, including surgical exploration and enucleation of apical lesion (Figure 6). In all three cases, trends between specialties and years of practice in clinical dentistry were not observed, there was no obvious indication that more experience yields a more consistent approach.

In response to Question 4, the confidence level was comparable in Cases 1 and 2 with 63.8% (n=30; 1 missing) and 60.4% (n=29) of respondents were at least fairly confident in managing the case successfully. This was reversed in Case 3 with 64.6% (n=31) not confident in successful management of the case. There was little deviation from these data between specialties and years of practice. Overall, although oral surgery students reported being more confident in treating Case 3 with 83.3% (n=5) being fairly confident, fewer than 50% of students from other specialties reported being at least fairly confident.

Finally, Question 5 assessed which specialty the respondent would refer to when further management was deemed necessary. Referral to a specialist endodontist was the choice for the majority in Cases 1 and 2 (n=36, 75.0% and n=41, 85.4% respectively). In Case 1, there was great variation between specialities; 100% (n=11) of endodontic students would refer to an endodontist followed by 92.3% (n=12) of periodontic students. Prosthodontic students were least likely to select this option (44.4%, n=4). In case 2, it was the periodontic students who were most likely to refer to a specialist endodontist (100%, n=13). Proportions for other specialties varied between 66.7% (n=4) studying oral surgery, to 90.9% (n=10) studying endodontics. In Case 3, a specialist oral surgeon referral was felt most appropriate by 47.9% (n=23) of respondents, with a specialist endodontist being chosen in 35.4% (n=17) of cases. This was driven mainly by the prosthodontic students where 77.8% (n=7) of them would refer to a specialist

oral surgeon. Endodontic and periodontic students were more likely to refer to an endodontist (54.5%, n=6 and 38.5%, n=5 respectively). No trends were noted by years of practice.

Discussion

The results demonstrated variation between specialities in their choice of CDM across the three cases of failed endodontically-treated teeth. The complexity of each case within this study fell into the moderate to high difficulty categories based on the American Association of Endodontists (AAE) Endodontic Case Difficulty Assessment Form and Guidelines.[21] This indicated that the cases would prove challenging for an experienced dentist and may necessitate specialist referral.

Perhaps unsurprisingly, respondents rated case 3 as having the highest complexity level with nearly 67% rating it as highly difficult to manage. This was possibly due to the presence of a well-circumscribed periapical radiolucency on a tooth 31 with an apparently adequate existing root filling, which appeared to extend accurately to working length. Some respondents also considered the possibility of surgical exploration and enucleation of the apical lesion associated with the diseased 31 hence complicating the management of the case. Periradicular surgery and enucleation of a mandibular incisor lesion has always been difficult due to complex root morphology and inclination of lower incisors, complicated by difficult access and limited visibility during surgery.[22]

Procedure predictability appeared to be the most important factor in all three case scenarios in CDM. The presence of a post-crown in tooth 11 would pose a challenge for endodontic retreatment. Although the risk of root/tooth fracture during the removal of post-crown has been reported to be low,[23] it is still a technical challenge for the operator and a risk that the patient has to consider. In view of that, most students would consider the difficulty in predicting the outcome of the tooth due to the technical difficulty of post-crown removal. Procedure predictability was also an important factor in decision making in Case 2. A good technical quality of existing endodontic treatment accompanied by a well-fitting crown on a tooth with complex anatomy would pose a question as to whether revisiting good existing treatment was justified in such situation, contributing its difficulty in predicting the outcome of successful endodontic retreatment. The presence of an apical lesion associated with 31 in Case 3 rendered the difficulty in

predicting the outcome of the tooth high as the success was determined by feasibility of the tooth, skills and training of the clinician,[24] the nature of the lesion[25] as well as patient's co-operation and compliance during procedure.[22] Lingual inclination of mandibular incisor and its proximity to adjacent teeth would affect the access to surgical site for periradicular surgery.[22] There was a significant difference in terms of the ranking of procedure predictability and years in practice in Case 3 which could be attributed to the complex nature of the case requiring combined endodontic and surgical knowledge in its management. Complex cases like these are often managed by clinicians working in specialist institutes or hospitals where extra postgraduate training, skills and state-of-the-art instruments are required to manage the cases to high standards.[26] These clinicians would be in a better position to predict the outcome and viability of the tooth/procedure based on extensive experience and regularity in managing such complex cases.

Non-surgical endodontic retreatment appeared to be the treatment of choice for students of restorative specialties because the students were trained to retain teeth in all possibilities using advanced restorative techniques. For example, the endodontically trained students were more confident in performing endodontic retreatment procedures with the aid of microscope. It has been suggested that non-surgical endodontic retreatment should be regarded as the first treatment modality in symptomatic endodontically treated tooth.[22, 27] Periapical lesions may regress with orthograde endodontic retreatment by reducing the bacterial load within the root canal system before a surgical option is considered.[28] Students from the surgical specialities were more likely than those in the restorative specialties to favour extraction and replacement with a prosthesis in Cases 1 and 2. It could be speculated that the trend of tooth retention versus extraction may be attributed to the training these postgraduate students received throughout their postgraduate careers.[1] The restorative specialties were more likely to prioritise non-surgical root canal retreatment over extraction as compared to surgical specialties, as seen in Cases 1 and 2.

Periradicular surgery as a treatment option was also selected in all cases, with this being the first choice of treatment in Case 3 across restorative and surgical specialties. This could be due to the well-circumscribed apical lesion which may necessitate surgical intervention and histopathological analysis. It must be noted that it is not possible to diagnose a cystic lesion from the radiographic assessment alone, including 3-dimensional CBCT images as radiographic analysis has shown no correlation

between the size and nature of the lesion.[29] Non-surgical endodontic retreatment alone would unlikely resolve the apical lesion if it were cystic in origin, surgical intervention would have been indicated if the signs and symptoms persisted. Surprisingly, a small number of students from restorative and surgical specialties opted for periradicular surgery for tooth 46 in Case 2. A meta-analysis reported a low healing rate of 63.7% with periradicular surgery on mandibular molars,[30] which may also be complicated by multi-rooted morphology, proximity of roots to the inferior dental canal potentiating iatrogenic nerve injury.[31]

In Case 3, students from different specialties chose to refer the case to an oral surgeon or endodontist for further management. This could be due to low confidence in the surgical management of the well-defined radiolucent apical lesion due to lack of training or exposure to surgical procedures at undergraduate level.[32] This could also be argued from another perspective, that more than 50% of GDPs in a study considered periradicular surgery as the main reason for their referral whilst experience did not matter since qualification had no impact on this decision.[33] It was interesting to find that endodontic and periodontic students chose to refer to a specialist endodontist rather than a specialist oral surgeon. This could be due to non-surgical root canal retreatment being the first line of treatment prior to surgical intervention.[10] Nevertheless, the clinical decision made in this study to refer Case 3 for further management was appropriate in ensuring patient safety and patient-centred care.

Most students were fairly confident in managing Cases 1 and 2 due to its' non-surgical nature compared to Case 3 which involved surgical intervention as part of the management. The students' CDM were appropriate in these cases because primary endodontic treatment in 11 and 46 may have failed due to insufficiently disinfected root canals or coronal leakage. Teeth with apparently adequate root fillings may still harbour bacteria within the root canal system,[34] therefore selecting endodontic retreatment to reduce the intracanal microbial load would be the ideal treatment.[22, 27] With appropriate techniques and devices, risk of root fracture after post and crown removal had been reported to be as low as 0.06%, enabling the clinician to regain access to the canal system for debridement and retreatment in Case 1.[23] In Case 3, the students made the appropriate decision in referring the diseased tooth 31 to a specialist oral surgeon or specialist endodontist for further management. Whilst both specialties are trained in periradicular surgery, some differences exist in the armamentarium used. Endodontists are trained to

use microsurgical techniques with the aid of a dental operating microscope which has shown significantly higher success rates compared to traditional root-end surgery techniques.[35, 36]

Differences in the CDM process in dentistry are associated with the existence of inter-clinician variability.[1, 3, 37] However, despite these differences the outcomes in patient management were largely consistent and sensible with patient-centred approach care adopted. Most clinicians would have worked in general dentistry acquiring the necessary broad-based experience prior to embarking on a postgraduate programme of their own interest to further hone the skills and knowledge within the specialty.[38] With most respondents having at least 6 to 10 years of dental treatment experience in this study, sensible decision-making processes would have been nurtured within a competent, responsible clinician. Decision-making involving the patient is pivotal as any decision made would have to be in the patient's best interest, putting the patient at the centre of care. Gaining informed consent by involving the patient's decision is significant in today's unprecedented era of the much discussed Montgomery ruling in the prevention of medico-legal litigation.[39] Making the patient aware of any 'material risks' involved in a proposed treatment and of the reasonable alternatives available ensures patient-centred care, reinforcing patient safety.[40] Having said that, it was interesting to note that no respondents chose the option of intentional replantation. Although not frequently carried out, the overall mean survival rates of replanted teeth have been reported to be as high as 88% with a follow up period of between 2 and 22 years.[41] If clinicians were to strictly adhere to the principles of ensuring that patients aware of all reasonable alternatives, then it would be appropriate to include this treatment during their discussion with the patients.

The main limitation of this study was the small sample size. The annual intake also differed for each specialty and this resulted in a relatively uneven spread of participants across the specialties. Despite a small sample size, this pilot study was able to demonstrate and evidence interesting findings about CDM in postgraduate students of a UK university, adding further evidence to the existing literature in decision-making. A multi-centre study would allow a larger number of participants from different geographical locations and backgrounds, inclusion of a wider range of population groups and the ability to compare results obtained from different centres nationally or internationally, all of which could subsequently increase the generalizability of the study. Future studies may include a comparison of CDM between postgraduates, specialists and general dental practitioners. Aspects of the shared decision-making

model may be included in future research in line with integration of patient autonomy in CDM.[42] It would also be ideal to achieve consensus amongst various dental specialties to formalise evidence-based treatment guidelines in complex endodontic cases. Tools such as the Dental Practicality Index (DPI) may aid systematic assessment of cases and enhance CDM as well as communication between clinicians.[43]

Conclusion

There were variations in CDM among the postgraduate students from different clinical specialties across the 3 cases. There were also differences in perception of difficulty levels of each case. In general, procedural predictability, technical difficulty, risk of damage to the tooth and patient preference were the most important factors considered in CDM by all specialties. Evidence-based treatment guidelines and dental curricula should be reviewed to enhance inter-clinician agreement in CDM, ultimately improving patient care.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available because they may contain information that could compromise the privacy of research participants.

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Tables

TABLE 1 Factors to be considered for the treatment planning of a failed endodontically treated tooth[11, 12, 13]

Factors	Remarks
Patient	*Patient's preference*
	Cost/financial situation
	Patient's expectation
	Patient's compliance
	Medical history
Clinician	*Appropriate training and experience*
	Clinical ability
	Knowledge and clinical exposure
	Time required to complete the procedure
Tooth	*Restorability of tooth, restorative status*
	Procedure predictability
	Technical difficulty of tooth
	Aesthetic considerations
	Risks of tooth/root damage from the procedure
Environment	*Location of tooth in the oral cavity (anterior, posterior, maxilla, mandible)*
	The tooth that requires treatment (molar, premolar, canine, incisor)
	General oral hygiene (periodontal and carious status)
	Availability of appropriate instruments/equipment

TABLE 2 Participant characteristics

Characteristic	**n (%)**
Gender	
Male	30 (62.5)
Female	18 (37.5)
Years of practice	
<10	31 (64.6)
>10	17 (35.4)
Type of practice	
Public health service	12 (25.0)
Private	23 (47.9)
Mixed	8 (16.7)
Dental hospital	3 (6.3)
University	1 (2.1)
Armed forces	1 (2.1)

Specialty studied	
Periodontics	13 (27.1)
Endodontics	11 (22.9)
Prosthodontics	9 (18.8)
Implantology	9 (18.8)
Oral surgery	6 (12.5)

TABLE 3 Case difficulty by years of practice and specialty

Case	Difficulty	Overall n (%)	Years of practice n (%)		Specialty n (%)	
		n=48	<10 (n=31)	>10 (n=17)	Restorative (n=33)	Surgical (n=15)
Case 1	Low	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
(missing: 1)	Moderate	20 (42.6)	13 (41.9)	7 (41.2)	13 (39.4)	7 (46.7)
	High	27 (57.4)	18 (58.1)	9 (52.9)	19 (57.6)	8 (53.3)
Case 2	Low	1 (2.1)	1 (3.2)	0 (0.0)	0 (0.0)	0 (0.0)
	Moderate	30 (62.5)	19 (61.3)	11 (64.7)	21 (63.3)	9 (60.0)
	High	17 (35.4)	11 (35.5)	6 (35.3)	12 (36.4)	5 (33.3)
Case 3	Low	2 (4.2)	2 (6.5)	0 (0.0)	1 (3.0)	1 (6.7)
	Moderate	14 (29.2)	9 (29.0)	5 (29.4)	9 (27.3)	5 (33.3)
	High	32 (66.7)	20 (64.5)	12 (70.6)	23 (69.7)	9 (60.0)

Figures

A 50-year-old fit and healthy gentleman was referred by his general dental practitioner (GDP) for the assessment and management of tooth 11. Non-smoker.

The patient previously attended his GDP complaining of a small swelling on the labial aspect of 11. Root canal treatment was carried out on 11 more than ten years ago and the tooth restored with post and core, followed by a metal ceramic crown.

A marginal defect was detected on probing at the distal aspect of the crown margin of 11. The 11 was tender to percussion and palpation. Periodontal probing was within 2-3 mm. The 12 responded within normal limits to the pulp sensibility testing. 21 was an asymptomatic implant with no bone loss or probing depths.

The periapical radiograph revealed an apical radiolucency associated with the 11. The tooth appeared to be restored with a prefabricated parallel metal post. Root canal filling was scantily condensed but extended to the radiographic apex. 21 was restored with an implant with no detected bone loss or associated radiolucency.

Diagnosis: Chronic apical periodontitis associated with failed endodontically treated tooth 11.

Figure 1. Case 1 extracted from the study questionnaire illustrating the endodontically treated tooth 11.

A 38-year-old fit and healthy lady attended the endodontic department for a review appointment following the completion of root canal treatment on the tooth 46 eighteen months ago. Non-smoker.

Upon presentation, the patient was complaining of sensitivity to touch and tenderness to bite on the tooth. The patient recently had a CAD-CAM full ceramic crown cemented on the tooth by her GDP.

Clinical examination revealed a well fitted full ceramic crown on 46. The tooth was tender to percussion and periodontal examination revealed no periodontal pockets all around.

The periapical radiograph revealed an apical radiolucency associated with the 46 mesial root. Root canal filling was well condensed and extended to within 0.5 to 1.0mm of the radiographic apex.

Diagnosis: Chronic apical periodontitis associated with failed endodontically treated tooth 46.

Figure 2. Case 2 extracted from the study questionnaire illustrating the endodontically treated tooth 46.

A 56-year-old fit and healthy lady was referred by her GDP to the oral and maxillofacial surgery unit for the assessment and management of lingual swelling associated with tooth 31. Non-smoker.

The swelling had been present for more than one year and no pain was associated with this. The GDP attempted re-RCT of 31 eight months ago, the swelling persisted but did not increase in size.

Intra-oral examination revealed a firm lingual swelling associated with 31, measured about 8.0mm in diameter. No associated tooth mobility or periodontal pockets were detected.

The periapical radiograph revealed well condensed root canal filling with good coronal seal, extended to within 0.5-1.0mm of the radiographic apex. There was a well-demarcated mixed radiolucent-radiopaque content associated with 31. 32 has poor root treatment with gutta percha points 8.0-10mm short of radiographic apex. There was possible radiolucency associated with poor root canal treatment of 32.

Diagnoses: Chronic apical periodontitis associated with failed endodontically treated tooth 31, +/- tooth 32.

Figure 3. Case 3 extracted from the study questionnaire illustrating the endodontically treated tooth 31.

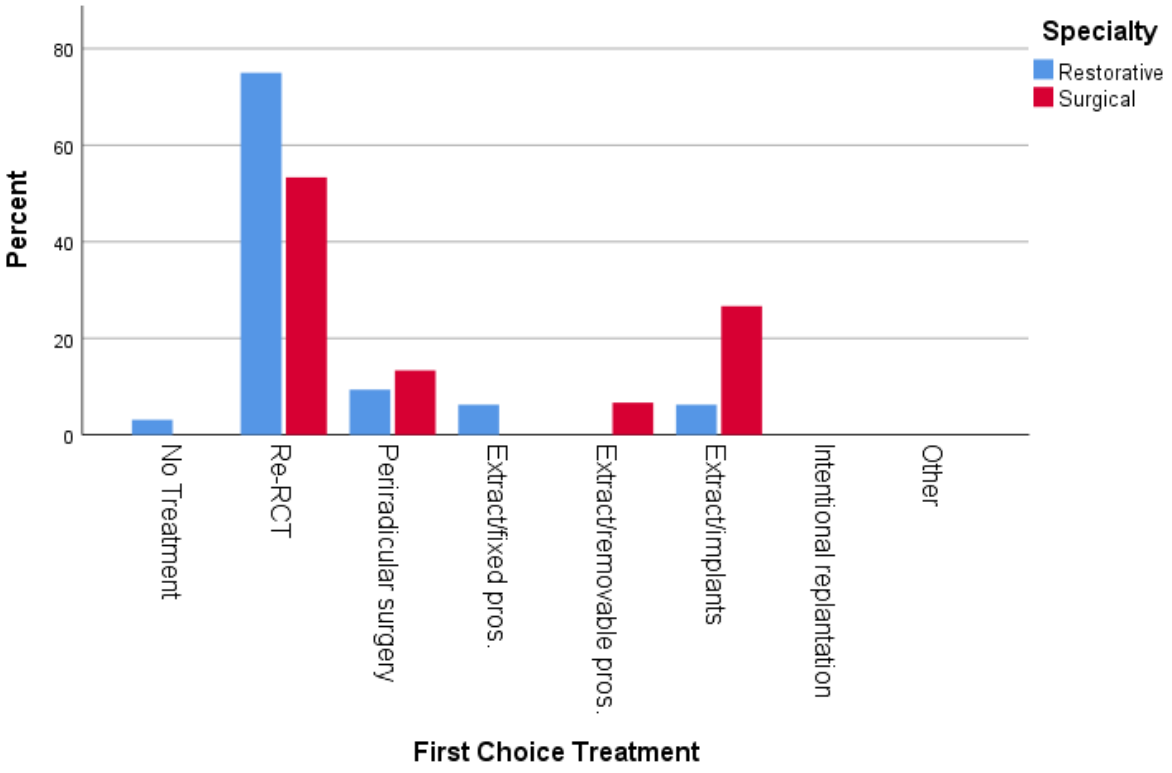

Figure 4. First choice treatment by specialty - Case 1 (Tooth 11).

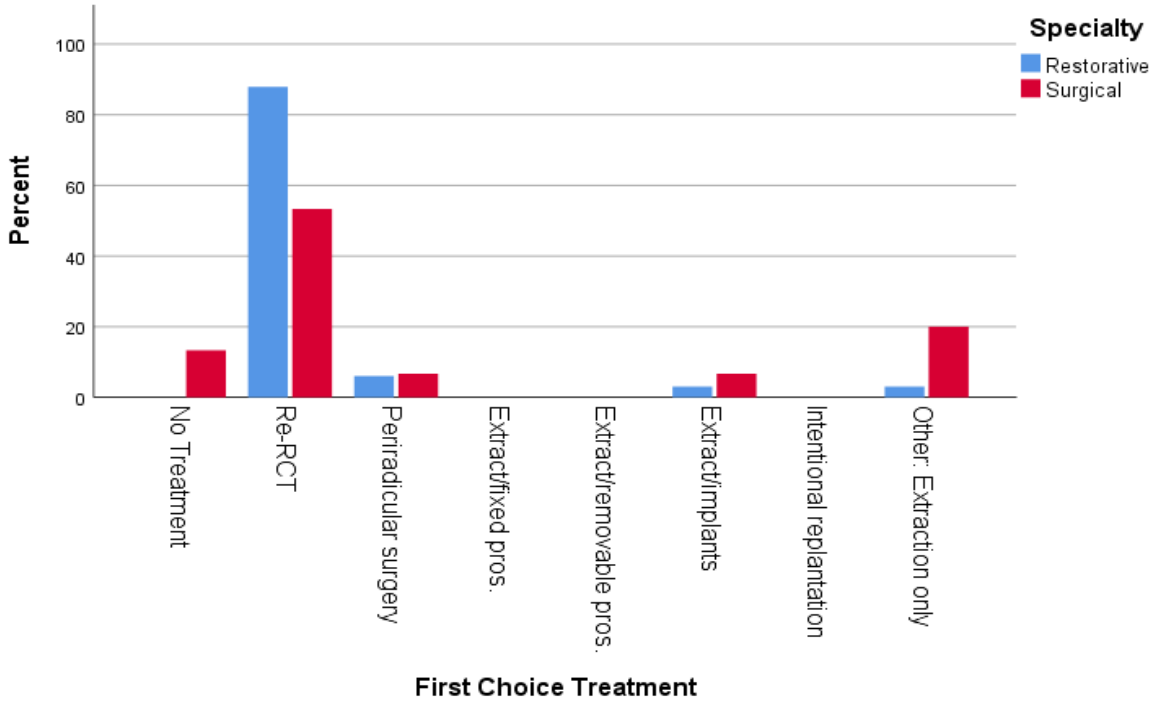

Figure 5. First choice treatment by specialty - Case 2 (Tooth 46).

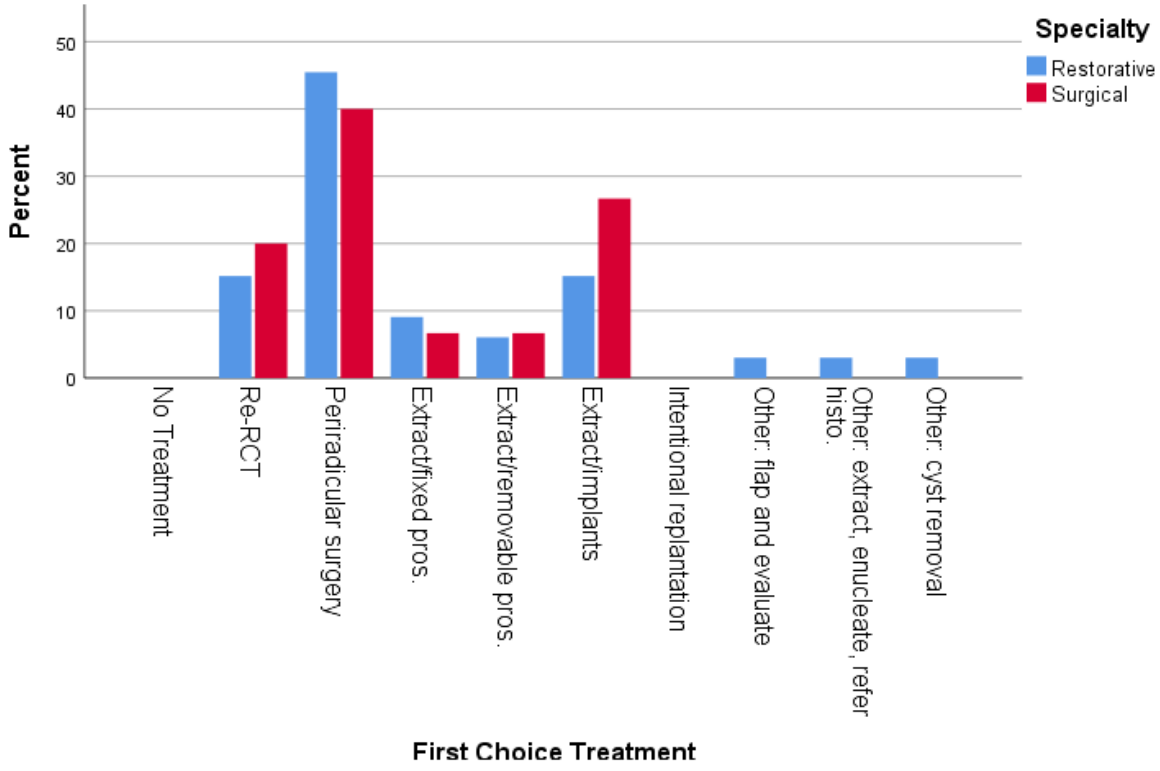

Figure 6. First choice treatment by specialty - Case 3 (Tooth 31).