The development, diagnosis, prognosis and management strategies for teeth diagnosed with endodontic-periodontal lesions

Introduct on:

Diagnosis, prognosis, and the range of management strategies for endodontic-periodontal lesions are of interest to the general dentist and the wider multidisciplinary team. Understanding the potentially complex nature of these lesions is key to developing an accurate diagnosis covering both endodontic and periodontal components, which will inform a treatment plan based on current evidence and patient wishes. In simple terms, endodontic-periodontal lesions are those which involve both periodontal and pulpal disease in or around the same tooth. Like many other aspects of dentistry, treatment of these lesions can vary hugely in complexity, with several treatment options available to a patient should they choose to pursue them. Whilst management of some endodontic-periodontal lesions will be within the scope of practice of the General Dental Practitioner, we must not forget our specialist colleagues, whose skillset and knowledge can certainly be drawn upon in appropriate cases.

What are endodont c-periodontal lesions?

The complex relationship between the pulp and periodontium was first described in 1964 by Simring and Goldberg [1]. Since then, the term "endo-perio lesion" (or indeed "perio-endo lesion") has been used to describe these potentially complex lesions. Endodontic-periodontal lesions (EPLs) are characterised by the presence of pulpal and periodontal disease in/around the same tooth [2]. They are largely thought to be due to inflammatory products found in both the pulp and periodontal tissues. Aetiological factors include those which are microbiological such as bacteria,

The co-existence of both pulpal and periodontal disease can make diagnosis and treatment planning tricky, as the varied pathogenesis can range from reasonably simple to relatively complex. A good knowledge of the disease processes involved is key in reaching a correct diagnosis, which will inform a treatment plan and provide a rough prognosis. Prognosis of these lesions can depend on the severity of the periodontal disease, but also the host response to periodontal treatment. The treating clinician should aim to create a treatment plan in which unnecessary or even harmful treatment is avoided, as per the bioethical principles [4].

Development and classification:

The two most prevalent oral diseases currently are dental caries and periodontitis [5]. Each of these, either independently or in combination, have the potential to damage both the periodontal tissues and the pulp. The main channel that connects the pulp and periodontium is the apical foramen, but communication between the two can also occur via the accessory and lateral canals, dentinal tubules, perforations, fractures and even dental anomalies [6]. The effect of periodontal disease on the pulp is a well-debated topic, and it has been suggested that until periodontal disease reaches the apex of the tooth, it has no effect on the pulp [7-10]. Some studies however, have suggested that periodontal disease can affect the pulp in a degenerative way, increasing incidence of calcifications, fibrosis and collagen resorption [11,12].

The most widely used classification of EPLs is that described by Simon et al [13]. It classifies EPLs into 5 distinct types as follows:

1. **Primary Endodontic Lesion –** These lesions are solely endodontic in nature. They may appear clinically with concurrent swelling and/or drainage of exudate from the gingival sulcus. The only involvement of the periodontium is that the exudate passes through this tissue. It is

often possible to trace the path of the infection back to its origins by inserting a gutta percha (GP) point into the drainage point.

2. **Primary Endodontic Lesion with Secondary Periodontic Involvement –** If a primary endodontic infection remains untreated or persists, it may begin to have secondary periodontal involvement. Persistent drainage creates an area where plaque and calculus may accumulate and cause periodontal disease.
3. **Primary Periodontal Lesion –** This is the typical presentation of periodontal disease, in which a patient presents with periodontal pockets around the teeth which have developed due to accumulation of plaque over a prolonged period. Whilst many patients with periodontal disease may have several sites of pocketing, some will have localised pockets perhaps due to local factors such as an overhanging restoration or a fractured tooth.
4. **Primary Periodontal Lesion with Secondary Endodontic Involvement –** In some cases, periodontal disease can progress such that it follows the root of the tooth to a point where an area of communication is established with the pulp. This will generally be the apical foramen, but may also be the other channels mentioned earlier if these have become exposed. In these cases, the pulp then becomes infected and typically necrotic.
5. **True Combined Lesion –** This is a situation where two separate disease processes have progressed independently of each other, but merge into one lesion. Whilst the periodontal condition degenerates, the tooth also happens to devitalise and causes an apical lesion. The two disease processes converge and form a true combined lesion.

Diagnosis:

Accurate diagnosis, though potentially difficult, is essential to alleviate any symptoms and provide the best prognosis possible. A methodical approach to reaching a diagnosis is imperative for any medical or dental condition. Newsome et al propose a method of diagnosing and formulating a treatment plan [14]. We will use this guide here.

- **Collecting relevant information –** Asking the patient open ended questions such as 'how can I help you?' imply that you are willing to help the patient, but it also provides a platform for the patient to speak freely about the problems they have been experiencing, if any. In the case of EPLs, patients may complain of pain, swelling, a bad taste or even teeth which have become wobbly. When a patient experiences a combined lesion, the pain may be well-localised, and they may describe the pain as severe. In some instances, patients may be aware of existing issues which have been highlighted at previous dental visits. It must be noted that some patients may experience no symptoms at all. Some of the signs and symptoms outlined by the patient may lead the treating dentist to some differential diagnoses.

- **Clinical examination –** Once a patient has described their issues, it is important to assess these clinically. Disease of either pulpal or periodontal nature may quickly become apparent on visual examination, with signs such as swelling, a discharging sinus, localised inflammation, or large carious lesions for example. Once the problematic tooth is identified (either through visual examination, or after special investigations), it must be considered whether this can be restored using a suitable index such as Dental Practicality Index [15]. Planning to carry out endodontic/periodontal treatment on a tooth which is unrestorable could be considered a waste of both clinician and patient time and resources.

- **Special investigations –** Often clinical examination alone does not yield sufficient information to make a full, informed diagnosis. In these instances, the treating dentist may choose to carry out special investigations which they deem appropriate for the scenario or symptoms. Some of the special tests which may be used to assist in diagnosing an EPL are:

- **Radiographs –** The gold standard radiograph for periodontal assessment, and the most common radiograph taken for endodontic assessment is a periapical radiograph taken using a long-cone paralleling technique [16,17]. This will highlight the extent of any areas of bone loss due to periodontal disease or periapical pathology.
- **Sensibility testing –** These assessments aim to test the ability of the tooth to respond to a stimulus, determining if the pulp has a sensory response [18]. The results of the sensibility tests allow clinicians to extrapolate and estimate the vitality of a tooth and the state of pulpal health. If a tooth responds to a stimulus, it is generally assumed that the pulp has a viable blood supply and is either healthy or inflamed. An absence of any response tends to be associated with pulpal necrosis or absence of a pulp [18]. It must be noted that these tests should not be relied upon as the only indicator of tooth vitality.
- **Detailed periodontal charting –** The British Society of Periodontology advise that detailed periodontal charting should be carried out in any areas which score a BPE code 3, along with a full mouth chart for any patient who scores a code 4. This charting should include; pocket depths, recession, attachment loss, any bleeding/suppuration, furcation involvement, and grading of any mobility [19]. These charts are useful tools both for the clinician and patient. They can be used to monitor any progress with treatment but also act as a vital tool for providing a record of monitoring the condition when faced with a patient who is non-compliant. If most of the bony support around a tooth has been lost due to periodontitis, regardless of whether the endodontic treatment would be predictable, the tooth may be considered to have hopeless prognosis.
- **Cone Beam Computerised Tomography (CBCT) –** CBCT is not currently considered an essential investigation for endodontic treatment planning, but it can provide some useful information. CBCT is a 3D imaging technique which can provide more accurate

information about periapical periodontitis than PA radiographs, and also give more detailed information about root canal anatomy. This additional information may prove useful, particularly in planning of complex endodontic cases [20]. However, the increased dose of radiation is of course not without risk and therefore as with all radiographs, a risk-benefit analysis of carrying out a CBCT must be considered.

Differential diagnoses:

One recent study found the prevalence of EPLs to be 0.4% of teeth [21]. Though this study had limitations, it was the first large-scale study into the prevalence of these lesions and the results were certainly interesting. This leads us to consider the well-known clinical axiom 'common things are common' [22]. Though of course not a strict diagnostic tool, it can be useful for estimating the probability of a diagnosis and gives reason to consider other, more common differential diagnoses. Some of the differential diagnoses for EPLs are given in the table below.

Differential diagnosis	Cause	Radiographic appearance	Clinical signs/symptoms
Root fractures	Trauma Weakening of dental hard tissue during root canal treatment or restoration Placement of posts/pins	Difficult to assess with x-ray investigation, beam needs to be set up at same angle of fracture to be visible J-shaped lesion sometimes	Mild pain Dull pain on mastication Tooth mobility Sinus tract Isolated, narrow periodontal pockets Periodontal-type abscess
Periodontal abscess	Accumulation of bacteria, or a foreign body within a periodontal pocket	Usually some widening of PDL Some horizontal or vertical bone loss expected Often no findings radiographically in acute phase	**Acute:** Pain Tenderness on palpation Presence of pus **Chronic:** Sinus tract Mild/absent pain
Lateral periodontal cyst	Noninflammatory developmental cyst, originating from the rests of Malassez	Round/oval shaped radiolucency with well-defined borders	Generally asymptomatic Tooth is usually vital
Other conditions	Various, some lesions occur which do not fit into the typical presentations we frequently see on clinic. These conditions may be unresponsive to our typical treatments and may warrant further investigations such as CBCT, biopsies, to rule out more sinister conditions.		

Figure 1. A table displaying differential diagnoses for endodontic-periodontal lesions, their causes, radiographic appearance and any associated clinical signs/symptoms.

Prognosis:

Just as the treatment of each individual EPL varies, so too does the prognosis. Many factors must be considered when estimating the expected prognosis of a tooth. Patients are inevitably interested in approximate prognoses as the treatment is certain to be an investment of time, and often money. Some of the factors which can influence prognosis of a tooth have been provided in the table below. They are split into patient, clinician, and material factors:

Patient factors	Clinician factors	Material factors
Endodontic treatment:		
Local factors: • Pre-operative condition of the tooth, extent of disease • Presence and size of periapical periodontitis • Anatomy of canal • Patency of canal • Positioning of tooth within the arch • Nature of the canal flora • Existing root filling (re-RCT) • Presence of coronal restoration • Mobility [23]	*Lack of:* • Adequate training with regards treatment required • Adequate knowledge of treatment required • Adequate skills to complete treatment • Incorrect diagnosis • Improper case selection • Human error/iatrogenic damage • Decision to treat in single or multiple visits • Decision regarding post endodontic restoration [23]	*Lack of :* • Proper specialised instruments/equipment to complete gold standard treatment (e.g. rubber dam, suitable irrigant) • Equipment to overcome complications e.g. calcification • Time
Behavioural/systemic factors: • Age, gender and health of the patient • Ability to cooperate with treatment [23]		
Periodontal treatment:		
Local factors: • Defective or overhanging restorations • Occlusal dysfunction • Furcation involvement [24]	*Lack of:* • Adequate skills and/or knowledge of treatment • Development of relationship between clinician and patient • Timely and correct diagnosis [24] • Inability to motivate patient appropriately • Improper removal of bacterial deposits and calculus [24]	*Lack of:* • Access to specialist equipment for more complex periodontal surgeries • Time
Systemic factors: • Conditions impairing immune response (diabetes mellitus) • Smoking status • Stress • Patient compliance • Presence of psychological issues such as depression [24]		
Behavioural factors: • Inability to comply with oral health instructions • Lack of motivation • Poor plaque control		

Figure 2. A table displaying factors which may affect treatment outcomes/prognoses of endodontic treatment and periodontal treatment. They have been divided into patient factors (local, systemic, behavioural), clinician factors and material factors.

Whilst the above table provides a general overview of some factors affecting endodontic and periodontal treatment outcomes, to provide an overview of prognoses of the specific types of EPL, it will be useful to consider the different classifications once more [13].

Primary Endodontic Lesion:

Endodontic therapy now shows a reasonably high overall success rate, with one review of the literature suggesting an overall success rate of 92% at 12 months [25]. Of course, this will vary depending on the complexity of the treatment (affected tooth, its anatomy, canal patency, existing root treatment etc) and on the level of skill and training of the treating dentist. A specialist endodontist may be able to offer a higher success rate than this and so patients may opt to be treated by such practitioners to have a higher certainty of positive treatment outcomes.

Primary Endodontic Lesion with Secondary Periodontal Involvement:

If root canal treatment is successfully completed, the integrity of the periodontium in these lesions will usually re-establish [26]. Therefore, the prognosis of these lesions is similar to the primary endodontic lesions described above.

Primary Periodontal Lesion:

Determining the prognosis of these lesions depends on both the extent of the disease and the efficacy of the treatment. As bony support around the tooth decreases, prognosis so too decreases. Equally the presence of systemic factors may mean the patient responds poorly to treatment and therefore prognosis would again be reduced.

Primary Periodontal Lesion with Secondary Endodontic Involvement:

As with primary periodontal lesions, prognosis of the tooth in question is largely determined by the extent of periodontal disease and destruction of supporting bone. The potential effects of

periodontal disease on the pulp means that it is relatively common to encounter issues which complicate endodontic treatment such as calcifications, which may also affect prognosis [11,12].

True Combined Lesion:

Prognosis of a true combined lesion will depend on a multitude of factors as discussed in the table above, and the factors likely to affect the outcome are similar to those in the other diagnoses, particularly the periodontal bone loss.

Management strategies:

To best manage these lesions, collaboration between the specialties of endodontics and periodontics and the general dental practitioner should be considered. The British Endodontic Society (BES) introduced an endodontic case assessment tool, 'BES EndoApp' which allows clinicians to input the details of the case, to generate a complexity score [27]. Based on this score, it gives a suggestion of who is best placed to carry out treatment. Though not strictly necessary, in cases where treatment is anticipated to be difficult, the dentist may sensibly choose to offer the option of referral to a specialist, who will almost certainly be able to offer a higher certainty of positive treatment outcomes. Even when a general dentist feels confident in their abilities to undertake a treatment, the option of referral to a specialist either for a second opinion or for treatment should always be offered, in order that the patient can give valid consent. The box below highlights the guidance published by the General Dental Council with regards referrals [28].

Box 1 – General Dental Council guidance on dental referrals

- Must refer appropriately and effectively, and when it is in the patient's best interest.
- Should only refer to a colleague if the clinician is confident that the colleague has been trained and is both competent and indemnified to do what is being asked.
- Should refer patients on if treatment required is outside their scope of practice or competence.
- Must provide patients with clear information about any referral arrangements.
- Should make their referral request clear and give the referring colleague all the information they need.

Figure 3. A box displaying the General Dental Council's guidance on dental referrals.

Ultimately, the decision on whether to proceed lies with the patient. Many factors will influence this decision, including time, ability to undergo lengthy/complex treatment, estimated prognosis, financial factors. Consent will of course need to be gained, and as part of this the treating practitioner should inform the patient of any potential risks and complications. The option of no treatment must always be presented to the patient.

The order of the disease process and the pathological origin is relevant when planning treatment of these lesions. It is generally accepted that the management of co-existing endodontic and periodontal lesions without communication is endodontic treatment to be carried out first, followed by periodontal treatment [29]. If a primary endodontic lesion exists, good endodontic treatment alone may be sufficient to resolve the symptoms even when there is drainage of pus through the periodontal tissues [26].

Placement of the medicament will increase the predictability of canal disinfection and therefore the outcome of endodontic treatment. Calcium hydroxide is an intracanal medicament that has been shown to promote hard tissue repair [30, 31]. It has been proven to lower the intracanal bacterial load, as well as positively influencing periodontal recovery. Sufficient time must be left between placement of the medicament and completion of root treatment for maximum benefit [32, 33]. Residual periodontal issues may be treated upon completion of successful endodontic treatment, via methods such as guided tissue regeneration.

When most of the bony support around a tooth has been lost, it may be deemed to have hopeless prognosis and extraction may be considered the most appropriate option. The flow chart below is adapted from Sonde and Edward's guide to diagnosis and management of perio-endo lesions and highlights some considerations for treatment provision [6].

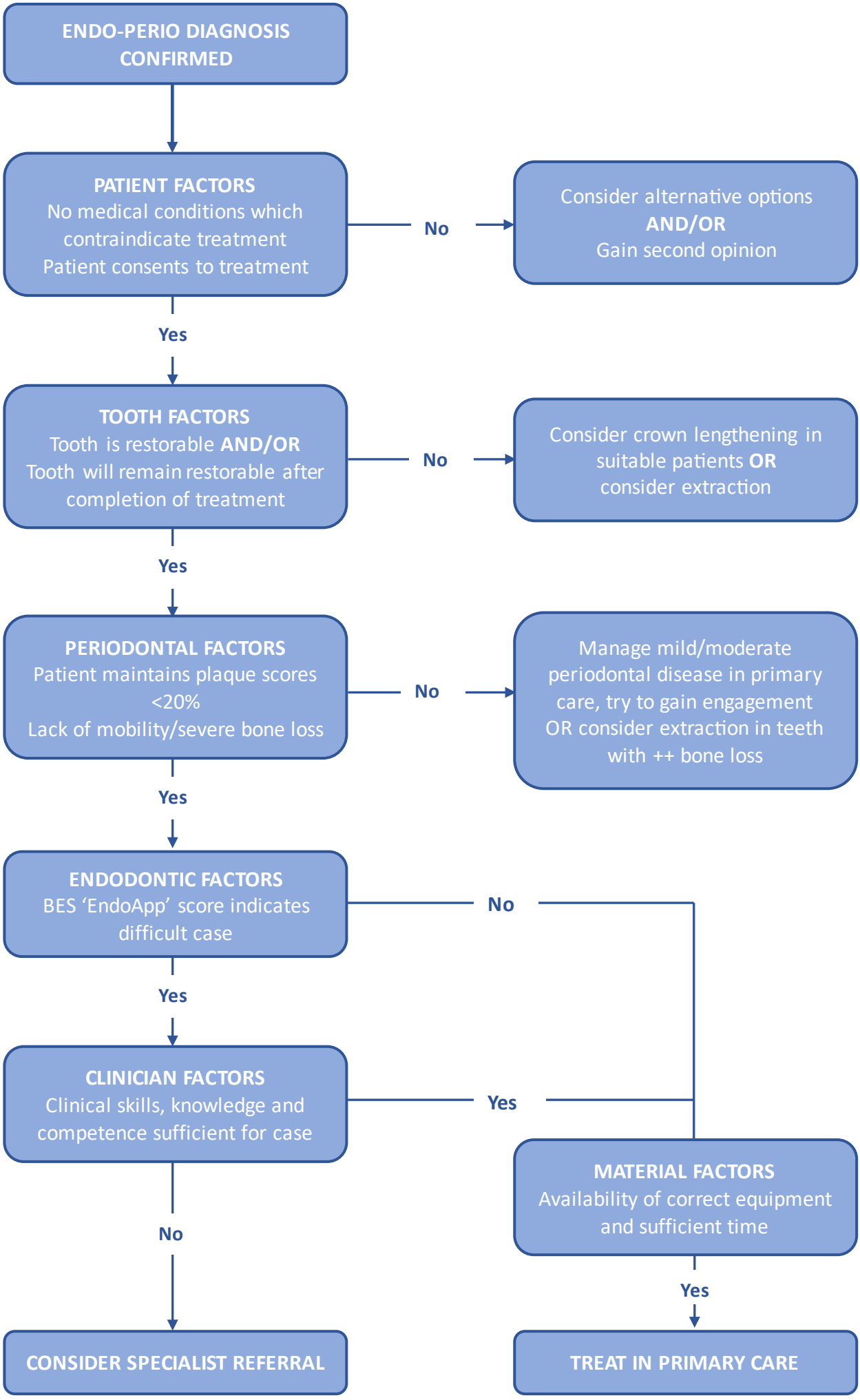

Figure 4. A flow chart displaying the considerations for different factors when treatment planning for a true combined endo-perio lesion.

Conclusions:

Endo-perio lesions can present clinical challenges for the treating clinician. These lesions can have a varied pathogenesis, ranging from simple to complex. Having the knowledge of these disease processes will help the treating dentist to come to the correct diagnosis, and therefore choose an appropriate treatment plan. This may or may not involve treatment from a specialist, but it should always be considered and offered at the very least. Case selection is an integral part of managing these lesions in a primary care setting.

In true EPL cases where the patient opts for treatment, both the endodontic and periodontal components must be treated. This is generally done by treating the endodontic disease first, followed by the periodontal disease. The definition of what success means to us dentists may differ from what patients consider to be success. For an individual who has suffered severe pain from a lesion, resolution of this by simple extraction could be considered a success. This may differ from our opinion, where a beautiful endodontic treatment and resolution of periodontal pocketing may be our ideal. Working with patients to achieve outcomes which fit their goals is imperative in any treatment planning and whilst we must be guided by the literature, we must also consider the patient's wishes, especially with regards to these lesions which are often lengthy and complex to treat.

References:

1. Simring M, Goldberg M. The pulpal pocket approach: retrograde periodontitis. Journal of Periodontology. 1964; 35: 22-48.

2. Al-Fouzan K S. A New Classification of Endodontic-Periodontal Lesions. International Journal of Dentistry. 2014. 919173.

3. Singh P. Endo-Perio Dilemma: A Brief Review. Dental Research Journal. 2011. 8(1): 39-47.

4. Beauchamp T L, Childress J F. Principles of Biomedical Ethics. 5th edition. New York: Oxford University Press. 2001.

5. World Health Organisation. Oral Health: fact sheet. 2023. Online resource available at: https://www.who.int/news-room/fact-sheets/detail/oral-health#:~:text=Severe%20periodontal%20diseases%20are%20estimated,oral%20hygiene%20and%20tobacco%20use [Accessed 06/11/23].

6. Sonde N, Edwards M. Perio-Endo Lesions: A Guide to Diagnosis and Clinical Management. Primary Dental Journal. 2020. 9(4): 45-51.

7. Seltzer S, Bender IB, Ziontz M. The interrelationship of pulp and periodontal disease. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 1963; 16(12): 1474-1490.

8. Mazur B, Massler M. Influence of periodontal disease on the dental pulp. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 1964; 17(5): 592-603.

9. Bender IB, Seltzer S. The effect of periodontal disease on the pulp. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 1972; 33(3): 458-72.

10. Czarnecki RT, Schilder H. A histological evaluation of the human pulp in teeth with varying degrees of periodontal disease. Journal of Endodontics. 1979; 5(8): 242-253.

11. Langeland K, Rodrigues H, Dowden W. Periodontal disease, bacteria and pulpal histopathology. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 1974; 37(2): 257-270.

12. Mandi FA. Histological study of the pulp changes caused by periodontal disease. International Endodontic Journal. 1972; 6(4): 80-83.

13. Simon JH, Glick DH, Frank AL. The relationship of endodontic-periodontal lesions. Journal of Periodontology 1972; 43: 202–208.

14. Newsome P, Smales R, Yip K. Oral diagnosis and treatment planning: part 1. Introduction. British Dental Journal. 2012. 213: 15-19.

15. Dawood A, Patel S. The Dental Practicality Index – Assessing the restorability of teeth. British Dental Journal. 2017. 222: 755-758.

16. British Society of Periodontology. The Good Practitioner's Guide to Periodontology. 2016. Online resource available at: https://www.bsperio.org.uk/assets/downloads/good_practitioners_guide_2016.pdf [Accessed 02/11/23].

17. British Endodontic Society. A Guide to Good Endodontic Practice. 2022. Online resource available at: https://britishendodonticsociety.org.uk/_userfiles/pages/files/a4_bes_guidelines_2022_hyperlinked_final.pdf [Accessed 02/11/23].

18. Chen E, Abbott P V. Dental Pulp Testing: A Review. International Journal of Dentistry. 2009. 365785.

19. British Society of Periodontology. Implementing the 2017 Classification of Periodontal Diseases to Reach a Diagnosis in Clinical Practice. London (GB); 2018.

20. Patel S, Brown T, Pimentel R, Kelly RD, Abella F, Durack C. Cone beam computed tomography in Endodontics – a review of the literature. International Endodontic Journal. 2019. 52(8): 1138-1152.

21. Reutters M, Gehrig H, Kronsteiner D, Schuessler DL, Kim TS. Prevalence of endo-perio lesions according to the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Disease in a university hospital. Quintessence International. 2022. 53(2): 134-142.

22. Aberegg S K, Callahan S J. Common things are common, but what is common? Incorporating probability information into differential diagnosis. Journal of Evaluation in Clinical Practice. 2021. 28: 1213-1217.

23. Srinivasan R, Raghu R. Treatment outcomes in endodontics. Journal of Operative Dentistry and Endodontics. 2016. 1(1): 13-17.

24. Shaddox L M, Walker C B. Treating chronic periodontitis: current status, challenges, and future directions. Clinical, Cosmetic and Investigational Dentistry. 2010. 2: 79-91.

25. Burns L E, Kim J, Wu Y, Alzwaideh R, McGowan R, Sigurdsson A. Outcomes of primary root canal therapy: An updated systematic review of longitudinal clinical studies published between 2003 and 2020. International Endodontic Journal. 2022 55(7): 714-731.

26. Oktawati S, Siswanto H, Mardiana A, Neormansyah IS, Basir I. Endodontic-periodontic lesion management: A systematic review. Medicina Clínica Práctica. 2020. 3(1).

27. British Endodontic Society. BES Case Assessment Tool. Online resource available at: https://britishendodonticsociety.org.uk/professionals/bes_case_assessment_tool.aspx [Accessed 08/11/23].

28. General Dental Council. Standards for the Dental Team. London (GB); 2013.

29. Schmidt JC, Walter C, Amato M, Weiger R. Treatment of periodontal-endodontic lesions – a systematic review. Journal of Clinical Periodontology 2014. 41: 779–790.

30. Bansal S, Tewari S, Tewari S, Sangwan P. The effect of endodontic treatment using different intracanal medicaments on periodontal attachment level in concurrent endodontic-periodontal lesions: a randomised controlled trial. Journal of Conservative Dentistry. 2018. 21: 413-418.

31. Duque TM, Prado M, Herrera DR, Gomes BPFA. Periodontal and endodontic infectious/inflammatory profile in primary periodontal lesions with secondary endodontic involvement after a calcium hydroxide-based intracanal medication. Clinical Oral Investigation. 2019. 23: 53-63.

32. Gomes BPFA, Montagner F, Berber VB, Zaia AA, Ferraz CCR, Affonso de Almeida JF, Souza-Filho FJ. Antimicrobial action of intracanal medicaments on the external root surface. Journal of Dentistry. 2009. 37(1): 76-81.

33. Silva MRR, Chambrone L, Bombana AC, Lima LA. Early antimicrobial activity of intracanal medications on the external root surface of periodontally compromised teeth. Quintessence International. 2010. 41: 427-431.