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Posterior Open Bite Due to Failure of Maxillary Molar Eruption

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Abstract

Posterior open bite can cause problems with occlusion. It arises from systemic or local factors such as physical or functional interference, ankylosis, and failure of eruption. Primary failure of eruption (PFE) is a rare condition that is difficult to differentiate from ankylosis and requires complex treatment strategies. Here we report a 12-year-old girl who was referred to our hospital by her dentist for re-evaluation of eruption failure of the left maxillary secondary premolar and first and second molars with congenitally missing maxillary lateral teeth. The maxillary first molar was extracted for a therapeutic diagnosis. The left maxillary secondary premolar and second molar reacted well to subsequent orthodontic treatment. Auto-transplantation of the mandibular premolar to the maxillary arch was carried out to achieve optimal overjet, overbite, and occlusion. The active treatment period spanned 4 years and 1 month. Assessment of the patient's medical and dental history, prior trauma, and clinical conditions resulted in a therapeutic diagnosis of PFE. Satisfactory orthodontic treatment results were achieved.

Key words: Failure of eruption — Ankylosis — Posterior open bite — Therapeutic diagnosis — Orthodontic treatment

Introduction

Posterior open bite is likely to cause various problems with occlusion. A number of systemic and local factors have been identified in the development of open bite, including physical or functional interference, ankylosis, and disturbance of the mechanism underlying eruption^{15,24}. Failure of eruption of the first and second permanent molars is rare, however^{16,19,25}. First described by Proffit and

Vig, primary failure of eruption (PFE) is defined as a non-ankylosed tooth which has failed to erupt due to malfunction of the eruption mechanism¹⁸. It is characterized by failure of the permanent teeth to erupt even in the absence of any mechanical obstruction or application of orthodontic force⁹. A mutation in the parathyroid hormone receptor 1 gene has been identified as being responsible for the development of PFE⁵ and, indeed, a genetic analysis is needed for a definitive diag-

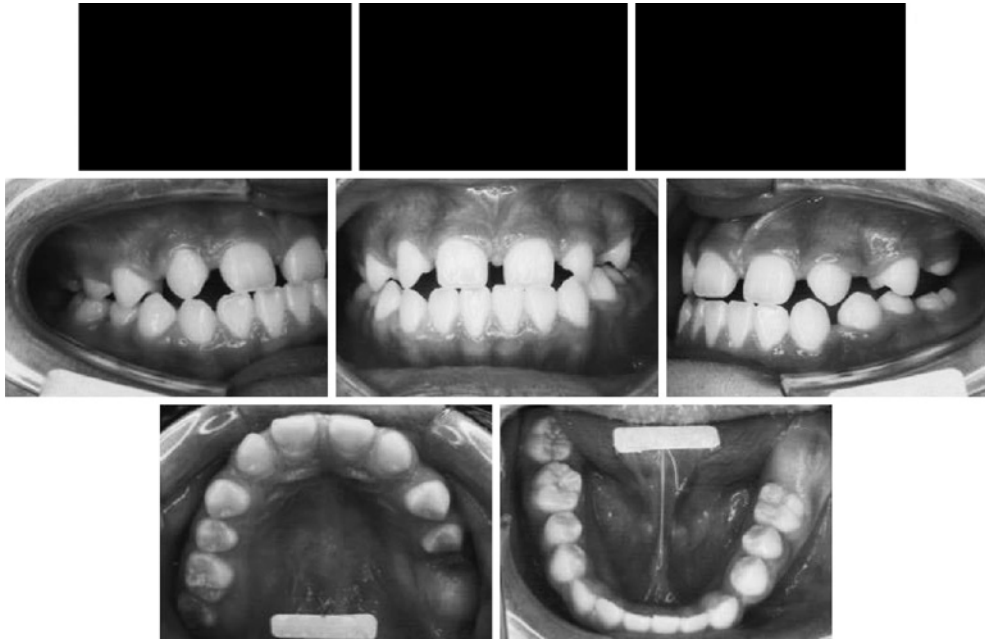


Fig. 1 Intraoral and facial photographs at pre-treatment

nosis. However, this option is not usually available in a clinical setting. This means that a diagnosis of PFE or ankylosis is usually based on an investigation of prior trauma, treatment history, and clinical conditions^{7,21}.

Here we describe orthodontic treatment for posterior open bite due to failure of molar eruption. Patient consent was obtained for publication of this report.

Case Report

1. Medical history

The patient was a 12-year-old girl referred to our hospital by her dentist for re-evaluation of failure of the left maxillary first molar to erupt. Her medical history showed no major systemic disease or dental trauma and the patient was otherwise in good health. Her deciduous left maxillary primary central incisor and lateral incisor were fused. She noticed that both maxillary lateral incisors were missing when she was 9 years old. Her mother did not recall any family history of tooth eruption

failure.

2. Present history

Seeking treatment for the missing teeth, she first visited her local dentist. At that time, the left maxillary first molar had not yet erupted, so it was decided to treat that problem first. Fenestration was carried out around the first molar region to promote spontaneous eruption when she was 10 years and 2 months. At a one-year follow-up visit, the first molar showed no change. Traction of the first molar was then performed using up-and-down elastics. Brackets were bonded to the first molar after subsequent fenestration. The left mandibular canine, first and second premolars, and first molar were also bonded for traction. After 4 months of exposure to elastic force, the first molar still showed no movement.

3. Analysis and diagnosis

Examination at our department revealed a slight concave profile, but no facial asymmetry. Intraorally, infra-occlusion of the left max-



Fig. 2 Panoramic radiograph at pre-treatment



Fig. 3 Tracing on pre-treatment cephalometric radiograph

illary second premolar and first and second molars was observed. Percussion of the maxillary first molar elicited a normal dull sound and mobility, indicating that ankylosis was unlikely¹⁾. Overjet was -1 mm and overbite was 0.5 mm, and the right molar relation was Angle Class III. Fibroma was suspected in the gingiva in the left mandibular second molar region. A panoramic radiograph revealed that both maxillary lateral incisors were missing, resulting in spacing in the maxilla. It also showed that the left mandibular second molar had erupted in the occlusal plane, and confirmed all four third molars. The patient reported no functional problems such as abnormal swallowing or tongue habits (Figs. 1, 2). Lateral cephalometric X-ray revealed

the following skeletal values: ANB, 3° ; facial angle, 83° ; Y-axis, 76° ; FMA, 44° ; SN-MP, 50° ; and gonial angle, 138.5° . These findings indicated a severely high angle facial pattern, downward growth of the maxilla, and clockwise rotation of the mandible. The U1 to SN angle was 100° ; IMPA, 83° ; and L1 to A-Pog, 6 mm. The mandibular incisors showed lingual inclination and forward displacement, resulting in an upper E-line of -1 mm and lower E-line of 2 mm (Fig. 3, Table 1). Based on these findings, Class III malocclusion with left posterior open bite with spacing of the maxillary arch due to missing maxillary lateral teeth was diagnosed.

4. Problem list and treatment planning

The problem list in the present case was summarized as follows: 1) failure of the left maxillary first molar to respond to exposure to orthodontic force, even in the absence of physical obstruction or ankylosis; 2) characteristic findings of PFE for the left maxillary second premolar and first and second molars in the intraoral and panoramic radiographs; 3) congenitally missing maxillary lateral teeth; 4) a severely high-angle facial pattern; 5) downward growth of the maxilla and clockwise rotation of the mandible; and 6) Class III malocclusion of the molars and minus overjet.

The following treatment plan was developed to tackle each of the above problems:

1) and 2): The maxillary left first molar had already been observed over a period of 1 year,

Table 1 Measurements on pre, post-treatment, and retention cephalometric radiographs

	Pre-treatment 12y1m	Post-treatment 16y8m	Retention (2 years) 18y8m
SNA (deg.)	79	79	79
SNB (deg.)	76	77	77
ANB (deg.)	3	2	2
Facial angle (deg.)	83	83	83
Y-axis (deg.)	76	70	70
FMA (deg.)	44	43	43
SN-MP (deg.)	50	50	50
Gonial angle (deg.)	138.5	140	140
Occ. Plane to SN (deg.)	27	23	23
U1 to SN (deg.)	100	99	99
IMPA (deg.)	83	70	70
FMIA (deg.)	53	67	67
Interincisal (deg.)	126.5	141	141
U1 to A-Pog (mm)	5	5	5
L1 to A-Pog (mm)	6	1	1
E-line: Upper (mm)	-1	-3	-3
E-line: Lower (mm)	2	-2	-2
Overjet (mm)	-1	2	2
Overbite (mm)	0.5	2	2

during which 4 months' of exposure to orthodontic traction had elicited no reaction. Therefore, the diagnosis here was PFE and extraction was scheduled. Therapeutic diagnosis of the maxillary left second premolar and second molar was also deemed necessary to establish whether these teeth were also affected. 3): Two options were offered here: to create a space for prosthetic treatment or dental implants in the missing teeth area after growth, or to extract the mandibular premolars and transplant the tooth to the left maxillary arch so that the maxilla and the mandible would have an equal number of teeth. The patient chose the second option. 4), 5), and 6): This case showed Class III malocclusion and a severely high angle facial pattern. Therefore, conventional orthodontic treatment was selected, aimed at controlling the occlusion and closing the Y-axis.

5. Treatment

Before commencing orthodontic treatment, the gingiva, which was covering the mandibular left second molar, was excised and subjected to a pathological analysis. The results showed that it was a fibrous polyp. It appeared to have had no effect on the tooth concerned.

Treatment for the left posterior open bite was carried out first. In accordance with the therapeutic diagnosis, the maxillary first molar was extracted and fenestration of the maxillary left second molar performed at the same time. At 1 month later, the maxillary left second molar had drifted mesially and the occlusal surface was visible (Fig. 4). This therapeutic diagnosis confirmed that this tooth was not affected by ankylosis or failure of eruption. Subsequently, a 0.022-inch slot pre-adjusted edgewise appliance was bonded to start orthodontic treatment. The maxillary left second premolar showed reaction to ortho-



Fig. 4 1 month after maxillary left first molar extraction



Fig. 5 3 months after application of orthodontic force to maxillary left second premolar



Fig. 6 Second molar was aligned in maxillary arch

odontic force, and after 3 months leveling to near the height of the first premolar was achieved (Fig. 5). The second molar was bonded at this time to begin the leveling phase. Two months later, the second molar was aligned in the maxillary arch (Fig. 6).

The next step was to treat the spacing in the

maxillary arch due to missing maxillary lateral teeth. The maxillary left canine was moved mesially and the first premolar distally to make space for auto-transplantation of the mandibular premolar. The mandibular right first premolar was selected from the shape of the crown and root. The root apex of the

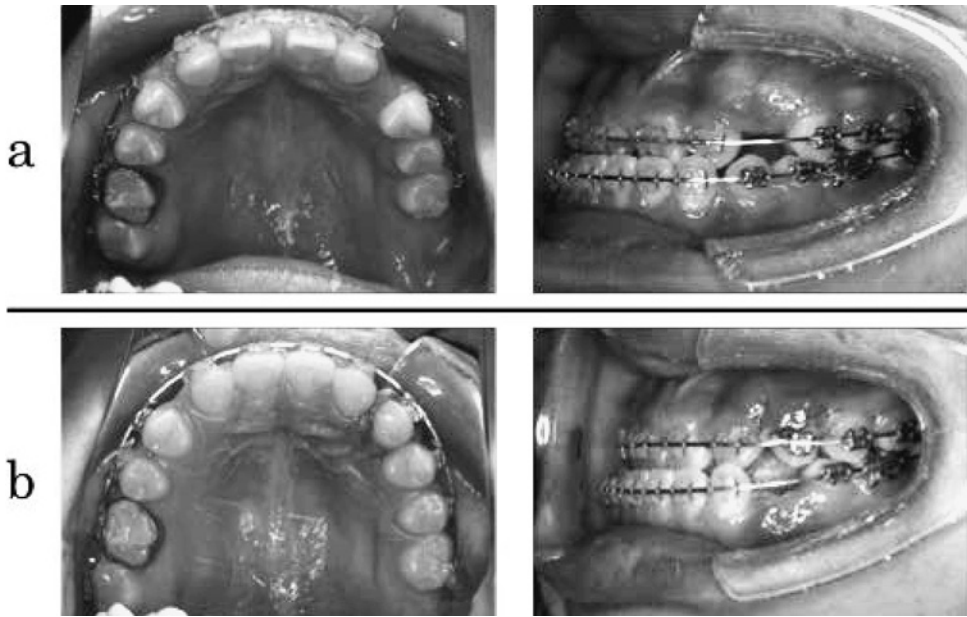


Fig. 7 Auto-transplantation of mandibular premolar to maxillary arch
a. before, b. after.

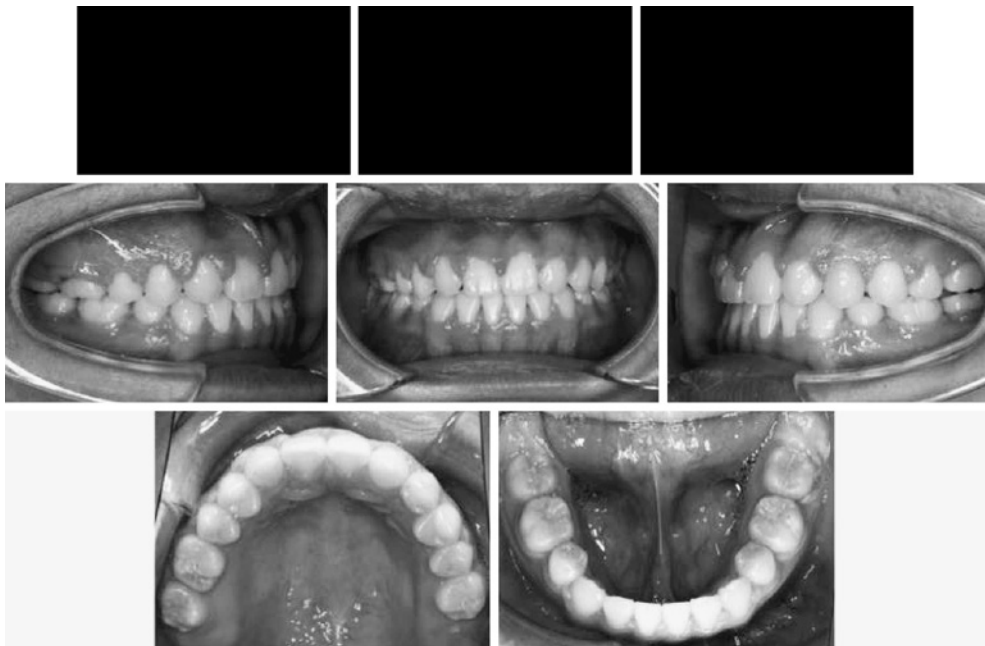


Fig. 8 Intraoral and facial photographs at post-treatment

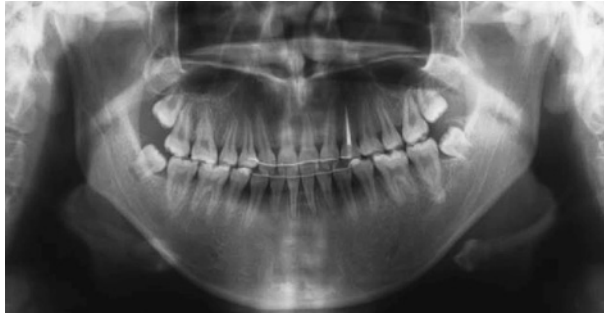


Fig. 9 Panoramic radiograph at post-treatment

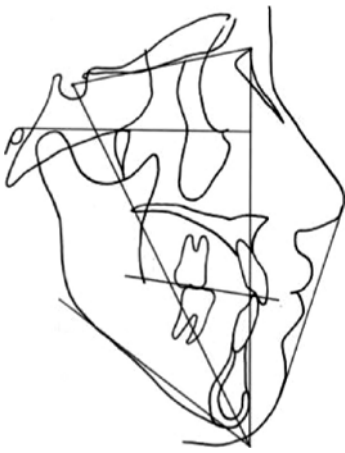


Fig. 10 Tracing on post-treatment cephalometric radiograph



Fig. 11 Tracing superimposition before treatment (black line) and after treatment (dotted line)

selected premolar for auto-transplantation was almost closed. Therefore it was endodontically treated. For splinting, an edgewise bracket was bonded and passive wire bent to allow periodontal healing (Fig. 7). Conventional orthodontic treatment and Class III elastics were used for space closure.

6. Treatment results

The active treatment period spanned 4 years and 1 month. Table 1 shows the subsequent changes in lateral cephalometric X-rays. The Y-axis improved from 76 to 70°, as did the occlusal plane to SN, from 27 to 23°. This was due to mandibular first premolar extraction and the use of Class III elastic, which elicited counter clock-wise rotation of

the mandible and occlusal plane. In terms of denture pattern, the U1 to SN only changed by 1°, but the IMPA changed from 83 to 70°, and the FMIA from 53 to 67°. This movement of the mandibular incisors was needed to close the extraction space and to obtain satisfactory overjet. Post-treatment panoramic radiographs showed that the auto-transplanted premolar was in a satisfactory condition (Figs. 8–11).

Circumferential and fixed-type retainers were fitted in both arches at post-treatment. Stable occlusion has been maintained at 2 years of retention, and all the third molars, except the left mandibular, have erupted (Figs. 12, 13).

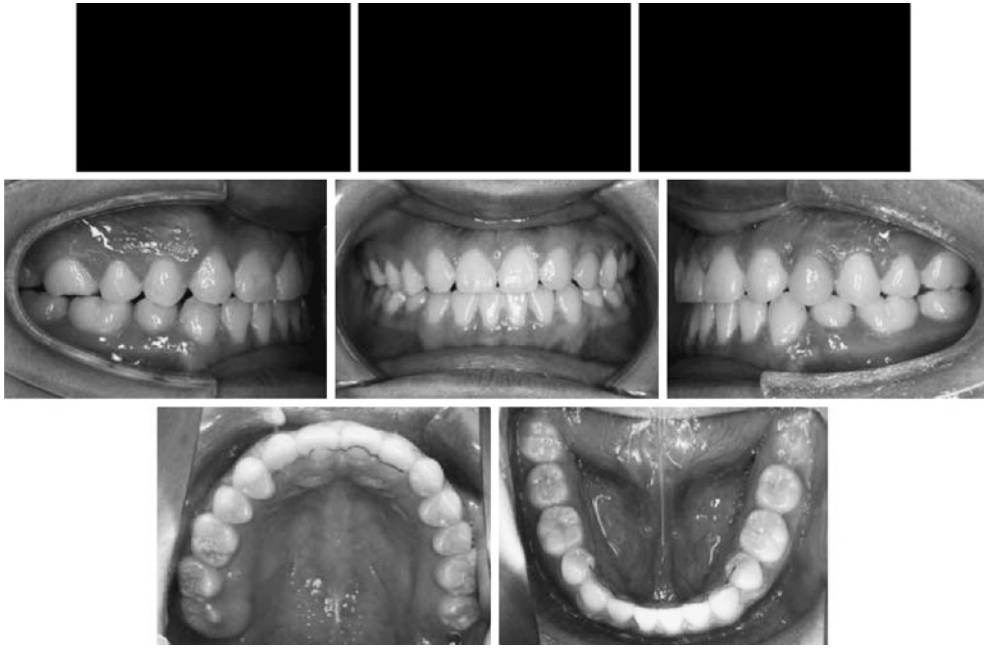


Fig. 12 Intraoral and facial photographs at retention



Fig. 13 Panoramic radiograph at retention

Discussion

Failure of the first and second molars to erupt is rare, and the prevalence in the normal population is 0.01% for the first molar and 0.06% for the second¹⁴. Many treatment charts and protocols have been proposed based on medical and dental treatment history, prior trauma, functional problems, and clinical conditions^{10,15,16,19,21,24}. In the present case, there were no systemic problems or

prior trauma; neither was there any physical obstruction to eruption. The suspected first molar had not responded to orthodontic force, causing the patient to be referred to our hospital for re-evaluation. Subsequent percussion of the first molar elicited only a normal dull sound and mobility, indicating that ankylosis was unlikely. Infra-occlusion of the left maxillary second premolar and first and molars was observed, however, suggesting PFE⁹. One genetic cohort study has shown

that the first molar is affected 93% of the time, and that the adjacent second premolar and second molar are also frequently affected. The same study also showed that 31% of patients with PFE had Class III molar malocclusion, suggesting a strong association between the two²¹.

In this case report, the patient and her family were reluctant to have a genetic analysis performed to obtain a definitive diagnosis^{5,8,10,21,22}. However, the clinical findings still indicated PFE of the first molar. The treatment options were to wait for completion of growth and apply single tooth osteotomy² or extract the first molar and conduct a therapeutic diagnosis of the adjacent teeth with the hope that they were unaffected^{10,20}. Since the fate of these teeth was not clear at that point, the latter option was selected. As a result, the second premolar and second molar teeth reacted well to orthodontic force, and leveling of the teeth in the occlusal plane as seen in normal teeth was achieved.

Minus overjet due to both congenitally missing maxillary lateral teeth also required orthodontic treatment, which comprised extraction of the mandibular first premolar and retraction of the anterior teeth. Creating adequate space to substitute the missing lateral teeth with prosthetics or dental implants was also considered as an alternative¹³, but the patient and her family were reluctant to select this option. This meant that the maxillary left quadrant would now be missing 2 teeth, which necessitated auto-transplantation of the mandibular right first premolar to that region. The advantage of canine substitution of congenitally missing lateral incisors is that occlusion can be completed at an early age²⁷ and with natural dentition. Auto-transplantation of teeth has evolved as an accepted treatment in orthodontics, and the survival rate is high^{11,17}. For splinting, an edgewise bracket was bonded and passive wire bent to allow periodontal healing and application of light orthodontic force after 3 months to prevent ankylosis⁴. The root apex of the auto-transplanted tooth was almost closed, so endodontic treatment was performed to avoid inflam-

matory resorption^{6,11,12,14}. Although some root resorption did occur, the amount was small and the condition of the root showed no further resorption or change in color, remaining stable at 5 years after auto-transplantation^{3,23,26}.

A genetic analysis is needed for a definitive diagnosis of PFE, and it would be very helpful for both the patient and the clinician in developing a treatment plan. Even if such an analysis is unavailable, however, the clinician can still make decisions based on a therapeutic diagnosis. Satisfactory treatment results can be obtained by carefully assessing information from medical and dental history, family history, prior trauma, and clinical conditions.

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