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Orthodontic and periodontal health interplay: insight from a case series

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Abstract

Orthodontic treatment improves dental aesthetics and function but may presents challenges in patients with compromised periodontal health. This case series highlights the importance of interdisciplinary care and patient compliance in managing these complexities. Three female patients aged 27 to 42 years old with histories of orthodontic treatment were referred to Periodontology Postgraduate Clinic for further periodontal management. All patients showed periodontal deterioration post-orthodontic treatment, with complications such as gingival inflammation, deep probing pocket depth (PPD), increased tooth mobility and severe bone loss involving lower incisors. Improper plaque control and non-compliance with retainers may contributed to these outcomes. All patients reported being unaware of their periodontal issues prior to this except the ones affected by tooth mobility. Following thorough periodontal examination, each patient was informed about the importance of proper plaque control and regular maintenance visits especially in patients with any appliance intraorally, as these appliances would promote bacterial plaque retention. The patients were then received non-surgical periodontal therapy, with regular follow-ups before periodontal stability achieved. This case series emphasizes the need for early periodontal screening, continuous monitoring, and interdisciplinary collaboration between orthodontists and periodontists. Patient compliance is crucial to prevent periodontal complications and to achieve optimal functional and aesthetic results during orthodontic therapy.

Keywords: *complication, maintenance therapy, orthodontic treatment, periodontitis, vertical defect*

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Introduction

Periodontal disease or periodontitis is a chronic inflammatory condition associated with dental plaque biofilm dysbiosis (Papapanou *et al.*, 2018). It leads to the destruction of the complex tooth-supporting structures, including the periodontal ligament, cementum, and alveolar bone (Lindhe *et al.*, 2022). This loss of periodontal support may lead to pathological tooth migration (PTM), affecting both aesthetics and function, and significantly impacting the patient's quality of life (Chapple, 2014).

In patients with pre-existing periodontal conditions, orthodontic appliances can further aggravate the disease, causing increased tooth mobility, bone loss, gingival inflammation, and root resorption (Feller *et al.,* 2015a). These complications may arise during or after orthodontic treatment, leading to both aesthetic and functional challenges.

Interdisciplinary care between orthodontists and periodontists is crucial for managing these complexities and ensuring successful outcomes. Early diagnosis, plaque

control, and comprehensive periodontal monitoring are essential to preserving periodontal health and dental aesthetics (Doulkeridou *et al.,* 2020).

Orthodontics treatment, while effective in addressing malocclusion and dental crowding (Erbe *et al*., 2022), involves the movement of teeth through a biological response in periodontal tissue caused by applied forces (Feller *et al.,* 2015b; Maltha *et al.,* 2021). In healthy periodontal patients, this process is generally safe, but in those with compromised periodontium, it presents additional risks (Jepsen *et al*., 2023). Maintaining a healthy periodontium is vital for optimal orthodontic outcomes and preventing relapse after treatment (Gkantidis *et al*., 2010).

A crucial component in managing these risks is early and through periodontal assessment before starting orthodontic treatment, followed by continuous monitoring throughout the treatment process. The collaboration between orthodontists and periodontists is critical in ensuring optimal outcomes, particularly for patients with existing periodontal concerns. Inadequate communication between these specialties, along with poor patient compliance, can lead to undesirable outcomes, such as relapse of alignment, gingival recession, and compromised aesthetic results.

Therefore, this case series explores the clinical and aesthetics outcomes in three female patients who underwent orthodontic treatment in the presence of varying degrees of periodontal disease. Each patient experienced complications ranging from bone loss to tooth mobility and gingival recession, all of which negatively affected both function and aesthetics. The report aims to highlight the importance of early periodontal screening, interdisciplinary care, and patient compliance in managing these complex cases and achieving successful outcomes.

Case 1

A 27-year-old female patient complained of mobile teeth and sudden exfoliation of lower anterior tooth and seeking for appropriate treatment in 2022 at our periodontal clinic. The patient noticed the symptoms 1-2 years ago, however, due to the movement restriction during the Pandemic Covid-19, she was unable to seek treatment earlier. The patient was medically healthy. She had undergone orthodontic treatment at a private clinic twelve years ago at the age of fifteen to address crowding in the lower incisors. All first premolars were extracted prior to the treatment, which lasted within 2 years, and she was provided with a removable retainer.

Upon visiting the periodontal clinic, she presented with a 4mm space between the central incisor and canine (Figure 1) due to the exfoliation of the lower right lateral incisor a few months before her first visit to our periodontal clinic. Clinically, the patient had minimal localized gingival inflammation and bleeding on probing (BOP), predominantly in interdental areas. The plaque score of 21.3% was noted, mostly in interdental areas. Deep probing pocket depths ranging 5-9mm were observed in several teeth included 17, 23, 25,45,46 and 47. The radiographs revealed severe bone loss, up to two-thirds of root length, particularly at teeth 25, 41, 45 and 47. Bone loss of about half of the root length or less was noted at teeth 17, 23 distal and 43 mesial (Figures 2 and 3). Tooth mobility was observed, with grade I detected at most of the teeth and grade II was detected at teeth 45 and 41. There was no occlusal interference detected.

Based on the clinical and radiographic findings, the patient was diagnosed with localized periodontitis stage III grade C. Management would focus on addressing the deep periodontal pockets and bone loss, with potential regenerative procedures and regular monitoring/ maintenance being essential.

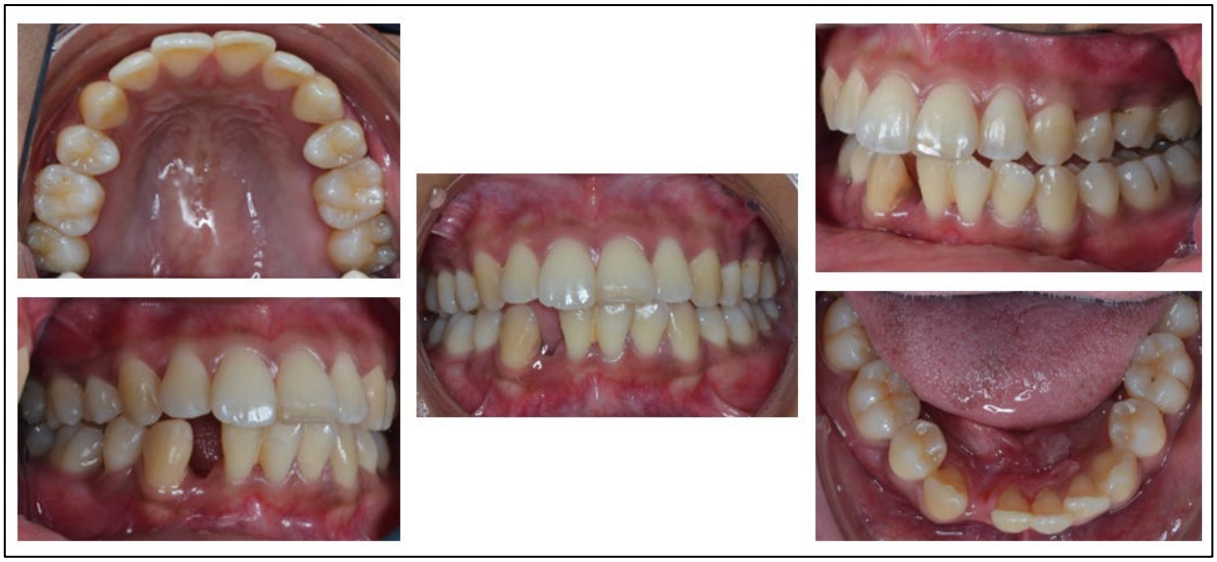

Figure 1. Intraoral photographs of Case 1.

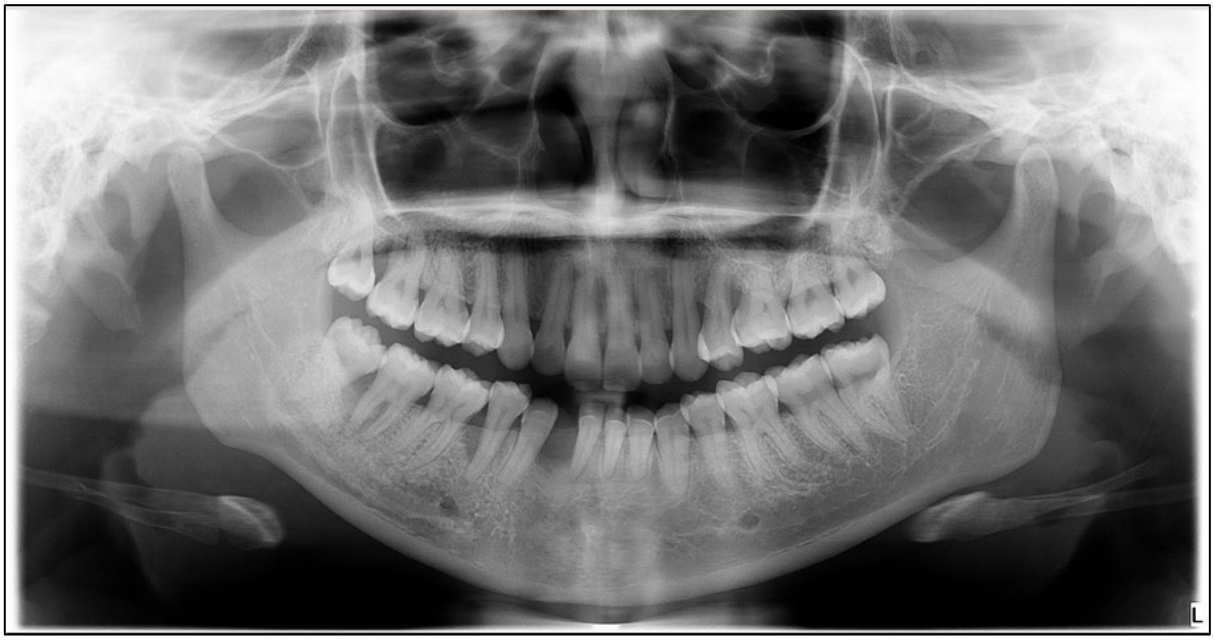

Figure 2. Panoramic radiograph (Orthopantomography) of Case 1.

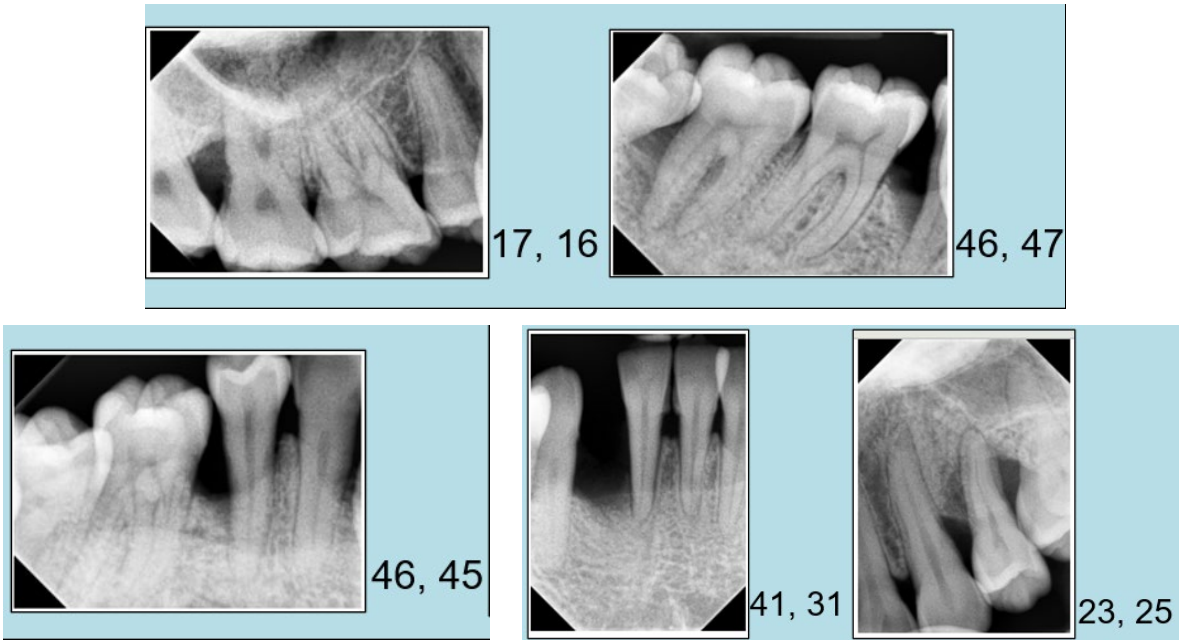

Figure 3. Intraoral periapical radiograph of Case 1.

Timeline-based summary of this first case of 27-year-old patient as below:

- **Year 2010 (age 15):** The patient underwent orthodontic treatment to correct lower crowding. All first premolars were extracted before the treatment. The treatment lasted for 2 years and was given a removable retainer.
- **Year 2020-2021**: The patient noticed mobile teeth and a worsening of symptoms over 1-2 years but could not seek treatment due to pandemic restrictions.
- **Early 2022**: The lower right lateral incisor was exfoliated a few months before visiting the clinic.
- **Year 2022 (age 27)**: The patient visited the periodontal clinic.
    - **Clinical findings**: A 4mm space between the lower left central incisor and canine, minimal gingival inflammation, deep PPD (5-9mm) at several teeth (17, 23, 25, 45, 46, and 47), and bone loss up to two-thirds of the root length at teeth 25, 41, 45 and 47.
    - **Diagnosis**: Localized periodontitis, stage III, grade C.
    - **Treatment**: Focused on managing deep pockets and bone loss with potential regenerative procedures, along with regular monitoring.

Case 2

A 42-year-old female patient complained of loose upper anterior teeth in year 2023 at our periodontal clinic, a problem she had noticed before starting orthodontic treatment in 2016 but had not sought treatment for. The patient is medically healthy. She began orthodontic treatment in 2019 in a private clinic, which involved the extraction of 3 teeth (first premolars except tooth 24) prior to the treatment. The treatment was completed in less than 2 years. She was provided with removable retainers, however, the patient admitted non-compliance, which led to relapse within a year.

Upon presentation in our periodontal clinic, in general, she exhibited inflamed gingiva (Figure 4) with a bleeding on probing (BOP) score of 59.6% and a plaque score of 36.5%. Deep PPD of 5-6mm were observed in several teeth included teeth 46, 12-22, 25, 26, 42 and 43. Teeth mobility was noted, with grade I was detected at teeth 11, 21, 23, 26, 37, 36, 31-43, and 45; and grade II was detected at teeth 12 and 22. Tooth 12 was also affected by buccal gingival recession of

2.5 mm. Occlusal interference was detected at tooth 12 upon closing and opening the mouth.

The radiographs findings showed severe bone loss, up to two-thirds of root length at tooth 12. Bone loss of about half of the root length or less was noted at teeth 17, 13, 11, 35, 32, and 31 (Figures 5 and 6). Apart from that, periapical radiographs showed apical root resorption was noted at all upper anterior teeth, teeth 42 and 43.

Based on the clinical and radiographic findings, the patient was diagnosed with localized periodontitis stage IV grade C without any risk factors. Treatment would aim to stabilize the mobile teeth and manage deep pockets and bone loss, with occlusal adjustments to correct interference which may help in reducing further damage. Comprehensive periodontal therapy, along with regular follow-ups, would be required. A possible advanced periodontal intervention would be necessary in managing this case.

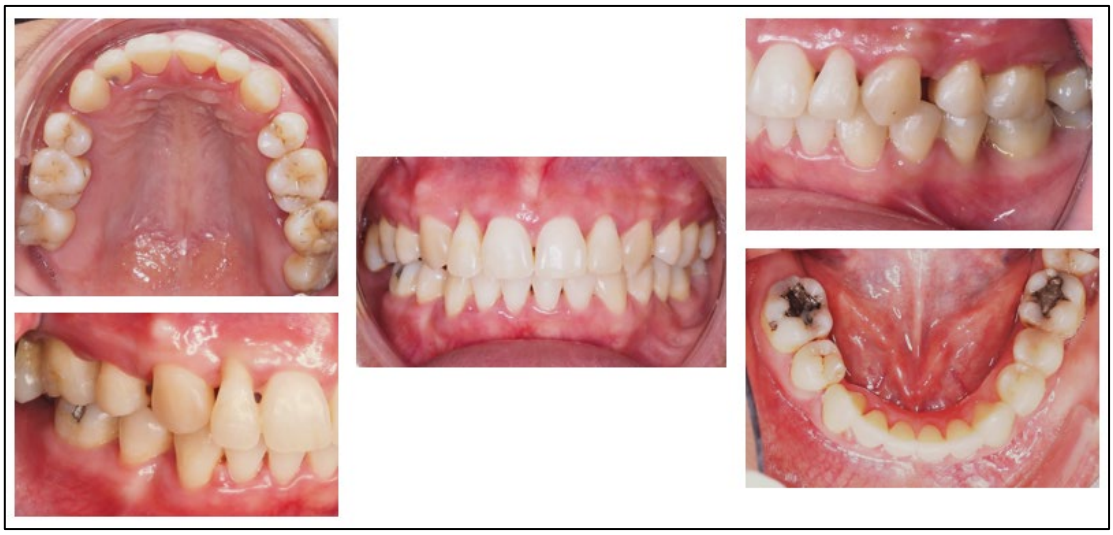

Figure 4. Intraoral photographs of Case 2.

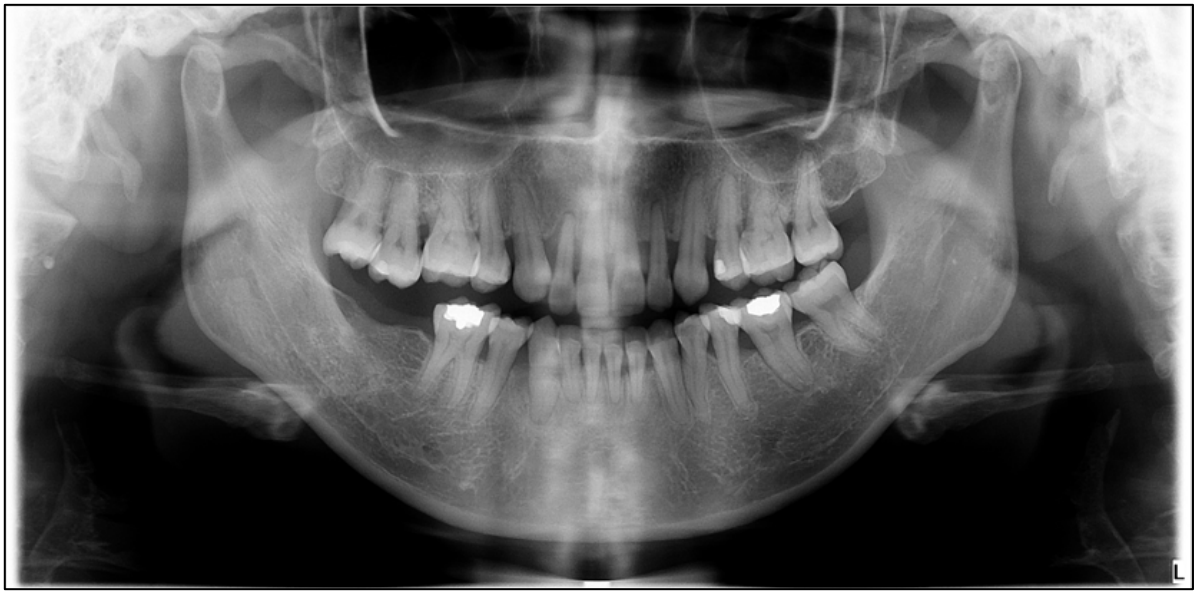

Figure 5. Panoramic radiograph (Orthopantomography) of Case 2.

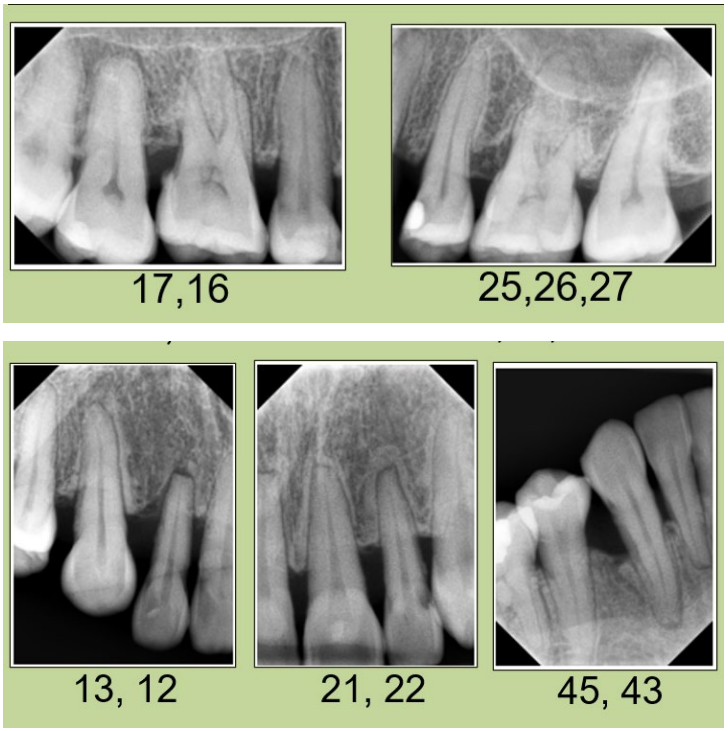

Figure 6. Intraoral periapical radiograph of Case 2.

Timeline-based summary of this second case of 42-year-old patient as below:

- **Year 2016 (age 35):** The patient noticed loose upper anterior teeth but did not seek treatment.
- **Year 2019**: The patient started orthodontic treatment, with the extraction of 3 premolars (except 24). She was provided with removable retainers.
- **Year 2020**: Non-compliance with the retainer led to a relapse in alignment.
- **Year 2023 (age 42)**: The patient visited the periodontal clinic.
    - **Clinical findings**: Inflamed gingiva with a BOP score of 59.6%, deep PPD (5-6mm) in several teeth (46, 12-22, 25, 26, 42, and 43), mobility of several teeth and occlusal interference at tooth 12. Severe bone loss was noted, particularly at tooth 12, and apical root resorption in several upper anterior teeth.
    - **Diagnosis**: Localized periodontitis, stage IV, grade C.
    - **Treatment**: Aimed at stabilizing mobile teeth, managing deep pocket, and addressing occlusal interference. Periodontal therapy and possibly advanced interventions were recommended.

Case 3

A 38-year-old medically healthy female patient complained of food impaction in the upper left posterior teeth during the first visit in our periodontal clinic in 2022. In the past dental history, the patient claimed that she had two extractions involving lower right and upper left first molars while pregnant due to mobility without any post-extraction complication. The patient also had undergone orthodontic treatment in a private clinic six years ago, in 2017, due to anterior teeth crowding, without any prior tooth extractions. The orthodontic treatment was completed in 3 years. The patient was provided with a retainer; however, she did not comply with the retainer provided.

Upon examination in our periodontal clinic, inflamed gingiva was noted with a BOP score of 41.8% and a plaque score of 42.5%. Deep PPD of 5-6mm were found in several teeth included at teeth 17, 16, 23, 38, 37, 36, 35, 32, 45, and 47. Tooth mobility was detected,

with grade I at tooth 36, grade II at tooth 31, and grade III at tooth 32.

The radiographic analysis confirmed the severe alveolar bone loss until the apical of tooth 32 (Figures 7 and 8), deemed to have a hopeless prognosis. Other areas showed minimal bone loss, which were less than one-third of the root length included at teeth 36 and 35. There was no occlusal interference detected.

Based on the clinical and radiographic findings the patient was diagnosed with localized periodontitis stage III grade B without any risk factors. The management approach would involve extraction of tooth 32 due to its hopeless prognosis, periodontal therapy to address inflammation and pocket depths, and careful prosthodontic planning for tooth replacement.

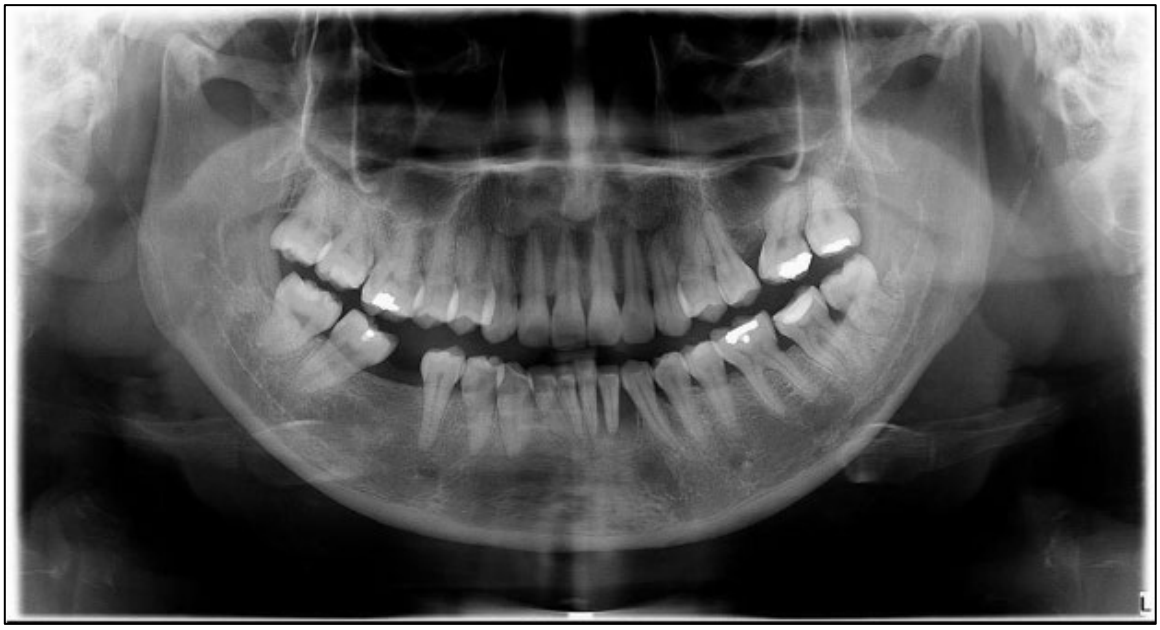

Figure 7. Panoramic radiograph (Orthopantomography) of Case 3.

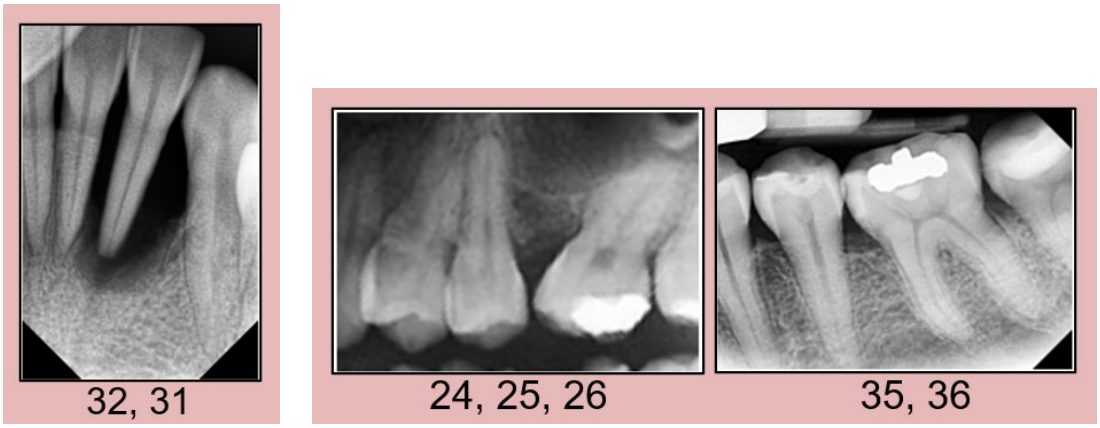

Figure 8. Intraoral periapical radiograph of Case 3.

Timeline-based summary of this second case of 38-year-old patient as below:

- **Before year 2017:** The patient had teeth extractions (lower right and upper left first molars) while pregnant due to mobility without any post-extraction complication.
- **Year 2017 (age 33):** The patient underwent orthodontic treatment for anterior crowding, which lasted 3 years without extractions. She was provided with a retainer, but non-compliance led to relapse.
- **Year 2022 (age 38)**: The patient visited the periodontal clinic.
    - **Clinical findings**: Inflamed gingiva with a BOP score of 41.8%, deep PPD (5-6mm) in several teeth, severe alveolar bone loss and mobility grade III at 32, and clinically missing of 46. Radiographic findings confirmed a hopeless prognosis for teeth 32.
    - **Diagnosis**: Localized periodontitis, stage III, grade B.
    - **Treatment**: Extraction of tooth 32 due to its hopeless prognosis, periodontal therapy, and prosthodontic planning for tooth replacement.

Discussion

Orthodontic intervention is recognized as an effective treatment modality for addressing issues related to both aesthetics and function (Erbe *et al.,* 2022). However, when periodontally compromised teeth are involved, orthodontic treatment become considerably more complex and challenging. Due to compromised supporting tooth structures, improper orthodontic intervention may lead to a range of undesirable consequences (Jepsen *et al*., 2023), including heightened bone loss, increased tooth mobility, exacerbated gingival inflammation, and root resorption (Feller *et al.,* 2016). These adverse effects emphasize the need for interdisciplinary collaboration between orthodontists and periodontists to prevent complications and ensure proper management of periodontally compromised patients undergoing orthodontic therapy.

A key observation across the cases is the lack of effective communication between healthcare providers and patients regarding the importance of maintaining periodontal health during orthodontic treatment. There was a failure to gather data on whether the patient underwent periodontal screening prior to orthodontic treatment, despite patients' history of tooth mobility before orthodontic treatment as seen in Case 2 and Case 3, which is often a significant indicator of potential periodontal issues (McGuire & Nunn, 1996a, 1996b). Without a clear record of whether periodontal evaluation took place, it is difficult to determine if any pre-existing periodontal conditions were identified or addressed before orthodontic intervention began. This lack of information raises concerns about the potential for missed opportunities to prevent or manage underlying periodontal disease, which could have contributed to the progression of the condition during treatment. If a periodontal screening had been conducted, and the patient's mobility had been properly evaluated, it would have warranted appropriate referrals to a periodontist for further management and care. Unfortunately, in this instance, such referrals do not appear to have been made.
Minor radiographic bone loss may be observed in patients with a healthy periodontium following orthodontic treatment. However, this bone loss generally does not lead to significant periodontal compromise. Research suggests that even in patients with stable-treated periodontitis, the slight bone loss seen on radiographs after orthodontic therapy does not have a meaningful impact on periodontal health or clinical outcomes (Martin *et al*., 2022). This indicates that, in properly managed cases, orthodontic treatment can be safely conducted without causing notable harm to the periodontium.

In these cases, deep infrabony defects and periodontal pockets were evident, indicating significant periodontal deterioration. Notably, Case 2 exhibited significant severe vertical bone defects, which were closely

associated with inadequate plaque control, as supported by earlier research (Årtun & Urbye, 1988). These findings underscore the critical role that plaque control and proper oral hygiene play in maintaining periodontal health, particularly in patients undergoing orthodontic treatment. Failure to adhere to stringent oral hygiene practices can lead to the accumulation of microbial biofilm, which exacerbates inflammation and accelerates the progression of periodontal disease. This highlights the need for comprehensive patient education and regular monitoring to ensure that oral hygiene is maintained optimal levels before, during, and after orthodontic treatment. By minimizing the microbial burden, the risk of further periodontal destruction, including deepening periodontal pockets and bone loss, can be significantly reduced, ultimately safeguarding both the patient's periodontal and orthodontic outcomes.

Apical root resorption was another notable complication as presented in Case 2 where shortened apical roots were observed in both the upper and lower anterior teeth. Apical root resorption is recognized as an unavoidable and undesirable iatrogenic consequence following orthodontic intervention (Feller *et al.,* 2016), often caused by heavy continuous orthodontic force and prolonged treatment duration (Bayir & Bolat Gumus, 2021). Without baseline data in this case, the extent of resorption could not be fully quantified.

Apical root resorption is typically categorized into three levels: mild (resorption less than 2mm of the original root length), moderate (resorption exceeding 2mm but remaining below one-third of the original root length), and severe (resorption exceeding 4mm or one-third of the original root length). According to existing literature, root resorption in orthodontically treated patients with healthy periodontium has been reported within the range of 1 to 1.5mm (Corrente *et al.,* 2003; Heravi *et al.,* 2011; Melsen *et al.,* 1989). In patients with periodontitis, the reported range of root resorption following orthodontic treatment varies from 0.2 to 3.0mm (Harris & Baker, 1990; Zasčiurinskienė *et al*., 2018, 2019a, 2019b). It is imperative to inform both patients and their parents about the risk of apical root resorption associated with orthodontic treatment before orthodontic treatment begins. Precautionary measures to mitigate this risk should be carefully considered, and any instances of root resorption should be promptly addressed to prevent further damage.

In addition to the well-known complications such as alveolar bone loss and tooth mobility or loss, orthodontic treatment in periodontally compromised patients can also result in gingival recession, alterations in gingival phenotype, gingival clefts, and loss of interdental papilla (Jepsen *et al.,* 2023). These conditions not only affect aesthetics but also impair function and reduce the patient's quality of life. Careful consideration and tailored management strategies are crucial when planning orthodontic treatment for patients with periodontal concerns.

Retainer non-compliance is a major cause of orthodontic relapse (Littlewood *et al*., 2017) and can worsen periodontal issues. Without retainer use, teeth tent to shift back, leading to crowding, plaque accumulation, which increases the risk of gingival inflammation, periodontal pockets and bone loss. In patients with a history of periodontitis, relapse can strain weakened periodontal structures, exacerbating tooth mobility and bone loss. Maintaining proper oral hygiene becomes difficult with relapse crowding, further aggravating the periodontal health. Therefore, strict adherence to retainer protocols and regular periodontal maintenance is crucial to prevent relapse and protect periodontal health.

The cases presented raise important questions about the qualifications and expertise of the healthcare providers at the private clinics where these patients received orthodontic care, specifically whether they were treated by trained orthodontists or general dentists performing orthodontic procedures. The absence detailed periodontal evaluations prior to orthodontic treatment, despite clear indicators such as

tooth mobility, suggests a potential lack of specialized knowledge in managing complex dental cases involving extensive training to manage cases that may involve compromised periodontal support, ensuring that treatment plans account for any underlying conditions that could be exacerbated by orthodontic forces. In contrast, general dentists may not have the same level of expertise in recognizing and addressing these challenges, particularly when interdisciplinary care involving a periodontist is required. The failure to make appropriate referrals for periodontal management in these cases further suggests that the provider may not have fully understood the risks associated with treating patients with periodontal concerns. This highlights the importance of ensuring that orthodontic treatment is conducted by a qualified orthodontist who has the skill and knowledge to manage complex cases and collaborate with other specialists as needed to prevent adverse outcomes.

Established guidelines must be followed diligently by practitioners when evaluating orthodontic therapy options for their patients. Initially, it is recommended to perform a Basic Periodontal Screening (BPE) during the initial examination, as suggested by Greer *et al*. (Greer *et al*., 2018). It is important to note that a BPE does not provide a definitive periodontal diagnosis, instead, it guides the clinician towards an appropriate diagnostic and treatment course. The British Society of Periodontology (BSP) offers a readily accessible online flowchart that demonstrates how BPE codes can guide clinicians to achieve an accurate diagnosis (BSP, 2018). Patients who score a code of 3 or 4 required a comprehensive examination which includes radiographic assessment to evaluate the crestal bone level, periodontal pocket depth, infrabony defect and furcation involvement. Additionally, it is crucial for practitioners to consistently record patients' plaque scores and bleeding scores to monitor plaque control and gum inflammation effectively throughout the treatment process.

As highlighted earlier, effective communication between the orthodontist and periodontist is vital in enhancing the treatment outcomes and reducing the likelihood of periodontal complications. To facilitate this communication, Table 1 outlines recommended protocols for periodontal screening, maintenance, and follow-up. It's essential to recognize that these protocols may differ for each patient based on factors such as age, medical background, dental history and periodontal condition. Therefore, the clinician must customize the protocol accordingly.

Table 1. Recommended Protocols.

Before Orthodontic Treatment	
Orthodontist	➢ Periodontal screening: basic periodontal examination (BPE) ➢ Refer the patients who score 4 or * to periodontists. ➢ Refer the patients who score 3 which not responding to the treatment to the specialist. ➢ Evaluate the site with the risk of mucogingival deformity. ➢ Refer the patients with a risk of mucogingival deformity to periodontist.
Periodontist	➢ Comprehensive (full mouth) periodontal assessment clinically and radiographically. ➢ Diagnose, plan and treat active periodontal diseases. ➢ Diagnose, plan and treat mucogingival deformity as necessary. ➢ Evaluate the periodontal condition after active therapy. ➢ Repeat the periodontal therapy if the condition persistent. ➢ Refer the patient who periodontally stable to the orthodontist.

Both	➢ Motivation/ Education: ▪ Explain the risk of developing periodontal disease during an active orthodontic treatment. ▪ The importance of adequate plaque control with proper oral hygiene home care. ▪ The importance of regular check-up 6 monthly for prevention and early intervention if necessary. ➢ Oral hygiene instruction: ▪ Proper toothbrushing. ▪ Interdental cleaning using interdental brush or floss. ▪ The uses of mouthwash and tongue cleaner. ▪ The uses of single tufted toothbrush if necessary.
During Orthodontic Treatment	
Orthodontist	➢ Start orthodontic when fulfilling the well-established endpoints of periodontal therapy (Sanz *et al.,* 2020). ➢ Monitor patient's plaque control and gingival inflammation regularly via plaque and bleeding scores. ➢ Monitor BPE score regularly (3- or 6-month intervals). ➢ Refer the patient as necessary. ➢ Tailored orthodontic treatment for periodontally compromised patients: avoid excessive orthodontic stress.
Periodontist	➢ Continuously monitor periodontal conditions. ➢ Update the periodontal parameters every 3 or 6 months including radiographic assessment as needed. ➢ Professional supragingival debridement regularly. ➢ Periodontal treatment when needed. ➢ Tailored a preventive regime.
Both	➢ Remotivate the patients. ➢ Reinforcement of proper oral hygiene care. ➢ Continuously monitor the compliance with recommended home care therapy. ➢ Monitoring and addressing apical root resorption.
After Orthodontic Treatment	
Orthodontist	➢ Remind the patient regarding the importance of compliance to the retainer prescribed. ➢ Remind about the risk of relapse.
Periodontist	➢ Periodontal re-evaluation (clinical and radiographic evaluation). ➢ Decide the appropriate therapy (if needed) and maintenance interval according to the periodontal risk assessment. ➢ Assess mobility once periodontal attachment has fully healed subsequent to recent orthodontic treatment completion.
Both	➢ Remotivate the patients. ➢ Reinforcement of proper oral hygiene care.

Conclusion

In conclusion, it is evident that improper orthodontic intervention may jeopardize the integrity of periodontal structures, potentially exacerbating undiagnosed and untreated periodontitis and leading to undesirable consequences. The cases presented highlight how the absence of comprehensive periodontal screening and inadequate referrals for periodontal management contributed to the progression of periodontal disease in these patients. Issues such as deep infrabony defects, severe bone loss, and tooth mobility could have been mitigated with early intervention, better oral hygiene management, and closer coordination between healthcare providers. However, when conducted to an acceptable standard, orthodontic treatment has proven to be an effective intervention for enhancing both the function and aesthetics, particularly in patients experiencing pathological tooth migration.

Therefore, periodontal screening and necessary referral to a periodontist are imperative prerequisites before initiating orthodontic intervention. This ensures that any underlying periodontal concerns are addressed and managed appropriately. Strong interdisciplinary collaboration between the periodontist and orthodontist is crucial for ensuring the success of orthodontic treatment and preventing unwanted complications. Ensuring proper patient education, adherence to treatment guidelines successful long-term outcomes for patients undergoing orthodontic therapy.

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