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The Perio–Ortho Interface: Latest Guidelines

Abstract: This article focuses on the latest S3-level clinical practice guidelines, which allow for an evidence-based and patient-centred decision-making process for managing periodontitis patients who require orthodontics as part of their interdisciplinary care. Orthodontic management, including types of appliances, movement, use of adjuncts and timing are discussed. Management of periodontitis relapse, as well as the importance of successful maintenance and retention, are also highlighted.

CPD/Clinical Relevance: Severe periodontitis can result in pathological migration of teeth that may benefit from orthodontic therapy.

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Periodontitis is characterized by the progressive destruction of the periodontium and severe periodontitis may lead to disability due to impaired chewing function and aesthetics, significantly impacting quality of life.¹

Stage IV periodontitis shares the severity and complexity characteristics of stage III periodontitis, but includes the anatomical and functional sequelae of tooth and periodontal attachment loss (tooth flaring and drifting, bite collapse, etc), which require additional interventions following the completion of active periodontal therapy.

The recently published clinical practice guideline for the treatment of stage IV

periodontitis provides evidence-based recommendations for the treatment of periodontitis patients,² defined according to the 2018 classification.³ It provides guidance on the necessary interdisciplinary therapy, including orthodontics, required to rehabilitate the compromised dentition in such patients.

Stage IV periodontitis cases may present with great phenotypic variation based on the individual patterns of their periodontal breakdown, number of missing teeth, inter-maxillary relationships and residual alveolar ridge, which will result in different degrees of functional and aesthetic compromise, as well as different treatment needs. When providing

recommendations on orthodontic management, the guidance² focuses on case type 2, defined by the patient with pathological tooth migration, characterized by tooth elongation, drifting and flaring, which is amenable to orthodontic correction. Table 1 summarizes the four case types that are referred to in the main guidelines.²

Periodontal management

Treatment of all patients affected by periodontitis should follow the step-by-step sequence as suggested in the S3-level guidelines.⁴ Table 2 summarizes these steps. This initial guideline highlights the importance of commencing with the basis of therapy – examination, assessment of risk factors and diagnosis. The patient should then be informed of the diagnosis, including causes of the condition, risk factors, treatment alternatives and expected risks and benefits, including the option of no treatment. This is followed by an agreed personalized care plan, which may need to be modified during the treatment journey, depending on initial treatment outcomes, patient preferences, clinical findings and

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Case type	Details	Management
1	Tooth hypermobility owing to secondary occlusal trauma	Can be corrected without tooth replacement
2	Pathological tooth migration, characterized by tooth elongation, drifting and flaring	Amenable to orthodontic correction
3	Partially edentulous patients who do not need full-arch rehabilitation	Can be prosthetically restored without full-arch rehabilitation
4	Partially edentulous patients who need full-arch rehabilitation	Needs full-arch rehabilitation either tooth or implant supported/retained

Table 1. The four major stage IV periodontitis phenotypes.

Step 1	Building foundations for optimal treatment outcomes through oral hygiene instructions, risk-factor control and supragingival professional mechanical plaque removal (PMPR)
Step 2	Subgingival PMPR
Step 3	Management of non-responding sites through further non-surgical treatment or surgery
Step 4	Supportive periodontal care

Table 2. Summary of the key steps in the management of patients with periodontitis.

changes to the patient's overall state of health.

When treatment planning for individuals with stage IV periodontitis, a detailed assessment and full diagnosis are required, including a tooth-by-tooth prognosis to identify the number, distribution, residual support, periodontal maintainability, and restorability of the remaining natural dentition. Most cases of stage IV periodontitis can be successfully treated, maintaining the natural dentition in a state of adequate health and function. The treatment plan will include the above steps; however, the introduction of specific additional treatment measures to meet the specific demands of stage IV periodontitis are required, i.e. periodontal therapy is combined with rehabilitation. Figure 1 shows a typical periodontitis case following steps 1, 2 and 3, prior to orthodontic treatment.

Orthodontic therapy can be *planned* during step 2 of care and, in some cases, step 3 of treatment, but the actual *execution* of orthodontic treatment should only be implemented *after* achieving the periodontal treatment objectives of shallow maintainable pockets and control of periodontal inflammation. Commencing prematurely will risk potential deterioration of periodontal health. Figure 2 highlights the overall timing of orthodontic therapy

in periodontitis patients. Figure 3 shows a periodontitis case that was inappropriately about to commence orthodontic therapy.

Orthodontic management

Tooth movements

Progression of periodontitis can result in pathologically migrated teeth that manifests as tooth drifting, flaring and elongation. As a result, it is not uncommon for successfully treated stage IV periodontitis patients to require orthodontic therapy to improve their dental appearance and functional occlusion. Treated periodontitis patients will have a healthy, but reduced periodontium, so the requirements and consequences of orthodontic treatment may differ compared with patients without attachment loss.

One of the most important prerequisites here is the importance of achieving the periodontal outcomes of shallow, maintainable pockets and control of inflammation before considering orthodontic treatment.^{2,5}

According to the guidelines,² the recommendations are reassuring and suggest that in successfully treated stage IV periodontitis patients, orthodontic therapy itself does not significantly affect periodontal outcomes (probing pocket depth and clinical attachment levels),

gingival inflammation, recession or increase the chances of root resorption, provided they maintain optimal periodontal health during treatment.⁶ Owing to the position of the teeth, often orthodontic treatment will involve intrusion (Figure 4), retraction (Figure 5) and optimal alignment tooth movements. The guidelines² suggest that there is evidence that these movements do not significantly affect periodontal outcomes, or alter gingival inflammation, and do not significantly alter gingival margin levels or impact root resorption.⁷ Positive effects can include improvement of interdental papilla height and potential reduction in tooth mobility.⁷ However, it is emphasized that orthodontic therapy should not commence until the endpoints of periodontal therapy have been achieved – specifically no sites with periodontal probing depths of 5 mm and bleeding on probing and no sites with periodontal probing depths 6 mm or more.⁵

In stage IV periodontitis patients, tipped molars are frequent sequelae of tooth loss and periodontal attachment loss (Figure 6), often in combination with bite collapse and loss of the vertical dimension of the occlusion. Thus, orthodontic treatment can also be beneficial in these instances, in not only achieving optimal uprighting of the molars, but also in facilitating subsequent restorative rehabilitation, if necessary. The guidelines² explored whether these movements would have adverse effects on the affected teeth in terms of further attachment and/or bone loss, but there was a lack of evidence in this area.⁸ For this reason, it is a treatment that may be considered, but the outcomes may be unpredictable.

As well as drifted and tilted teeth, periodontitis patients may also present with intra-bony defects. As per the guideline for the periodontal treatment for stage I–III periodontitis,⁴ these intra-bony defects should be treated during step 3 of periodontal therapy by surgical periodontal regenerative interventions. When undergoing orthodontic therapy, tooth movements may occur through regenerated tissues. In terms of timing and details, the guidelines² suggest that combined orthodontic therapy can be implemented safely in these affected teeth. In fact, orthodontics significantly improves periodontal outcomes and reduces gingival inflammation. There

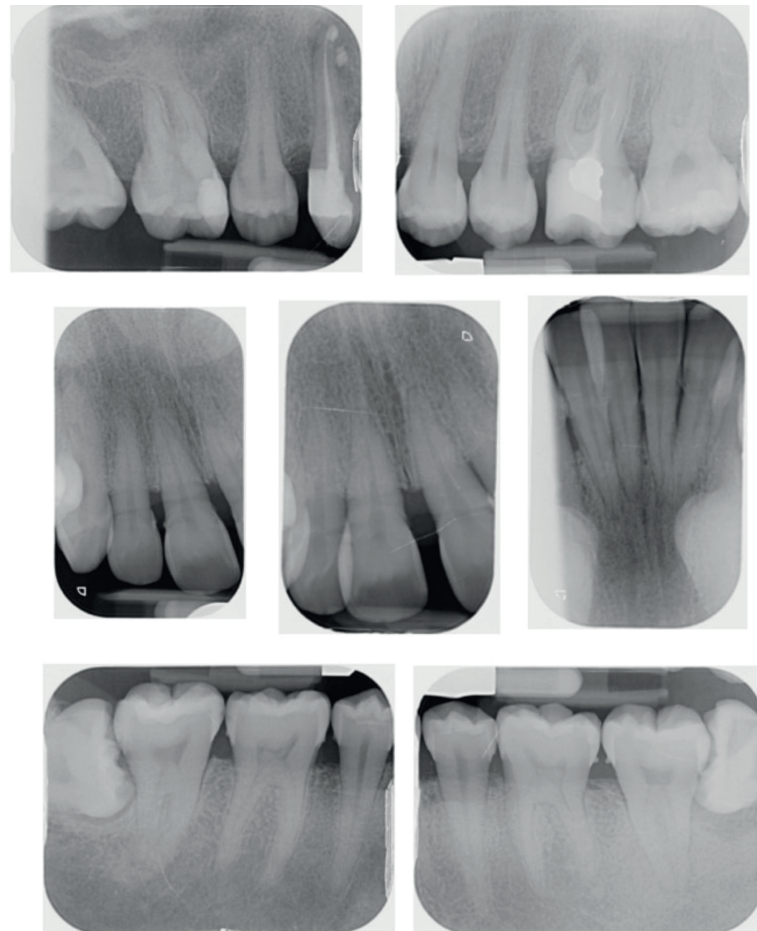
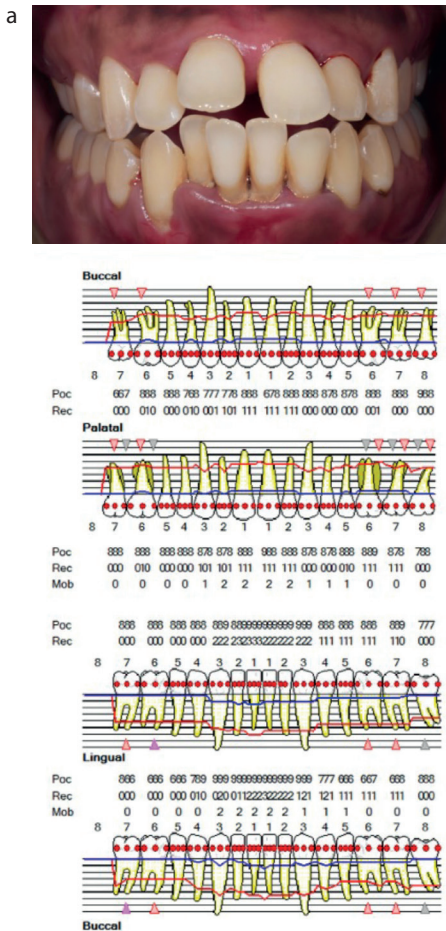


Figure 1. Typical periodontitis case following steps 1–3. **(a)** Pre-periodontal therapy: swollen inflamed gingivae, deep probing depths with generalized bleeding on probing. **(b)** Post-periodontal therapy: resolution of swelling and inflammation, all probing depths no more than 4 mm with minimal bleeding on probing. (Periodontist: Dr Reena Wadia.)

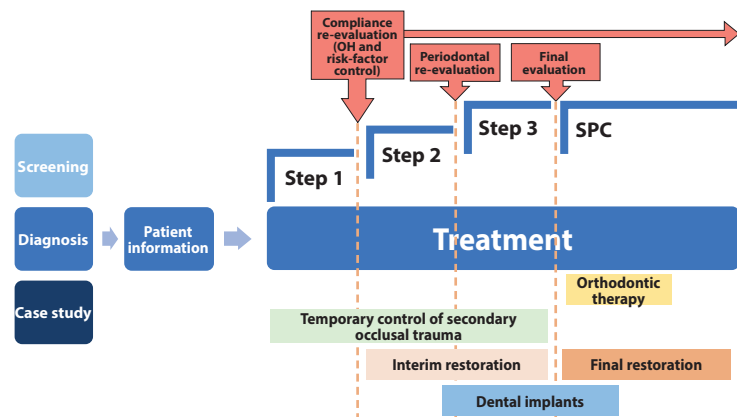
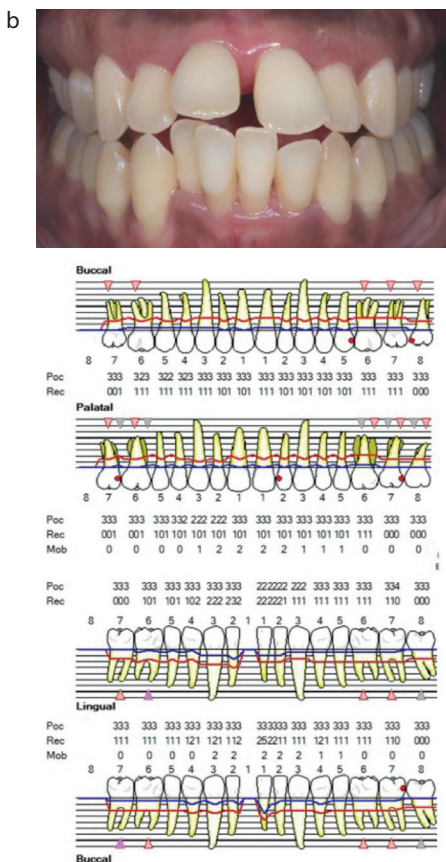


Figure 2. Visual description of timing/sequence of orthodontic and periodontal treatment.²

is a high level of evidence suggesting that a short (1 month) and a prolonged (6 months) period between periodontal regenerative treatment and orthodontic therapy results in comparable outcomes, so there is no need to wait for a prolonged healing period

after regenerative interventions before commencing orthodontics.^{2,6-8} However, it is important to highlight the grade of recommendation for the timing was grade B, a recommendation rather than a strong recommendation owing to the limitations of the studies.

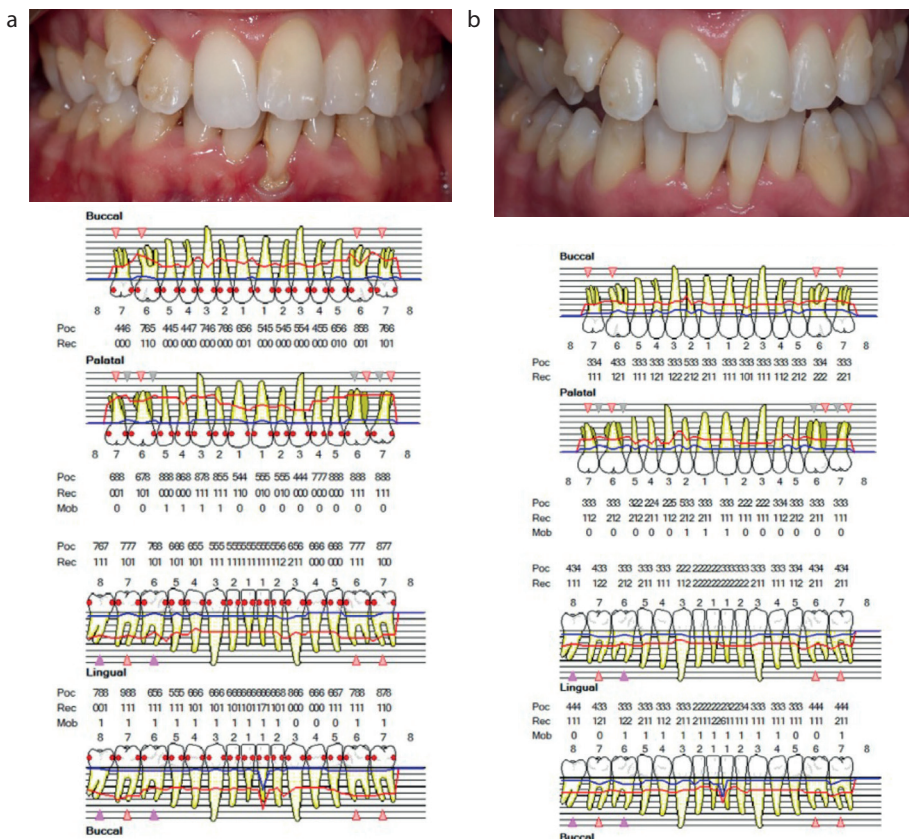


Figure 3. (a) Pre-periodontal treatment. (b) Post-periodontal treatment (non-surgical periodontal therapy and a free gingival graft for the lower left central incisor). This patient was inappropriately about to commence orthodontic treatment, hence the composite on the buccal surfaces of the teeth. The importance of not going ahead with orthodontics at this stage was explained to the patient and periodontal intervention was completed first. (Periodontist: Dr Reena Wadia.)



Figure 4. Stabilized periodontitis case requiring intrusive orthodontic movement for the upper right central incisor. (a) Pre-orthodontic intrusion. (b) Post-orthodontic intrusion. (Periodontist: Dr Reena Wadia; Orthodontist: Dr Stefan Abela.)



Figure 5. Stabilized periodontitis case requiring retrusive orthodontic movements. (a) Pre-orthodontic retrusion. (b) Post-orthodontic retrusion. (Periodontist: Dr Reena Wadia; Orthodontist: Dr Stefan Abela.)

Biomechanics

The immediate consequence of the application of orthodontic forces is an accompanying change in the stress-strain distribution in the periodontal ligament.

This is associated with bending of the alveolar bone and the so-called 'cone effect'. The cone effect is the result of the resolution of a force into a horizontal and vertical component once applied to an

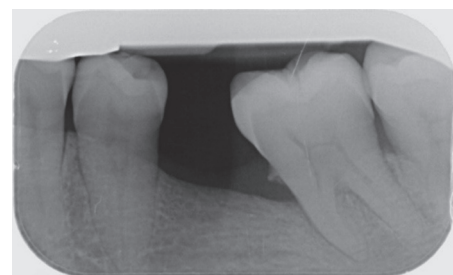


Figure 6. Tipped molar with evidence of bone loss and calculus.

inclined plane. Any horizontal force application will cause an extrusive component, which in a healthy situation is controlled by the supracrestal fibres. In periodontally affected teeth, however, where the bone support is reduced, the stresses and strains are distributed over a smaller surface area, so the resistance offered by the alveolar crest is less and the extrusive component is more pronounced.^{9,10} In patients with periodontitis whose teeth have already extruded because of the condition, maximum control of the vertical movement therefore becomes increasingly important.

In patients with reduced periodontal support, the centre of resistance is displaced more apically. The clinical consequence is that any force applied at the level of the crown will result in tooth movement characterized by a large rotational component. In other words, tipping movements are easier to achieve.^{9,11,12} The stress-strain distribution is uneven when tipping occurs, being most concentrated at the coronal and apical levels. These high force levels may risk causing obstruction of capillary vessels, leading to hyalinization,¹³ which has been shown to cause indirect bone resorption and root resorption.^{14,15} The emphasis is therefore on applying light controlled forces on these teeth.

The bone support of periodontally affected teeth is reduced not only in the vertical dimension, but often also in the buccolingual dimension. When this is the case, there is a greater risk of hyalinization, and indirect resorption will take place from the periodontium, further reducing the vertical height and causing irreversible damage to the bone support.

As a consequence, the force levels being applied for specific tooth movements, need to be carefully



Figure 7. Ceramic brackets (both arches). (GDP: Dr Krupesh Patel.)

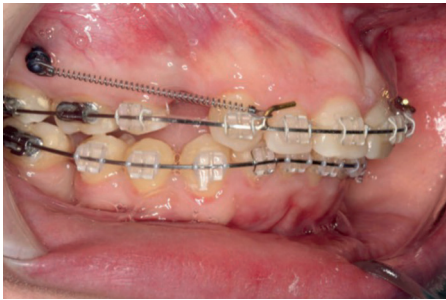


Figure 8. Mini-screw/temporary anchorage device.



Figure 9. Completion of fixed orthodontics. (a) Pre-gingivectomy. (b) Post-gingivectomy. (Periodontist: Dr Reena Wadia.)



Figure 10. Fixed retention. (GDP: Dr Sahil Patel.)

considered. When there is a reduced periodontal ligament present, the amount of stress and strain increases. To avoid undesired hyalinization in periodontally compromised teeth, it is key that light controlled forces are applied to the teeth.¹⁶

Thus, the biomechanical principles of orthodontic tooth movement in these vulnerable periodontitis patients with a

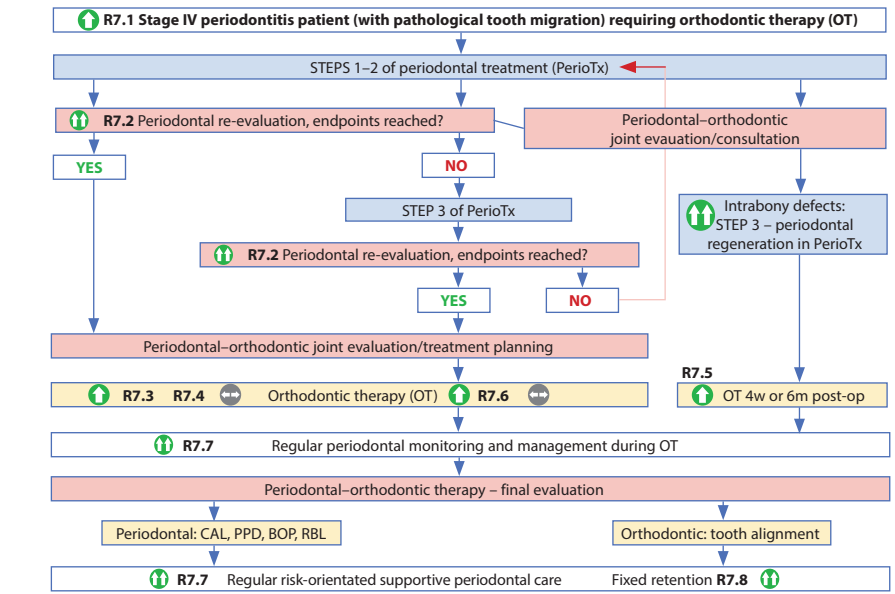


Figure 11. Flowchart of how orthodontic therapy of stage IV periodontitis patients can be integrated in the overall periodontal treatment plan, with reference to all the latest recommendations (R7.1–R7.8) from the S3-level clinical practice guideline for the treatment of stage IV periodontitis.² CAL: clinical attachment loss; PPD; probing pocket depth; BOP: bleeding on probing; RBL: radiographic bone loss.

healthy, but reduced periodontium differs from that of healthy patients with no attachment loss. The cellular activation of the periodontal ligament must be limited as much as possible in the teeth to be moved. The force level must be kept as low as possible and the loads should be evenly distributed ideally with root-controlled movements.⁹

Orthodontic management

Fixed or removable?

Orthodontic tooth movements may be carried about using either fixed (braces) or removable (able to be inserted/removed by the patient, such as removable plates, thermoplastic aligners etc.) orthodontic appliances. In patients with severe periodontitis requiring orthodontic therapy to maintain/improve periodontal stability, fixed rather than removable appliances are advised.^{2,6,7}

Removable clear aligners have become increasingly popular, and patients often prefer these owing to enhanced aesthetics and easiness for oral hygiene in comparison to fixed appliances. However, braces have been historically well accepted by adults and there are also now more aesthetic alternatives available within fixed appliances such as ceramic brackets (Figure 7) or lingual appliances.

Orthodontic management

Adjuncts

In stage IV periodontitis patients where there is a healthy, but reduced periodontium anchorage is often an issue. The use of skeletal anchorage devices (implants or temporary anchorage devices – mini-screws or mini-plates) compared with conventional anchorage systems, may be considered as adjuncts to improve the efficacy of orthodontic therapy and its effect on periodontal outcomes (Figure 8).² Some patients might experience discomfort when receiving temporary anchorage devices, although this has not been evaluated in the reported studies.^{2,6,7}

Circumferential fiberotomy of the supracrestal periodontal fibres has been suggested as an adjunct surgical procedure to improve the post-treatment stability after correction of severely rotated teeth or as an intervention aimed to improve attachment levels during orthodontic tooth intrusion. The guidelines² suggest that these may be considered, although fiberotomy is a surgical intervention requiring specific surgical experience and skills, and albeit minimally invasive, might be less acceptable by some patients. The evidence base in support of this practice, however, remains weak.^{6,7}

Management of periodontitis recurrence and complications during orthodontics

Orthodontic appliances can be associated with increased microbial colonization and plaque retention, so it is important to implement an appropriate oral hygiene and periodontal management protocol throughout orthodontic therapy to ensure periodontal health and avoid adverse effects, such as enamel demineralization, tooth discolourations and further loss of periodontal support, e.g. periodontal abscess formation, with consequent bone loss. Professional plaque control and other supportive oral and periodontal care must be implemented according to the patient's risk profile and appropriately advised during the consent process.

There is a high level of evidence recommending that, while undergoing orthodontic therapy, the patient's periodontal status should be closely monitored and managed, ideally at each orthodontic appointment.^{2,17,18} If any signs of periodontal relapse or recurrence are detected, active orthodontic therapy must be interrupted. The affected teeth can then be maintained passively while rendering the appropriate periodontal treatment and oral hygiene reinforcement. Only once periodontal health/stability has been re-established, should active orthodontic therapy be continued.^{2,17,18}

Enlargement of the gingival tissues during orthodontics is more of an issue with fixed orthodontics, but can still be seen with aligner systems. It may also interfere with the full completion of the orthodontic treatment. If this occurs, it is important to reinforce the importance of optimal oral hygiene and usually in these cases, a gingivectomy is performed (Figure 9). On most occasions if the key periodontal parameters are otherwise stable, this is completed following orthodontic treatment.

As mentioned, orthodontic therapy does not increase the risk of root resorption in periodontitis patients. It appears as though apical root resorption is a result of a combination of individual biological variability and the effect of mechanical factors. It is more common with fixed compared to removable appliances, and with longer duration treatment courses.¹⁹ Although, periodontal parameters do not seem to have an influence on the likelihood of this complication, the impact of the root resorption in a periodontitis patient with significant bone loss is important to



Figure 12. Orthodontic treatment in a stable periodontitis patient. **(a)** Pre-orthodontic treatment: tooth rotation, drifting and extrusion. **(b)** Post-orthodontic treatment: alignment. (Periodontist: Dr Reena Wadia; Orthodontist: Dr Stefan Abela.)

consider in relation to an anchorage or support point of view. If this is detected, and it is progressing significantly, then orthodontic treatment may need to be halted if the risks outweigh the benefits. No treatment as such is required unless the tooth or teeth lose vitality. If there is increased mobility, it is likely that permanent retention, in the form of a fixed retainer would be required.

Maintenance and retention

Relapse following orthodontic treatment towards their pre-treatment positions is not uncommon, particularly in this population. This can have both aesthetic and functional consequences that compromise treatment outcomes and patient satisfaction.

For this reason, after completing orthodontics, life-long supportive

periodontal care and life-long orthodontic retention are recommended. These should be tailored according to the patient's specific needs and risk profile.^{2,17,18}

There is a high level of evidence to recommend appropriately designed, permanent fixed passive retention (with or without additional removable retention; Figure 10).²⁰ These can be more prone to retention failure, more plaque accumulation, and inadvertent movements owing to distortion of the bonded wire. For this reason, life-long supporting protocols would also be important to identify early retainer failures (such as partial de-bonds), and undesired tooth movements, as well as assess periodontal stability.^{2,20} Consideration therefore should also be given to the provision of removable clear retainers, to be worn on a night-time basis.

Summary of recommendations

Figure 11 illustrates how orthodontic therapy of stage IV periodontitis patients can be integrated in the overall periodontal treatment plan with reference to all the latest recommendations.²

Orthodontic therapy can be successfully completed in stable, treated periodontitis patients with an interdisciplinary approach to maintain a harmonious periodontal–orthodontic relationship. Figure 12 depicts a patient with successfully treated periodontitis who underwent orthodontic treatment. This will then be followed by any final restorative treatment.

Conclusion

All dental practitioners are advised to follow the latest evidence-based guidelines as discussed for safe and predictable results when treating patients with periodontitis who require interdisciplinary orthodontic management. The importance of achieving the periodontal outcomes of shallow, maintainable pockets and control of inflammation before considering orthodontic treatment is key. Orthodontic treatment should involve careful risk assessment and treatment planning, as well as the use of light controlled forces.

Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflict of interest.
Informed Consent: Informed consent was obtained from all individual participants included in the article.

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