

# A service evaluation assessing the root canal referral and treatment pathway within the Royal London Dental Hospital

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## Key points

Previous service evaluations have been completed in Level 1 and 2 endodontic services but less is known about Level 3 service provision to which the most complex endodontic treatment is referred.

Evaluates endodontic treatment output, complexity and timescales within a London NHS dental hospital.

Provides insight into the referral pathways of endodontic treatment which primary care practitioners can use to better inform their referral decision-making.

## Abstract

**Aim** Within the National Health Service (NHS) England, dental hospitals are tasked with assessing and managing complex root canal treatments (RCTs) referred from various service providers. The aim of this service evaluation was to investigate the root canal treatment and retreatment (RCrET) output, case complexity designation and referral pathways to the Royal London Dental Hospital.

**Methods** Data were collected and analysed on non-surgical RCTs completed between 1 April 2021 to 31 March 2022, including the number of completed treatments, reason and origin of referrals, referral-to-treatment timelines and complexity of treatments.

**Results** In total, 339 teeth met the inclusion criteria, with external referrals (n = 198) taking an average of 47 weeks from referral to treatment commencement compared to 16 weeks for internal referrals (n = 141). Maxillary incisors and first permanent molars were most commonly referred, with anatomical challenges (33.5%), RCrET (32.2%) and trauma (18%) being the most common reasons. Treatment was completed within an average of 2.7 appointments, with a high proportion of complexity Level 2 and 3 cases being completed.

**Conclusions** The RCT output was shown to be increasing within the service. External referrals are taking longer to be seen and treated compared to NHS targets and internally referred patients; although, further information is needed to understand the exact cause of this. Allocation of treatment complexity appeared to be in line with the clinician's skill set and experience level, taking an average of 2.7 appointments to complete treatment. Further information on the number of referrals, available consultations and clinic space would provide additional insight into the efficiency and pressures of the service.

## Background

Root canal treatment (RCT) is a commonly undertaken dental procedure worldwide, with an average of two RCTs being completed per patient.<sup>1</sup> In the UK, demand for RCT within the National Health Service (NHS) is high

and will continue to rise with an ageing and increasingly dentate population.<sup>2</sup>

The aim of RCT is to prevent or eliminate apical periodontitis and preserve the natural dentition.<sup>3</sup> Where RCT is not clinically appropriate or where patient preference dictates, the alternative treatment is extraction; however, this may not be suitable in all groups of patients, such as those at risk of osteoradionecrosis (ORN) and medication-related osteonecrosis of the jaw (MRONJ).

RCT provision within the NHS in England is divided into three levels, depending on treatment complexity. The majority of RCTs are carried out in primary care (Level 1): this is typically limited to straightforward, non-surgical RCT.<sup>4</sup> Level 2 treatment complexities are undertaken by dentists with special interests/enhanced skills, who may or may

not be a specialist, and Level 3 treatment complexities are performed or overseen by a consultant or specialist, often in a hospital setting, where patients are referred to.

Within London, the Pan-London endodontic referral form exists to communicate RCT referrals to Level 2 and 3 services. At the Royal London Dental Hospital (RLDH), this document is triaged by restorative consultants or specialty training registrars, which, if accepted, will lead to a consultation and subsequent treatment by postgraduate trainees, dental core trainee (DCT), specialist or consultant clinicians within that trust. Pan-London Level 2 and 3 complexity criteria are outlined in Appendix 1 and reflect the national commissioning guidelines put forward by NHS England.<sup>5</sup>

Previous service evaluations have discussed endodontic complexity and service

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provision within Level 1 and Level 2 NHS services;<sup>2,4</sup> however, little is known about Level 3 endodontic service provision within the NHS.

The aims of this service evaluation were to:

- Determine the origins and reasons for referrals to the service
- Establish the number of patients undergoing and completing RCT and root canal retreatment (RCrE) at the RLDH
- Determine the timeline from referral to completion of treatment
- Determine the level of complexity of treatment being carried out and whether this is appropriate for the service.

**Methods**

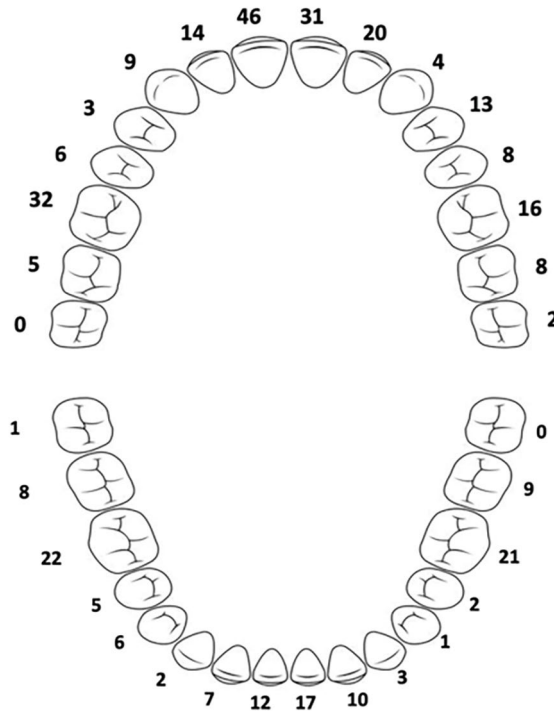
A retrospective service evaluation of patients attending for RCT or RCrE in the RLDH was conducted. A total of 339 teeth were treated between 1 April 2021 and 31 March 2022 in restorative treatment clinics. Our inclusion criteria included patients aged 16 and above seen for RCT or RCrE. Our exclusion criteria included teeth with incomplete RCT and those subjected to surgical endodontic treatment (apicectomy).

Data were collected by two DCTs from electronic and paper clinical records and analysed on Microsoft Excel version 16.71. Data included: clinician completing treatment (DCT, specialty doctor, Master of Science postgraduate [MSc PG], Doctor of Clinical Dentistry postgraduate [DClinDent PG], specialty training registrar [StR], consultant); origin of referral (general dental practitioner [GDP], internal, or other); referral-to-treatment timelines (from referral to assessment, treatment start and treatment finish dates); complexity level of endodontics (in accordance to the Pan-London referral guidelines); number of appointments to complete treatment; tooth treated; and reason for referral.

**Results**

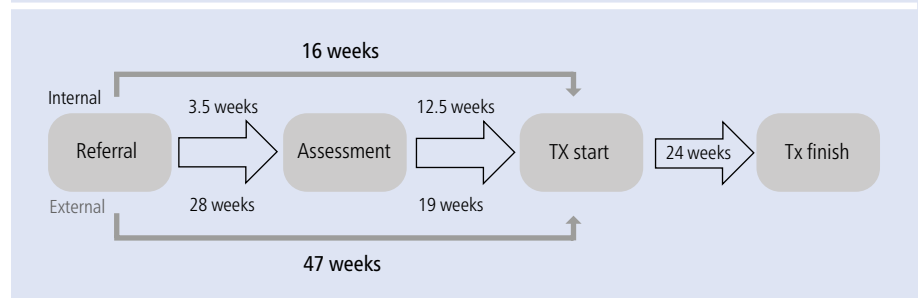
**Origins and reasons for referral**

Of the 339 teeth treated, 198 referrals were external referrals, with 191 originating from primary care services via the Pan-London endodontic referral pathway. Seven were from other tertiary care facilities and 141 referrals from internal departments within the RLDH. The most frequently referring departments for internal referral were trauma, oral and



**Fig. 1** Dental chart depicting numbers of endodontic treatment completed per tooth in 2021–22

**Fig. 2** Flow diagram showing the referral-to-treatment pathway timeline for internal referrals and external referral



maxillofacial surgery (OMFS), periodontal, restorative head and neck cancer (HANC) clinics, restorative and oral surgery.

The most common reasons for referral included anatomical challenges (33.5%), followed by RCrE (32.2%), trauma (18%), medical factors (10%) and iatrogenic errors (6%).

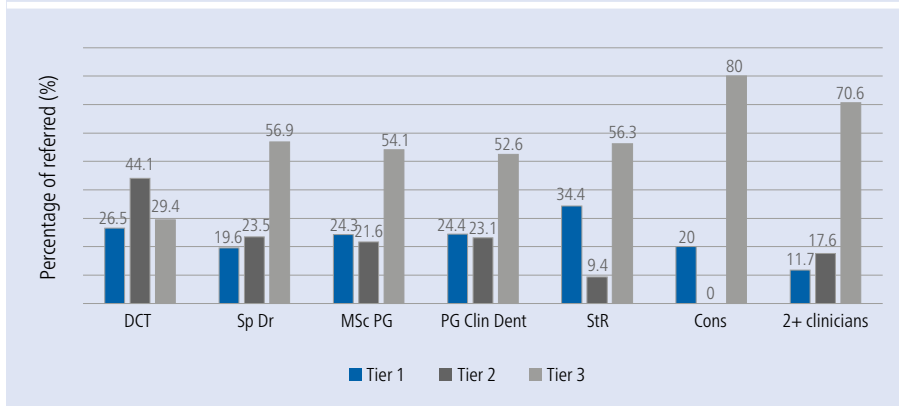
**Number of patients undergoing and completing endodontic treatment**

RCT or RCrE was completed in 339 teeth, of which 322 were completed by a single clinician type: endodontic specialty dentists (35%); DClinDent PG students (24%); DCTs (18%); MSc PGs (10%); restorative StRs (10%); and consultants (2.5%). In 17 cases, treatment was shared between more than one clinician type. Figure 1 shows the different

tooth types treated. The most commonly treated teeth were 11 (n = 46), 16 (n = 32) and 21 (n = 31).

**Treatment timeline**

Figure 2 shows an overview of the time taken from referral to treatment for both external and internal referrals. For the GDP pathway, referrals were initially vetted, and those meeting the acceptance criteria were assessed on a new patient consultation clinic within 28 weeks, with a further 19 weeks between the consultation appointment and the first treatment appointment. The overall average time was 47 weeks from referral to commencement of treatment from GDP-originating referrals, with a large range from 1–168 weeks. This was significantly lower for internal referrals, which do not undergo the

**Fig. 3 Percentage of Tier 1, 2 and 3 complexity endodontics completed by each clinician type**

same vetting process. For internal referrals, the average time from referral to assessment by a restorative clinician was 3.5 weeks, and from assessment to the start of treatment was a further 12.5 weeks. The total referral-to-treatment start time was, on average, 16 weeks, with a range of 0–121 weeks.

Once patients had commenced treatment, the origin of referral was irrelevant and the average number of weeks from treatment starting to completion was 24 weeks. The average number of appointments to complete treatment were 2.7. Molars took an average of 2.9 appointments, premolars 2.5, and incisors and canines 2.4.

### Treatment complexity

Treatment complexity was assessed by two DCT1-level clinicians using the pre-treatment periapical radiographs in conjunction with the guidance from the Pan-London endodontic referral form (Appendix 1). Treatment complexity was designated into Levels 1, 2 and 3 and separated according to clinician type. Figure 3 shows the percentage of the complexity type treated by different clinicians. The clinician with the highest percentage of Level 3 cases as a proportion of their overall endodontic cases were consultants (80%) and treatment shared between two or more clinicians (70.6%). Specialty dentist, MSc PG, DCLinDent PG and StRs' Level 3 cases were all just above 50% of their overall case load, with DCTs having the lowest proportion (29.4%). There was a significant variation in Level 2 cases, ranging from 44% for DCTs to 0% for consultants. Level 1 cases produced the smallest variation between clinicians as a proportion of their endodontic treatment, ranging from 11.7% with shared treatment to 34.4% with StRs.

### Discussion

Our data set comprised 339 teeth, which provides a sufficient data set to assess trends within the endodontic service at a large, London-based teaching hospital. This represents a significant increase from previous data collected at the dental hospital between 2020–2021 ( $n = 146$ ). It should be noted further data from the 2020–2021 cycle were not included within this paper as other data were not collated. The primary factor contributing to this increase was likely the lessening of COVID-19 restrictions, which permitted an increase in clinicians, clinical chair capacity and patients returning for non-urgent treatment. In addition, our most recent data set included more clinician types with the introduction of the DCLinDent PG endodontic programme in September 2020, which will have contributed to increased activity.

With NHS primary care dentists reducing their NHS activity,<sup>6</sup> it is likely secondary and tertiary pathways will have to manage increasing numbers of referrals for RCT and RCreT. Since the switch from fee-per-item to units of dental activity (UDA) in 2006, NHS treatment in the UK has been divided into three bands for which a practice is paid a fixed fee by the NHS. RCT, irrespective of tooth type, falls into the Band 2 treatment category, which equated to three UDAs before 2022 (during our data collection period). Due to the way the banding structure worked, dentists would be remunerated the same for a Class V filling as they would for a molar RCT, despite requiring more skill, time and equipment cost to complete the latter procedure. However, following recent contract reform in 2022, this was increased to five UDAs for RCT of non-molar teeth and seven UDAs for molar teeth. This may contribute to reducing the number

of referrals to the Pan-London endodontic service.

The majority of treated teeth came from primary care and were most commonly for anatomical challenges, such as root canal curvature and sclerosis followed by the need for retreatment. This supports previous findings within Level 2 settings.<sup>2</sup> This was as expected as these are recognised factors that can increase treatment complexity and may be beyond the skillset of many primary care practitioners. A proportion of patients had medically compromising factors, such as severe bleeding disorders, previous head and neck radiotherapy, or bisphosphonate treatment. These patients were already under the care of other departments within the dental hospital and referred internally. The most common internal referrals were from trauma, OMFS, HANC and periodontal, which was not surprising due to the importance of timely RCT in dental trauma to prevent root resorption, avoid dental extraction in patients at risk of ORN or MRONJ, and in the treatment of perio-endo lesions alongside periodontal treatment.

The most treated teeth were maxillary central incisors and first permanent molars. This is likely due to the functional importance of the first permanent molars and their often complex root canal anatomy. In addition to the aesthetic value placed on maxillary incisor, they are most commonly implicated in traumatic injury.<sup>7</sup> Wisdom teeth were least commonly treated, which was again expected due to their reduced prevalence in the population<sup>8</sup> and their lack of aesthetic and functional value, meaning they are often extracted instead. In our data collection, only three wisdom teeth were treated, which were exclusively for patients who had received previous radiotherapy treatment.

The timeline from referral to treatment was far longer for external referrals (47 weeks) than internal referrals (16 weeks). The 47 weeks for external referrals breaches the NHS non-urgent referral-to-treatment time (RTT) target of 18 weeks.<sup>9</sup> This was due to the impact of the COVID-19 pandemic on treatment capacity and limitation of consultant clinics during this period. This is supported by the markedly reduced RTT for internal referrals, which bypass the official consultation appointment stage and are allocated for treatment. Internal referrals can often be fast-tracked due to their urgency in relation to wider treatment planning or ongoing medical care. The pan-London

endodontic referral form completion is not required for internally referred cases and did make determining an exact referral and assessment date more challenging. An internal referral system within the hospital does exist but was not always present in the patients notes, in which case-relevant note entries were assessed instead. This meant referral and assessment dates at times coincided, which may have shortened the referral-to-assessment timeline for internally referred cases, but did not impact the more pertinent figure of the referral-to-treatment timeline.

The average waiting time of almost a year for externally referred patients could negatively impact patients in a multitude of ways. Clinical outcomes may be reduced in the form of increased microbial load in chronic conditions<sup>10</sup> and possible caries progression, reducing the restorability of teeth. Patients may also have to re-attend their dentist for further dressings of the root canal system and/or antibiotics to manage acute episodes of pain and/or infection, affecting patients psychologically and financially. Many patients may also choose to seek private specialist treatment or decide to have the tooth extracted as a result of long waiting times.

To try and reduce these waiting times, the vetting and new patient consultation clinic capacity may need to be increased. In addition, the training of more specialists, who within this service evaluation completed the highest proportion of endodontic treatment, and operate within primary or secondary care settings, would help reduce the pressure on dental hospitals.

RCT within the dental hospital should primarily be Level 3 treatment, except for trainees. There were, especially from internally referred cases, a significant number of Level 1 and 2 complexity teeth that were also treated. This is supported by 70% of externally referred cases being deemed Level 3 versus only 27% of internally referred cases. The results show overall appropriate allocation of treatment to clinicians based on their levels of experience. DCTs, MSc PGs, DClinDent PGs and registrars also undertake a significant proportion of Level 1 and 2 treatment. Some of these simpler cases are necessary, especially in the early stages of training; however, as DCTs and trainees progress, the complexity of the cases they treat increases, and this is demonstrated by trainees also treating a significant number of Level 3 cases. Consultants, on the other hand, completed a very high proportion of Level 3

treatment, in addition to specialist doctors (Fig. 3), which is to be expected considering their specialist status.

A limitation to the complexity data in Fig. 3 is complexity designation from a pre-operative periapical radiograph can be subjective and challenging. A multitude of tools have been developed to aid this, including the Endodontic Complexity Assessment Tool and the British Endodontic Society Case Assessment Tool. For the complexity assignment, the pan-London referral form (Appendix 1) was used, which provides objective descriptors, which still requires subjective interpretation. The DCT1 trainees have less experience in the provision of endodontic treatment, and thus their assessment of treatment complexity may differ from more experienced specialists and consultants.

In future endodontic service evaluations within the service, it would be helpful to collect data on the numbers and rejection rates of referrals, incomplete endodontic treatment, surgical endodontic treatment and numbers of patients not attending appointments, which may give a better overall picture of the service, as these factors can make up for a significant proportion of endodontic administrative and clinical time, which was not accounted for within our data collection. Data on the numbers of referrals compared to consultation clinic capacity and the number of empty treatment slots would give a more precise picture of resource allocation to reduce patient waiting times, in addition to more calibration within the vetting process. With the development of artificial intelligence (AI) (which is already being developed at the University of Surrey in relation to reading radiographs),<sup>11</sup> this could speed up the vetting process in relation to assessing endodontic treatment complexity and provide a more consistent assessment approach.

It is important to remember an efficient Level 3 provider is only of value to patients if they can access and be referred from a robust NHS primary care sector, which, across the country, patients are finding increasingly challenging (and to a greater extent in more rural areas). A recent Health and Social Care Committee report<sup>12</sup> found that 90% of NHS dental practices across the UK were not accepting new adult NHS patients, with 'dental deserts' existing across the country. Within endodontics, there are areas of the country where Level 2 and level 3 NHS service provision is sparse/does not exist and thus

creates regional disparities for patients and health inequalities, whose only option may be to extract the tooth or seek often costly private endodontic care. London is fortunate to have a high proportion of dentists and specialists compared to more rural areas, so access and referral structures are likely to be more robust, but are not free from challenges.

## Conclusion

This service evaluation demonstrates that there is increasing activity within the service after the COVID-19 pandemic but there are long waiting times, especially for externally referred patients, far exceeding NHS targets. Allocation of treatment is overall appropriate based on clinician experience and is being completed within a suitable number of appointments. Improvements must be made to ensure the patient pathway from primary care is more efficient and further data should be collected to best inform the resources required to do this. The Pan-London-managed clinical network for endodontics in London has been very successful in helping to create Level 3 capacity in the hospitals and outsource the Level 2 work. Further work is required to improve engagement with Level 1 and 2 endodontic practitioners to ensure these services are being fully used.

### Ethics declaration

*The authors declare no conflicts of interest.*

*This service evaluation was registered with the Barts Health Trust Clinical Effectiveness Unit (audit number 13234). The data collected was both retrospective and anonymised and not deemed research by the Medical Research Council; ethical approval and consent were therefore not required.*

### Data availability

*The data that support the findings of this study are available from the corresponding author upon reasonable request.*

### Author contributions

*James Wootton – conceived and designed the analysis, collected data, contributed to data/analysis tools, performed the analysis, wrote the paper. Millie Forrester – collected data, contributed to data/analysis tools, performed the analysis. Mitul Patel – contributed to data/analysis tools, wrote the paper. Naren Thanabalan – conceived and designed the analysis, contributed to data/analysis tools, performed the analysis, wrote the paper. Mital Patel – performed the analysis, wrote the paper.*

## References

1. Pak J G, Fayazi S, White S N. Prevalence of periapical radiolucency and root canal treatment: a systematic review of cross-sectional studies. *J Endod* 2012; **38**: 1170–1176.
2. Thomas G M, Newton R, Tolley W J, Bishop K. Novel tier 2 service model for complex NHS endodontics. *Br Dent J* 2021; DOI: 10.1038/s41415-021-2840-3.
3. Ørstavik D, Pitt Ford T. Apical periodontitis: microbial infection and host response. In Ørstavik D, Pitt Ford T (eds) *Essential endodontology: prevention and treatment of apical periodontitis*. 2nd ed. pp 1–9. Oxford: Blackwell Munksgaard Ltd, 2008.
4. Essam O, Kasperek D, Boyle E L, Jarad F. The epidemiology of endodontic complexity in general dental practice: a prevalence study. *Br Dent J* 2022; DOI: 10.1038/s41415-022-4405-5.
5. NHS England. Clinical standard for restorative dentistry. 2022. Available at <https://www.england.nhs.uk/wp-content/uploads/2022/10/B1640-clinical-standard-restorative-dentistry.pdf> (accessed July 2024).
6. NHS England. Dentists working patterns, motivation and morale – 2022/2023. 2024. Available at <https://digital.nhs.uk/data-and-information/publications/statistical/dental-working-hours/2022-23-working-patterns-motivation-and-morale> (accessed July 2024).
7. Atabek D, Alaçam A, Aydintuğ I, Konakoğlu G. A retrospective study of traumatic dental injuries. *Dent Traumatol* 2014; **30**: 154–161.
8. Al-Ani A H, Antoun J S, Thomson W M, Merriman T R, Farella M. Hypodontia: an update on its etiology, classification, and clinical management. *Biomed Res Int* 2017; DOI: 10.1155/2017/9378325.
9. UK Government. Referral to treatment consultant-led waiting times: rules suite (October 2022). 2022. Available at <https://www.gov.uk/government/publications/right-to-start-consultant-led-treatment-within-18-weeks/referral-to-treatment-consultant-led-waiting-times-rules-suite-october-2022> (accessed July 2023).
10. Gulabivala K, Ng Y L. Factors that affect the outcomes of root canal treatment and retreatment – a reframing of the principles. *Int Endod J* 2023; DOI: 10.1111/iej.13897.
11. University of Surrey. Dentists could soon have a new AI co-pilot to detect tooth decay. 2023. Available at <https://www.surrey.ac.uk/news/dentists-could-soon-have-new-ai-co-pilot-detect-tooth-decay> (accessed July 2024).
12. House of Commons Health and Social Care Committee. NHS dentistry: ninth report of session 2022–23. 2023. Available at <https://committees.parliament.uk/publications/40901/documents/199172/default/> (accessed July 2023).

**Level 2****Routine treatment (root canal treatment and retreatment)**

- Root canals with:
  - Curvatures > 30° but < 45° to the root canal, following straight line access, not > 25 mm long and with root canals radiographically evident, but not for their entire length.
  - Moderately complex technical problems in location, negotiation, instrumentation, disinfection (persistent infection/symptoms) and obturation of root canals.
- Previously root treated - root fillings should be well-compacted and amenable to removal using conventional techniques and may be short of the optimal working length **with** radiographic evidence of likely canal patency beyond the root filling.
- Treatment may include the removal of short posts/ fractured posts (less than - 8mm in length) and not accompanied by other complications cited for Level 3 complexity.
- Molar tooth endodontic treatment accompanied by limitation of mouth opening (between 25mm and 35mm inter-incisal opening).

**Emergency Treatment**

- The treatment of teeth affected by dental trauma when root canal treatment is designated at Level 2 complexity, and including vital pulp therapy e.g. partial pulpotomy.

**Specific to Level 2:**

- Diagnosis of teeth with suspected "cracked tooth syndrome". This includes examination, diagnosis and may involve placement of an orthodontic band etc if required. The permanent restoration will be provided in general dental practice.
- Teeth with incomplete root development, requiring root canal treatment.

**Level 1****Routine treatment (root canal treatment and retreatment)**

- Root canal with:
  - Curvatures > 45° to the root canal following straight line access, length > 25 mm and with root canals NOT radiographically evident through their entire length.
  - Multiple curves (in the same or opposite directions e.g. S-shaped).
  - Complex technical problems in location, negotiation, instrumentation, disinfection (persistent infection/symptoms) and obturation, e.g. difficult but potentially rectifiable ledges, blocked canals, perforations, etc.
  - Associated perforations.
  - Fractured instruments.
- Previously root treated:
  - Root fillings should be well-compacted and amenable to removal using conventional techniques, and may be short of the optimal working length with NO radiographic evidence of likely canal patency beyond the root filling.
  - Roots may be overfilled with clinical and radiographic signs of infection where standard techniques for removal are not possible.
  - Treatment may include the removal of well-fitting posts/fractured posts longer than 8mm and carrier-based, resin or silver point root-fillings.

**Emergency treatment**

- Assessment and planning the long-term multi-disciplinary management of severely traumatised teeth (including delayed reimplantation/non-reimplantation of avulsed teeth, intruded, laterally luxated and extruded teeth).

**Specific to Level 3:**

- Root canal systems with anatomical complexities other than curvatures; e.g., complex developmental tooth anomalies, additional roots, bifid apices, complex branching of root canal(s), invaginations such as dens-in-dente, fused teeth, C-shaped canals, etc.
- The management of restorable teeth with structural damage due to iatrogenic causes, or resorption (excluding resorption at their root tips due to chronic infection).
- Periradicular surgery, when endodontic retreatment under any Level is not possible or when conventional root canal treatment has been completed to guideline quality standards (details of treatment to be given e.g. rubber dam isolation, sodium hypochlorite irrigant, restored with a restoration with no obvious signs of microleakage).
- Pain diagnosis, when a definitive diagnosis is unclear. Teeth must have been pulp tested (cold and electric pulp tester) and have been challenged with stimulating/exacerbating factors e.g. cold, hot and sweet prior to referral, and the results given. Cases where there are obvious clinical and radiographic signs of infection from the referral **will** not be considered.
- Second opinions. This may not necessarily require an appointment if the information and/or the radiograph provided are sufficient to give a second opinion.

**Appendix 1 Pan-London endodontic Level 2 and 3 referral criteria. From Barts Health NHS Trust, <https://www.bartshealth.nhs.uk/dental-referrals/>**