Case Report | Dentistry

Periodontics and Orthodontics Integration to Enhance the Prognosis of Compromised Anterior Teeth: A Report of Two Cases

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Abstract

Introduction. Modifying the prognosis of a periodontally compromised tooth from “questionable” to “favorable” or “favorable” is a challenging clinical task. However, it has the potential to significantly impact the preservation of natural dentition over time and achieve satisfying results for both patients and clinicians. The aim of this case series is to report on the multidisciplinary management of two periodontally compromised anterior teeth with “questionable” prognosis.

Case Presentation. Two adult patients were diagnosed with severe periodontal disease. Each patient exhibited a maxillary central incisor with deep periodontal pocket, mobility, pathological migration, radiological evidence of severe bone loss, and infrabony defect resulting in a “questionable” prognosis for the affected teeth. Function and esthetic were compromised in both teeth. The periodontal diagnosis was Stage III and Stage IV Grade C periodontitis. To save the teeth, a multidisciplinary management plan was implemented, including both surgical and non-surgical periodontal therapy followed by orthodontic tooth movement with light forces to eliminate the occlusal trauma and improve esthetics. Follow-ups were conducted for one year.

Treatment Outcomes. The periodontal condition improved significantly, with reductions in the periodontal pocket depth up to 9 mm, clinical attachment level gain up to 4 mm, and radiographic bone fill of up to 90%. The tooth prognosis improved from “questionable” to “fair”. All patients were enrolled in a strict maintenance program to prevent disease recurrence and maintain long-term stability.

Conclusions. In this case series, we demonstrated that a multidisciplinary treatment approach involving non-surgical periodontal therapy, regenerative periodontal therapy, and orthodontic treatment, can preserve periodontally compromised teeth, maintain long-term periodontal health, improve tooth prognosis, and achieve satisfying functional and esthetic outcomes.

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Multiple prognostic systems for periodontal disease are available in the literature; some are based on evaluating tooth mortality, while others focus on predicting periodontal stability [2, 3]. Regardless of the system used, changing the prognosis of a periodontally compromised tooth from “questionable” to “fair” or “favorable” is not an easy task [4].

Periodontal therapy aims to inhibit disease progression and preserve natural dentition through comprehensive periodontal treatment. Fortunately, with advances in knowledge and therapy, most patients can keep their teeth for the rest of their lives with proper treatment. Adequate plaque control, and strict maintenance care [5]. Multiple periodontal therapies are available, starting with non-surgical treatment, which includes patient education, dental biofilm removal, debridement by supragingival and subgingival...
scaling, adjunctive systemic and local antimicrobial therapy, and occlusal therapy [6]. Occasionally, non-surgical therapy alone can be effective, especially in the presence of moderately deep periodontal pockets on single-rooted teeth [7]. On the other hand, surgical periodontal therapy is recommended for sites that have not responded to non-surgical therapy, aiming to achieve long-term success. Over 96% of teeth retained function for ten years after surgical periodontal regeneration [8].

The treatment options for a “hopeless” anterior tooth include retention, extraction, and replacement with either a prosthesis or a dental implant [9]. However, in most patients with severe periodontitis, periodontal therapy alone is not enough to restore both esthetic and functional dentition. The combination of periodontics and orthodontics has demonstrated positive outcomes in numerous clinical studies [10–12]. In addition, orthodontic tooth movement can be safely performed in treated and well-maintained periodontitis patients, with long-term periodontal stability maintained [13].

In this case series, successful management of periodontally compromised maxillary incisors with an initially “questionable” prognosis is presented. The complex interdisciplinary periodontal and orthodontic treatment resulted in favorable outcomes and an improvement of tooth prognosis.

**Case 1**

**Patient Information & Clinical Findings**

A 36-year-old male patient, a non-smoker with no known allergies or medical conditions, presented to the periodontics clinic of a university-based dental hospital, with a chief complaint of “feeling something wrong with my teeth, especially the upper front ones”. He noticed movement and increased spacing between his anterior teeth over time. The patient started orthodontic treatment two months prior to visiting the periodontics clinic.

On clinical evaluation, orthodontic brackets were attached to the upper arch from the maxillary right second premolar to the maxillary left second premolar (#15 to #25). Spacing between the maxillary left central incisor and the maxillary left lateral incisor (#21, #22) and diffuse gingival erythema were observed on the buccal side of tooth #21. Additionally, tooth #21 exhibited grade II mobility and purulent exudate (Fig. 1A).

A comprehensive periodontal examination was performed. The plaque index (PI) and bleeding index (BI) were 23% and 68%, respectively. The periodontal pocket depth (PD) ranged from 2 mm to 13 mm, and the clinical attachment loss (CAL) ranged from 0 mm to 12 mm. Tooth #21 exhibited PD ranging between 7 mm and 13 mm, with the mesiopalatal site presenting the deepest PD. The CAL ranged from 9 mm to 12 mm at tooth #21. Additionally, the mandibular right first molar (#46) had deep PD and class II lingual furcation involvement. Radiographic examination revealed localized severe bone loss around the first molars, deep vertical bone loss at tooth #21, and furcation involvement at tooth #46. The mandibular left third molar (#38) exhibited an extensive caries lesion with periapical radiolucency along the distal root (Fig. 2A & B).

All teeth were vital except for the mandibular left third molar (#38). The patient exhibited a thick periodontal phenotype.

**Diagnosis & Prognosis**

The periodontal diagnosis was Stage III Grade C molar-incisor pattern periodontitis. The overall prognosis was poor, with the individual tooth prognosis for tooth #21 being “questionable” [14] (Table 1).

**Therapeutic Intervention**

**Periodontal Therapy**

The orthodontic wires were removed as orthodontic tooth movement was undesired during the active disease stage. The treatment started by educating the patient about the nature of the disease, and customized oral hygiene instructions were given, followed by non-surgical full-mouth supra- and subgingival debridement, along with pus drainage at tooth #21. The patient received adjunctive systemic antimicrobial therapy after subgingival instrumentation (amoxicillin 500 mg and metronidazole 500 mg three times a day for seven days) [15].

At the follow-up appointment, gingival redness reduced, but tooth #21 was observed to be over-erupted (Fig. 1B); therefore, a stainless steel 0.16 mm orthodontic wire was used as a passive extraoral splint. Teeth #28 and #38 were extracted due to caries and extensive periodontal involvement.
Figure 2. Case 1. A) Full-mouth radiographs: a deep vertical bone defect related to tooth #21 and an advanced furcation defect at tooth #46, along with some calculus deposits in the left posterior teeth and a large caries lesion at tooth #38, with a vertical bone defect on the distal side of the tooth. B) Periapical radiograph of tooth #21: a wide and deep vertical defect (indicated by arrows), accounting for 80% bone loss on the mesial aspect. C) Bone fill in the defect after six months of treatment. D) Stability of the bone fill at tooth #21 one year after periodontal maintenance. Bone loss on the mesial aspect is 30%.

Table 1. Periodontal findings and prognosis of case 1. Non-surgical periodontal treatment, orthodontic treatment, and Emdogain® application resulted in a satisfactory response and improved tooth prognosis. The results were maintained over a year of maintenance therapy.

<table>
<thead>
<tr>
<th>Tooth #21</th>
<th>Initial Presentation</th>
<th>After Orthodontic TX</th>
<th>One-Year Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD range</td>
<td>7-13 mm</td>
<td>3-5 mm</td>
<td>4-8 mm</td>
</tr>
<tr>
<td>CAL range</td>
<td>9-12 mm</td>
<td>2-5 mm</td>
<td>3-5 mm</td>
</tr>
<tr>
<td>Recession</td>
<td>0 mm</td>
<td>0 mm</td>
<td>0 mm</td>
</tr>
<tr>
<td>Mobility</td>
<td>Class II</td>
<td>Class I</td>
<td>Class I</td>
</tr>
<tr>
<td>Alveolar bone level</td>
<td>Localized</td>
<td>Moderate bone loss</td>
<td>Moderate bone loss</td>
</tr>
<tr>
<td></td>
<td>vertical bone loss</td>
<td>(40% of root length)</td>
<td>(30% of root length</td>
</tr>
<tr>
<td></td>
<td>(80% of root length)</td>
<td>on the mesial</td>
<td>on the mesial</td>
</tr>
<tr>
<td></td>
<td>on the mesial</td>
<td>aspect).</td>
<td>aspect).</td>
</tr>
<tr>
<td>Prognosis</td>
<td>Questionable</td>
<td>Fair</td>
<td>Fair</td>
</tr>
</tbody>
</table>

Notes: PD – periodontal probing depth, CAL – clinical attachment level.

Another session of periodontal debridement was performed. The PI and BI reduced to less than 20% during a re-evaluation visit after six weeks. However, the PD of more than 5 mm remained persistent in the incisor and molars. The patient received additional periodontal debridement every three months for a duration of six months.

Orthodontic Treatment
Six months after treatment initiation, the PD at tooth #21 reduced from 13 mm to 6 mm without bleeding on probing (BOP). Recession increased to 3 mm on the mesial aspect and 2 mm on the buccal aspect. Evidence of radiographic bone fill was detected, accounting for 80% defect fill associated with tooth #21 (Fig. 2C). At this stage, the periodontal condition was considered stable; therefore, orthodontic intrusion was initiated. Tooth #21 was intruded using a simple leveling and alignment method to achieve a level similar to the contralateral tooth (#11).

The patient continued to receive periodontal maintenance during the orthodontic treatment. After six months from the initiation of orthodontic treatment, the PD at tooth #21 measured 5 mm with no BOP (Fig. 1C).

To achieve further PD reduction at tooth #21, the root surface was conditioned for 2 min with 24% ethylenediaminetetraacetic acid (EDTA) (PrefGel® Institut Straumann AG, Basel, Switzerland). The site was rinsed with normal saline solution and air dried. Then, enamel matrix derivative (EMD) (Emdogain®, Institut Straumann AG, Basel, Switzerland) was gently applied with a blunted- tipped sterile syringe until overflowing from the gingival margin (Fig. 1D). The patient was instructed to avoid brushing and flossing in the treated site for two weeks and use a 0.2% chlorhexidine digluconate mouthwash. The patient was scheduled for periodic periodontal check-ups every three months while undergoing active orthodontic treatment.

Additional Treatments
Osseous resective periodontal surgeries were performed in the maxillary left and mandibular right posterior region. Additionally, guided tissue regeneration (GTR) was performed to treat the lingual furcation defect at tooth #46.

Treatment Outcomes
One year after EMD application, the PD at tooth #21 reduced from 5 mm to 4 mm. No recession was detected. A slight discrepancy between the gingival margin of tooth #21 and that of the contralateral tooth (#11) was noticed (Fig. 1E).

At the final periodic periodontal check-up visit, a stable periodontal condition was observed, with both the PI and BI maintained below 20%, reflecting the patient’s reasonable efforts to follow oral hygiene instructions. Additionally, tooth #21 continued to exhibit the PD of 4 mm without BOP. The CAL ranged from 3 mm to 5 mm, and tooth mobility decreased to class I. The periapical radiograph showed the stability of the treatment results, with the maintenance of bone fill (Fig. 2D). Considering these findings, tooth #21 prognosis has improved from “questionable” to “fair”.

Case 2
Patient Information & Clinical Findings
A 50-year-old female patient was referred from the emergency dental clinic to the periodontics clinic of a university-based dental hospital. She complained of severe constant pain and a loose tooth in the anterior area. The patient
Figure 3. Case 2. A) Initial case presentation: severe gingival inflammation and calculus deposits in the maxillary anterior teeth. B) A combined 3- to 2-wall defect found on the facial and mesial surface of tooth #11 during periodontal surgery. C) A resorbable collagen membrane covering the added allogenic particulate bone graft. D) Primary flap closure achieved using vertical mattress sutures and sling sutures. E) Six months after guided tissue regeneration: gingival recession increased in the maxillary anterior teeth. F) Orthodontic treatment initiated to intrude tooth #11. G) After the placement of an upper bonded retainer and the reshaping of the incisal edge of tooth #11. H) Anterior proclination resulted in a 3-mm overjet at tooth #11.

reported being a smoker (≤19 cigarettes/day). Otherwise, she did not report any medical conditions or known allergies.

Upon examination, generalized severe gingival erythema and significant supra- and subgingival calculus deposits were found (Fig. 3A). The BI was 60% and PI was 50%.

The patient was sensitive to any touch in the anterior region. A complete periodontal examination revealed multiple deep periodontal pockets, with PDs ranging from 2 mm to 8 mm and BOP. The CAL ranged from 3 mm to 7 mm. The most affected site was the maxillary right central incisor (#11), with a PD of 7 mm on the mesial aspect, grade II mobility, and pain upon palpation. The tooth was extruded by 1 mm when compared to the contralateral one. Radiographic examination showed generalized moderate bone loss with vertical bone loss related to tooth #11 (Fig. 4A & B).

Figure 4. Case 2. A) Full-mouth radiographs with generalized moderate bone loss. B) Periapical radiograph of tooth #11 at the initial presentation: a deep and wide vertical bone defect and periapical radiolucency. C) Resolution of the periapical lesion three months following endodontic treatment, with the persistence of the vertical bone defect. D) Periapical radiograph four months after guided tissue regeneration. E) Outcome after the completion of orthodontic treatment: the stability of bone gain by the end of the treatment.

Diagnosis & Prognosis

After the endodontic examination, tooth #11 was diagnosed with symptomatic irreversible pulpitis and symptomatic apical periodontitis. In the anterior teeth, traumatic occlusal forces were evident, exacerbating the severity of the lesion. The periodontal diagnosis was Stage IV grade C generalized periodontitis. The overall prognosis was poor, with the individual tooth prognosis for tooth #11 being “questionable” [14] (Table 2).

Table 2. Periodontal findings and prognosis of case 2.

<table>
<thead>
<tr>
<th>Tooth #11</th>
<th>Initial Presentation</th>
<th>After GTR</th>
<th>One-Year Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD range</td>
<td>7 mm</td>
<td>4 mm</td>
<td>4 mm</td>
</tr>
<tr>
<td>CAL range</td>
<td>3-7 mm</td>
<td>7 mm</td>
<td>7 mm</td>
</tr>
<tr>
<td>Recession</td>
<td>2 mm</td>
<td>3 mm</td>
<td>3 mm</td>
</tr>
<tr>
<td>Mobility</td>
<td>Class II</td>
<td>Class I</td>
<td>Class I</td>
</tr>
<tr>
<td>Alveolar bone level</td>
<td>Localized vertical bone loss (77% of root length on the mesial aspect), periapical radiolucency.</td>
<td>Mild bone loss</td>
<td>Mild bone loss (30% of root length on the mesial aspect).</td>
</tr>
</tbody>
</table>

Notes: GTR – guided tissue regeneration, PD – periodontal probing depth, CAL – clinical attachment level.
Therapeutic Intervention

Periodontal Therapy

The first phase of periodontal treatment involved the placement of a periodontal splint extending from the maxillary right to the maxillary left canine (#13-#23) to stabilize the anterior teeth. Supra- and subgingival debridement were performed under local anesthesia. Afterwards, tooth #11 received root canal treatment (RCT). Traumatic occlusal forces were controlled by raising the bite with posterior occlusal stoppers.

Six weeks after the initial therapy, periodontal re-evaluation revealed an improvement in all periodontal parameters, with the BI reduced to 21% and PI to 15%. Three months after RCT on tooth #11, a re-evaluation revealed uneventful healing of the periapical lesion; however, deep PD and vertical bone defects persisted (Fig. 3C).

To regenerate the lost bone, GTR was performed. A full-thickness flap with a palatal approach was raised. The flap extended from the distal surface of tooth #12 to the distal surface of tooth #22. Thorough cleaning and degranulation of the defect were performed. The defect exhibited a combination of three-wall to two-wall defect topography (Fig. 3B).

Allogenic particulate bone graft (OraGraft®, LifeNet Health, VA, USA) was added. This particulate bone graft combines 70% cortical freeze-dried bone allograft with 30% demineralized freeze-dried bone allograft. The defect was covered by a resorbable pericardium collagen membrane (Shelter®, Ubgcn, Italy) (Fig. 3C). The surgical site was sutured using internal matters sutures and sling sutures (Cytoplast®PTFE Suture, BioHorizons, USA) (Fig. 3D).

For sextants 1 and 3, periodontal surgeries were carried out using osseous resection. Within six months, significant CAL gain and radiographic bone fill were observed; the PD at tooth #11 reduced to 4 mm. However, gingival recession of 3 mm was noticed (Fig. 3E).

None of the sites exhibited PDs > 5 mm or BOP. Therefore, the periodontal condition was considered stable, and the patient was referred to the orthodontic clinic.

Orthodontic Therapy

Orthodontic therapy aimed to intrude the previously extruded maxillary right central incisor and eliminate occlusal trauma on the maxillary anterior teeth. Throughout the orthodontic treatment, the patient continued to receive periodic periodontal maintenance visits every three months.

Due to the patient’s periodontal condition, traumatic deep bite, and fremitus, orthodontic leveling and alignment were carried out using a 22-slot size with Roth prescription as 2x4 to increase wire springiness and avoid excessive forces. 0.016-inch and 0.018-inch nickel-titanium archwires were used for two months, respectively. Intrusion of the upper right central and lateral incisors was initiated with a 0.018-inch stainless steel archwire with intrusion loops mesial to the first molars to gently intrude teeth, along with a nominal proclamation. Anchorage for this intrusive movement was provided by the upper first molars. After achieving the proclamation of the upper incisors, a 0.016 x 0.022-inch stainless steel archwire was placed to establish the final root position. Care was taken to avoid excessive tooth movement due to the reduced periodontal bone support. The orthodontic treatment lasted for six months (Fig. 3F), followed by the placement of a bonded retainer during the retention phase.

Additional Treatment

Tooth #11 was 0.5 mm longer than its counterpart. It was reduced and reshaped to achieve a symmetrical contour similar to tooth #21 (Fig. 3G).

Treatment Outcomes

During periodontal maintenance visits, all PDs were < 5 mm without BOP, indicating stable periodontal health. At the end of orthodontic treatment, there was a 1-mm intrusion at tooth #11 and a 3-mm overjet (Fig. 3H). Radiographic examination revealed a reduction of up to 90% in the vertical bone defect (Fig. 4E). Based on those findings, the tooth prognosis was changed from “questionable” to “fair”.

Discussion

In this case series, we present successful management of periodontally compromised central incisors, demonstrating stable results maintained for a year. In both cases, the base line prognosis of the teeth was “questionable” according to McGuire and Nunn’s classification (1996) [14], but it improved after periodontal therapy and orthodontic treatment.

The decision of whether to preserve or extract a periodontally compromised tooth with an aesthetic aspect and a “hopeless” or “questionable” prognosis is challenging, especially when implant replacement is a viable treatment option [9]. Several factors affect the decision-making process and the ability to develop an appropriate treatment strategy. The overall periodontal condition of the dentition, periodontal biotype, esthetic demands, local anatomical factors, patient age, compliance with treatment, and overall health are among the most important ones. Typically, treatment involves a combination of periodontal, endodontic, orthodontic, and restorative therapy to achieve a satisfactory functional and esthetic result.

Periodontal therapy aims to increase the longevity of natural teeth, emphasizing efforts to improve the probability of tooth survival [1]. Factors negatively influencing non-surgical periodontal treatment outcomes include smoking habits, supragingival plaque, and deep PD in molar teeth [6]. In case I, tissue regeneration in the central incisor #21 was achieved solely through non-surgical therapy. The PD reduced significantly from 13 mm to 4 mm without BOP. The positive predictive factors in that patient included good overall health, non-smoking status, high motivation, the involvement of a single-rooted tooth, and maintenance of good oral hygiene throughout the treatment process. In addition, EMD was used as an adjunctive treatment for the residual pocket. A recent systematic review evaluated the potential additional clinical effect of applying EMD following non-surgical periodontal therapy and concluded that CAL changes up to 2.9 mm and PD reduction of 2-3 mm could be expected over a 12-month follow-up period [16].

On the other hand, case II showed only modest improvements following non-surgical therapy in the vertical
bone defect located at the mesial surface of the central incisor #11. Consequently, the deep vertical defect was treated with periodontal regeneration. Regenerative techniques aim to improve tooth local anatomy, function, and prognosis, resulting in an average clinical attachment gain of 2 mm [17]. Periodontal regeneration was shown to maintain 83% of teeth with a “hopeless” prognosis that were deemed for extraction and replacement with implants [17]. A ten-year follow-up study showed an 88% survival rate in the regenerated group, suggesting that most of the control group underwent premature tooth extractions [4]. Consistent with the reported literature, case II exhibited improvements in all periodontal parameters and radiographic bone fill after regenerative therapy.

Intrusion of a single-rooted tooth with over-eruption and a vertical bone defect may be a reliable treatment option after periodontal surgery [18]. It is of paramount importance to understand that orthodontic treatment cannot be initiated in the presence of active periodontal disease. Orthodontic forces applied during inflammation may exacerbate the attachment and bone loss [11]. Monitoring the patient’s periodontal status throughout orthodontic therapy is crucial. Additionally, maintaining light orthodontic forces is essential due to the reduced periodontal support of the teeth. A prolong retention phase after the completion of orthodontic treatment is vital to prevent relapse [19].

Our patients achieved periodontal stability with PDs < 5 mm before and during orthodontic treatment, along with low plaque and bleeding indices. Consequently, orthodontic treatment successfully positioned the teeth apicocoronally to the desired level, improving esthetics and alleviating occlusal trauma. Despite these favorable results, gingival recession and an uneven gingival margin are inevitable. Gingival recession often results from the successful resolution of gingival edema and deep PDs. Discussing all treatment outcomes, even the undesirable ones, with the patient is important. This case series validates previous reports that orthodontic tooth movement can improve clinical condition, change tooth prognosis, and promote long-term stability in periodontally compromised patients [12, 13].

Conclusions
In this case report, we demonstrated that a multidisciplinary treatment approach involving non-surgical periodontal therapy, regenerative periodontal therapy, and orthodontic treatment, can preserve periodontally compromised teeth, maintain long-term periodontal health, improve tooth prognosis, and achieve satisfying functional and esthetic outcomes.

Acknowledgements
The authors would like to thank Dr. Njood Alangari for the restorative and orthodontic treatments.

Ethical Statement
This case report was conducted in accordance with the World Medical Association Declaration of Helsinki “Ethical Principles for Conducting Medical Research Involving Human Subjects”.

Informed Consent
Written informed consent for publishing the details of the medical case and management was obtained from both patients.

Data Availability
All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Conflict of Interest
The authors declare that they have no conflicts of interest.

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