Two-phase treatment of iatrogenic periodontitis: an eight-year follow-up

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The mixed dentition is often accompanied by transient malocclusions, such as a midline diastema. The general principle is to monitor development to ascertain the appropriate timing of possible intervention. The present clinical article reports the case of a seven-year-old boy who suffered from severe iatrogenic periodontitis of the maxillary incisors due to direct closure of a diastema by a rubber band. The incisors survived and exhibited periodontal and pulpal health at an eight-year review. Carefully-sequenced interdisciplinary management and co-operation, appropriate biomechanics aided by temporary anchorage devices, and a long-term follow-up are noted as key factors determining success when clinicians encounter such challenges.
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Introduction

The midline diastema, a common transient malocclusion occurring in the mixed dentition,[1,2] is often referred to as the 'ugly duckling' stage.[3] With the eruption of the lateral incisors and, subsequently, the permanent canines, the diastema will eventually close. Fischer et al.[4] confirmed that only 7% of cases presented with diastema after the age of 12, suggesting that the timing of treatment should be delayed until the eruption of the permanent canines.

As well as the timing, the mechanism of space closure is also of importance. Early in the 1970s, several cases were reported of severe periodontal damage caused by uncontrolled elastic application. Despite the low incidence, the prognosis is poor[5,6] and, sadly, some practitioners currently still use inappropriate mechanics to close a central diastema,[7,8] resulting in pulp necrosis and tooth exfoliation.

In addition to aesthetics, speech and oral function, the maxillary central incisors can significantly influence psychological development. It has been reported that teenagers with a severe malocclusion are more likely to exhibit a sense of inferiority resulting in an introverted personality and affected self-esteem.[9,10]

The present case report demonstrates the outcome of a two-phase treatment program to manage iatrogenic periodontitis. The affected incisors were preserved and maintained good function and aesthetics after long-term follow-up.

Case report

A boy, aged seven years four months, presented with the chief complaint of extruded upper front teeth that created difficulty in biting and apposing the lips. The dental history revealed that he had been taken to a general dentist for management of an upper central diastema a month previously. After several days, the diastema gradually closed; however, the rubber band used for incisor approximation had disappeared. One week later, the boy returned to the dentist with swollen gingiva and extruded anterior teeth. As the symptoms worsened, the dentist suggested extraction of the two incisors due to an unoptimistic periodontal condition.

Figure 1. Phase one pretreatment photographs.

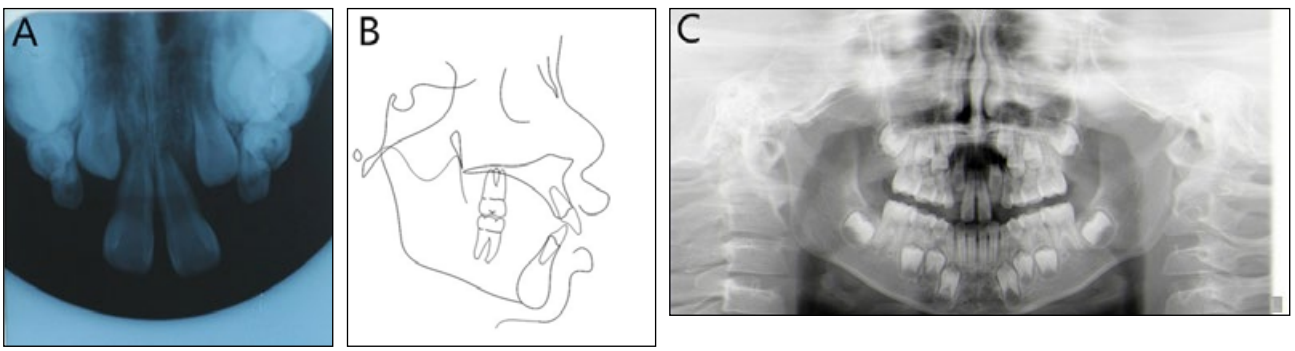

Figure 2. Phase one pretreatment radiographs and cephalometric tracing.

Clinical examination

An extra-oral examination indicated that the maxillary incisors overlapped the lower lip in the rest position (Figure 1). The patient was reluctant to close his lips and kept his mouth half-open to avoid pain. An intraoral examination revealed a mixed dentition with a Class II molar relationship. Tooth 11 and 21 exhibited subluxation with advanced gingival recession. Severe tenderness and mobility with occlusal interference were also observed. Tooth 12 and 22 had not yet erupted and the corresponding deciduous teeth had already exfoliated. A periodontal examination showed a gingival index (GI) of 3, a plaque index (PLI) of 3, bleeding on probing (BOP) (+), periodontal pockets (PD) ranging from 6 to 8 mm, and gingival recession (GR) of 3 mm together with attachment loss (AL) of 9–11 mm. Radiographs indicated advanced bone loss with incomplete development of the incisor root apices (Figure 2). Pulp electro-vitality test values were 54 for 11 and 53 for 21, which revealed pulp deterioration of the injured incisors.

Treatment plan

The following two-phase treatment was considered due to the patient's age and dentition:

1. Surgical exploration to eliminate the aetiologic agent.

2. Periodontal therapy for control of the inflammation.
3. Bite-blocks to avoid excessive occlusal trauma.
4. Orthodontic management to intrude and reposition the incisors with the help of temporary anchorage devices (TADs).
5. A program of periodontal and pulpal maintenance performed on a regular basis.

Treatment progress

The patient was referred to an oral surgeon and flap surgery was immediately performed. The rubber band was cut and removed from the apices of the incisors beneath the gingiva (Figure 3). Scaling and root planing were carried out by the periodontist to control the localised inflammation.

Brackets were placed on the incisors, and a 0.016 inch Australian arch wire was engaged for prompt repositioning and fixation. Adhesive bite-blocks were placed to avoid unwanted occlusal trauma. A week later, a temporary anchorage device (TAD, 1.6 × 9 mm, Forestadent, Pforzheim, Germany) was placed between the maxillary incisors to provide sufficient anchorage for intrusion (Figure 4). The anterior teeth were ligated with an elastomeric thread to deliver a light force. After six months, the central incisors were repositioned and fixed. The eruption of the lateral incisors was monitored closely.

Figure 3. Rubber band was cut and removed.

Phase two treatment started at the age of 13 years, following complete eruption of the permanent dentition. As a result of the differential crowding between the upper and lower arches, protruded maxillary incisors and a convex profile, maxillary first premolars were extracted. A genioplasty was recommended when the patient reached adulthood.

During phase two treatment, 0.022 × 0.028 inch straight wire brackets with an MBT prescription were placed. Two TADs (1.6 × 11 mm, Cibei Medical, Ningbo, China) were inserted between the maxillary second premolar and the first molar to reinforce posterior anchorage. Finally, vacuum-formed and Hawley retainers were prescribed on a full-time basis after active treatment.

Treatment outcome

Following phase one treatment, the incisors were well aligned, the diastema closed and the midline corrected. Regular radiographs taken from the initial presentation to the beginning of phase two showed continuous development of the incisors' roots,

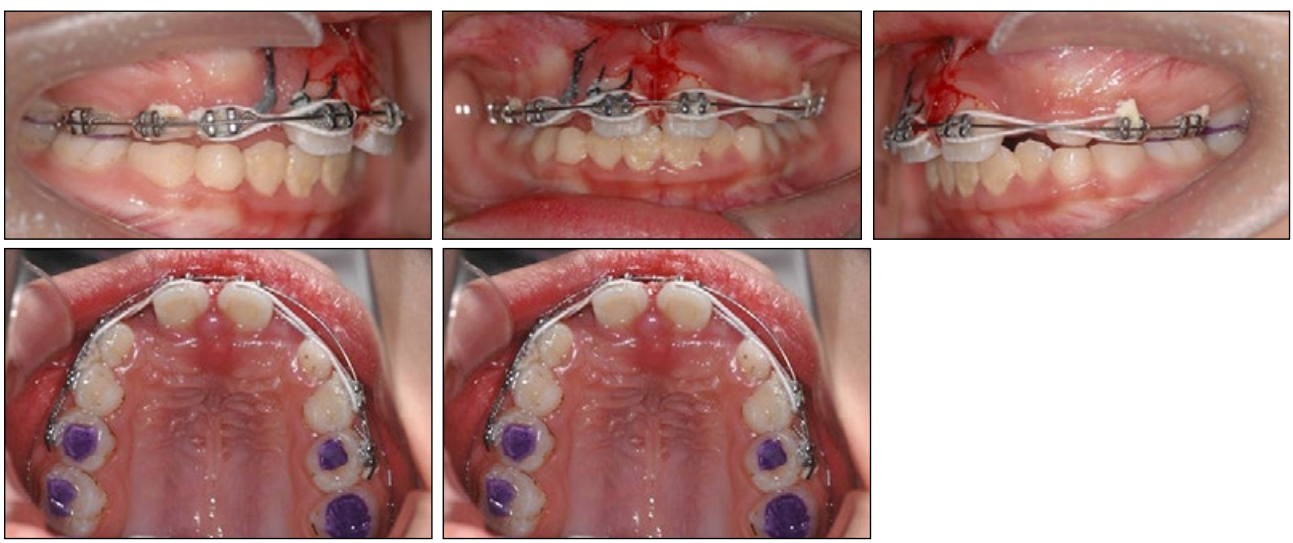

Figure 4. Intraoral photographs during phase one treatment. Placement of a TAD and adhesive bite-blocks. TAD, temporary anchorage device.

closure of the apical foramina and a greatly improved periodontal condition (Figure 5).

Phase two pretreatment photographs showed a dental class II malocclusion with a large overjet and moderate maxillary crowding. A convex profile, lip incompetence and an undeveloped chin were also observed (Figure 6). A lateral cephalometric analysis confirmed a skeletal Class II relationship with obviously proclined maxillary incisors (Table I). Two maxillary premolars were extracted to manage the problems.

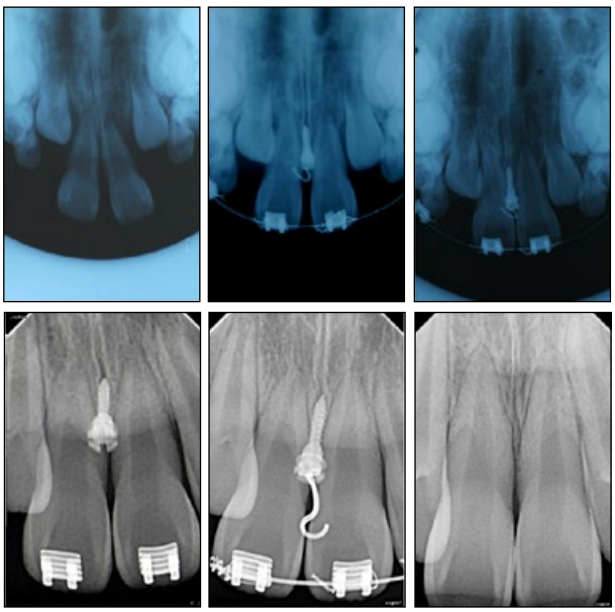

Figure 5. Continuous periodontal tissue of central incisors on periapical radiographs after phase one treatment.

Following treatment, an ideal overbite and overjet were achieved with accurate control of incisor torque. The parents were satisfied with their son's improved facial profile (Figure 7). The cephalometric measurements also confirmed the changes and are presented in Table I.

Although severe periodontal problems and pulp deterioration were noted at the initial visit, clinical examination showed that GI decreased to 1, PLI to 1, BOP (-), and PDs decreased to normal levels after the two-phase treatment. Cone beam computed tomography revealed a significant amount of bone remodelling and the restoration of attachment around the roots (Figure 8). A pulp electro-viability test showed the response values changed back to within the normal range, suggesting pulp vitality. After a retention period of 21 months, the patient's maxillary incisors and occlusion also showed acceptable stability.

Figure 6. Phase two pretreatment photographs and cephalometric tracing.

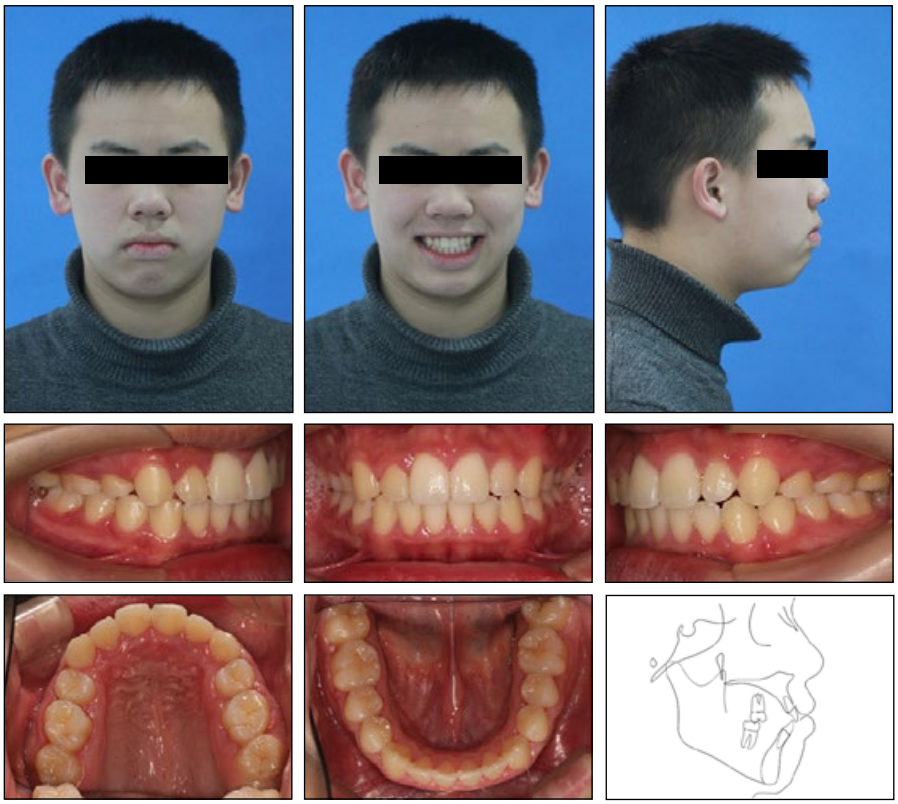

Figure 7. Phase two post-treatment photographs and cephalometric tracing.

Discussion

Severe iatrogenic periodontitis is a significant challenge for clinicians. In the present case, the outcome of orthodontic treatment was satisfactory after a long-term follow-up. The general management principle is to identify and eliminate any underlying aetiology to avoid continuing damage. Compared with splinting, an orthodontic arch wire has obvious advantages related to reduced gingival damage and better prospects of oral hygiene, and its placement is influenced by personal experience. Reliable fixation provided by an archwire is a positive prerequisite to establish and improve the prognosis of localised periodontitis. In addition, effective mechanics using light forces are conducive for the gradual repositioning of teeth and the recovery of tissues, while interdisciplinary co-operation between the members of the management team is also an essential requirement for success.

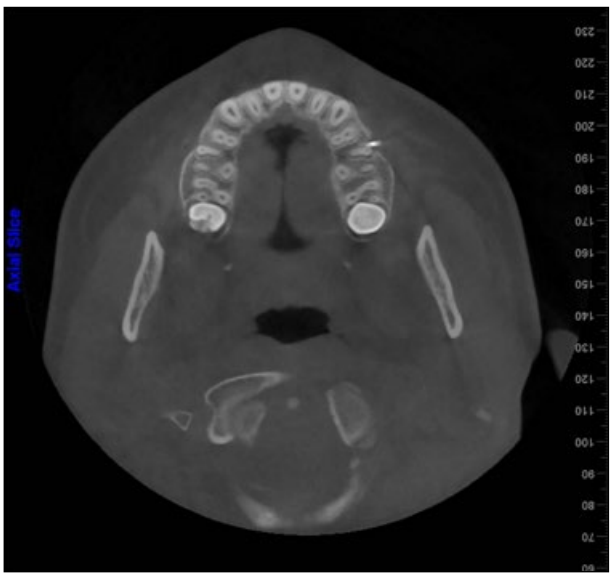

Figure 8. Bone remodeling around roots of maxillary central incisors.

Previous publications have suggested that the chance of tooth loss in iatrogenic localised periodontitis is high and referred to as 'bloodless extraction'.[5,6] An inadvertently applied rubber band tends to creep towards the apex due to the anatomical shape of the crown and the conical nature of the roots. When a rubber band slides beneath the gingival margin, it squeezes the teeth together and temporarily closes the central diastema. However, with continuous apical sliding and pressure, damage to the periodontal tissue results.[11] Furthermore, a rubber band also exacerbates periodontitis through inflammation generated by the

Table I. Cephalometric measurements.

Variables	Norm	Pretreatment of phase one	Pretreatment of phase two	Post-treatment
SNA (°)	82.8 ± 4.0	78.8	79.3	78.3
SNB (°)	80.1 ± 3.9	73.3	73.4	74.7
ANB (°)	2.7 ± 2.0	5.5	6.0	3.6
FMA (°)	31.1 ± 5.6	32.1	33.5	34.6
FH-NPo(°)	85.4 ± 3.7	81.1	81.4	82.5
NA-APo(°)	6.0 ± 4.4	14.8	13.2	8.6
U1-NA (mm)	5.1 ± 2.4	4.6	10.6	6.4
U1-NA(°)	22.8 ± 5.7	23.3	32.4	22.7
L1-NB (mm)	6.7 ± 2.1	7.5	8.5	8.7
L1-NB(°)	30.5 ± 5.8	35.0	32.6	28.5
U1-L1(°)	124.2 ± 8.2	115.7	109.5	125.3

presence of a foreign body. Diedrich et al.[12] reported that inflammatory reactions close to rubber bands were independent of the level of plaque colonisation. In addition, the traumatic occlusal contacts increase the tissue damage after the teeth have been displaced. Therefore, a rubber band may cause subluxation or even extraction of the teeth under the combined effects of mechanical, chemical and inflammatory trauma.

In the present case, the alveolar bone remodelled and the attached gingiva returned to biological acceptability after the intrusion of the affected teeth. In addition to the appropriate environment provided by thorough debridement, recovery may have occurred due to new periodontal ligament formation that occurred during the process of orthodontic intrusion. The intrusive movement might have led to the formation of a long-junctional epithelium.[13]

Orthodontic force can cause inflammatory changes and vascular disturbances not only in the periodontium, but also in the dental pulp.[14] Previous studies[15,16] have reported a higher incidence of pulp necrosis in teeth of orthodontic patients who presented with a severe periodontal history. Severe periodontitis can lead to pulp ischemia, which gives rise to chronic pulp inflammation, degeneration, and subsequent necrosis or perhaps root resorption. A light force was applied throughout the entire treatment of the present case to prevent irreversible effects on pulpal blood supply. Since the apical foramen was developing, the blood supply of the upper incisors was rich, supplied by the maxillary branch of the intracranial artery. This was beneficial to the recovery of pulp vitality.

The development of TADs has greatly improved biomechanical applications during orthodontic treatment.[17-19] At the outset, with insufficient adjacent anchorage to intrude target teeth, the treatment effect would be limited. In phase one treatment, the TAD between the maxillary central incisors provided vertical anchorage, while in phase two treatment the TADs between the maxillary second premolars and first molars provided anteroposterior and vertical anchorage, resulting in better control of facial outcome. In the present case, the magnitude and direction of the applied forces were more predictable and facilitated by the use of TADs.

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