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CLINICAL SECTION

Segmental alveolar distraction for the correction of unilateral open-bite caused by multiple ankylosed teeth: A case report

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Ankylosed teeth fail to erupt to meet their counterparts in the opposite jaw. In cases where ankylosis occurs in multiple teeth, the occlusion shows an open bite. This article describes a case of unilateral open bite caused by multiple ankylosed teeth, where treatment involved segmental alveolar bone distraction. A 25-year-old female patient presented with a left-sided unilateral open bite. On the left-hand side, only the lower incisors were not ankylosed. On the right, the maxillary first molar was ankylosed. All these ankylosed teeth were positioned below the occlusal plane. Her mother and brother also had multiple ankylosed teeth, and a familial cause was considered. Orthodontic tooth movement was considered impossible and segmental osteotomy on the left maxillary alveolar bone and downward bone distraction were performed as an alternative. A distractor consisting of orthodontic bands, wires and screws was devised and worn in the left mandibular dentition. Multi-bracket orthodontic appliances were also used for distraction. The amount of vertical movement was 7 mm at the premolar region. Five months after distraction, the multibracket appliance was removed, and fixed and removable retainers were placed. Eight months after distraction, prosthodontic restorations on the occlusal surfaces of the ankylosed teeth were made to obtain the final occlusion. The unilateral open bite was successfully treated and a good occlusion was obtained. The occlusion has shown good long-term stability for more than 3 years.

Key words: Alveolar bone distraction, open bite, segmental osteotomy, tooth ankylosis

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Introduction

Ankylosis of teeth occurs from an anatomic fusion of tooth cementum or dentin with the alveolar bone. The pathogenesis of ankylosis is unknown and may be secondary to one of many factors. For example, disturbances from changes in local metabolism, trauma, injury, chemical or thermal irritation, local failure of bone growth and abnormal pressure from the tongue have been suggested. Several investigators believe genetic predisposition has a significant influence.[1] The affected teeth fail to erupt to meet their counterparts in the opposite jaw at the appropriate occlusal plane. In cases where ankylosis occurs in multiple teeth, the occlusion shows an open bite.[2,3] In these circumstances, orthodontic tooth movement to correct the open bite is impossible and surgical repositioning of the ankylosed teeth is required.[2,4,5]

Recently, bone distraction has become popular in the treatment of the patients with cleft lip and/or palate,[6,7] hemifacial microsomia,[8–10] and syndromic craniosynostosis.[11–13] This technique can also be applied to alveolar ridge augmentation to assist in the placement of dental implants.[11,14–18] Several authors have reported on the treatment of ankylosed teeth: Isaacson *et al.*,[19] Kinzinger *et al.*[20] and Kofod *et al.*[21] reported the movement of an ankylosed central incisor using a distraction osteogenesis technique.

In this article, a case is described of a unilateral open bite caused by familial multiple ankylosed teeth which was treated using segmental alveolar bone distraction.

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(a) (b) (c)

Figure 1 (a–c) Occlusion before treatment. Occlusal contact only on UR7 and UR5 to UR1

Patient

The patient was a 25-year-old female whose chief complaint was a unilateral open bite in her left occlusion (Figure 1). The only teeth in occlusion were the right-hand labial segments and the right-hand buccal segments except for UR6. This tooth and all left-hand teeth were positioned below the occlusal plane. These infra-occluded teeth showed no mobility and had a dull sound on percussion. The panoramic radiograph showed an unclear delineation of the periodontal membrane of these teeth and root resorption was found in several teeth (Figure 2). Dental caries was found in the left mandibular molars. The lateral cephalogram showed a long face with an increased Frankfort-mandibular planes angle. The anterior-posterior maxillo-mandibular relationship was skeletal Class II (Figure 3 and Table 1). The postero-anterior cephalogram showed a symmetrical facial contour (Figure 3). These findings suggested a diagnosis of multiple ankylosed teeth and reduced alveolar bone height. The patient's mother and brother also had multiple ankylosed teeth, and had been treated by overlay prosthetics. A familial cause was considered. The patient had a history of orthodontic treatment to correct the open bite in another hospital, but this had failed, resulting in the intrusion of adjacent normal teeth.

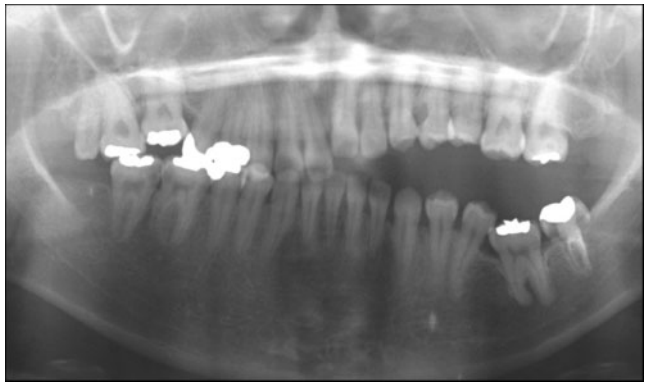


Figure 2 OPT taken before treatment. The periodontal membrane of the ankylosed teeth showed unclear delineation, and root resorption was found in several teeth

Treatment

Orthodontic tooth movement was considered impossible, and a segmental osteotomy and gradual inferior movement of the left maxillary dentition and supporting alveolar bone was planned. Multi-bracket appliances were placed prior to surgery and segmental rectangular wires (0.016 × 0.022-inch) were passively fitted to the brackets on the left and right maxillary teeth. A rectangular wire (0.016 × 0.022-inch) was also placed in the lower dentition. A distraction device consisting of orthodontic bands, wires and screws (Figure 4) was placed on the left lower dentition.

A segmental alveolar osteotomy was carried out under general anaesthesia to the upper left maxillary segment. Horizontal osteotomies on the maxillary buttress and the palatal alveolar bone were performed in the maxilla, as well as a vertical midline osteotomy, which continued

Table 1 Cephalometric values

	Patient	Mean SD	Japanese norm
SNA (°)	91.4	3.5	82.3
SNB (°)	83.8	3.5	78.9
ANB (°)	7.6	1.8	3.4
FMA (°)	39.2	5.2	28.8
U1–SN (°)	104.4	5.6	104.5
L1–MP(°)	88.1	5.8	96.3

FMA: Frankfort-mandibular planes angle; U1–SN: Maxillary incisor-SN plane angle; L1–MP: Lower incisor-mandibular plane angle.
SD: standard deviation.
Japanese norm is from Iizuka and Ishikawa.[26]

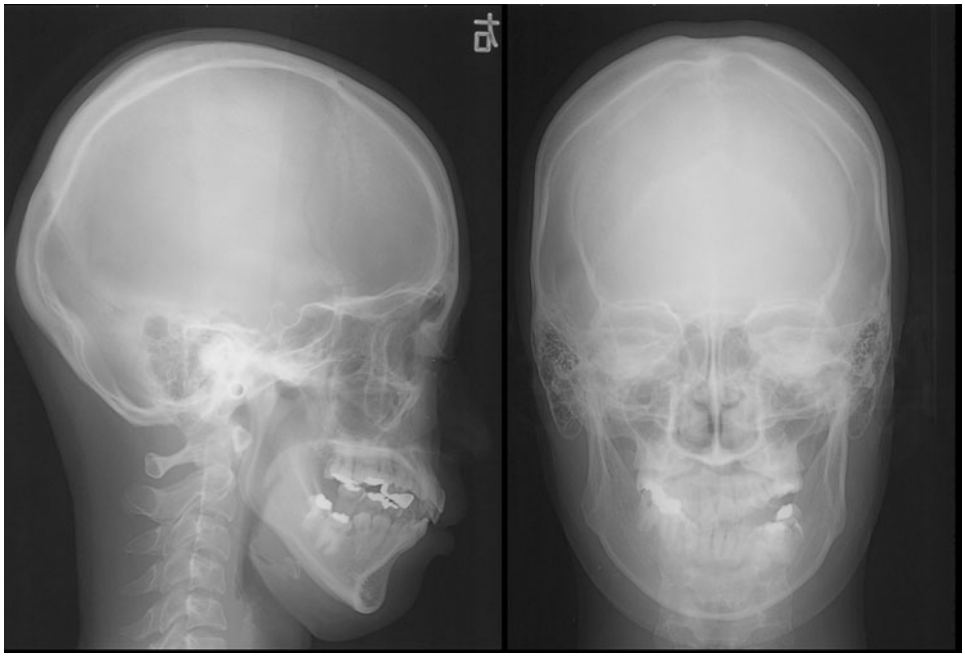


Figure 3 Cephalograms taken before treatment. The lateral cephalogram showed a long face with a steep Frankfort-mandibular planes angle and Skeletal II pattern. The postero-anterior cephalogram presented a symmetric facial contour

to the cut end of the palatal osteotomy (Figure 5). After completing the osteotomies, the segment was mobilized. The left maxillary arch wire was ligated to the distractor on the lower left dentition. Intermaxillary fixation was then placed on the right dentition to prevent mandibular movement and to stabilize the occlusion during distraction (Figure 6a,b).

The screws of the distractor were placed parallel to the occlusal plane so that they moved in a posterior direction as they were turned. The wires ligated to the screws were pulled in a posterior direction and changed the direction vertically at hooks soldered to the orthodontic bands. Thus, the maxillary segment was pulled downwards. The screws were turned twice a day, creating 0.7 mm downward distraction per day of the left maxillary dentition. The distraction continued for 17 days. The measurement of dental models taken before and after distraction revealed that overbite at the maxillary first premolar increased from −9.5 mm to −2.5 mm. Thus, the total amount of downward movement was estimated as 7 mm at the premolar region. After a 1 month consolidation period, the inter-maxillary fixation was released and the distractor was replaced with orthodontic brackets. Continuous rectangular wires were worn in both maxillary and mandibular dentitions and inter-maxillary elastics were applied to prevent relapse (Figure 7a,b).

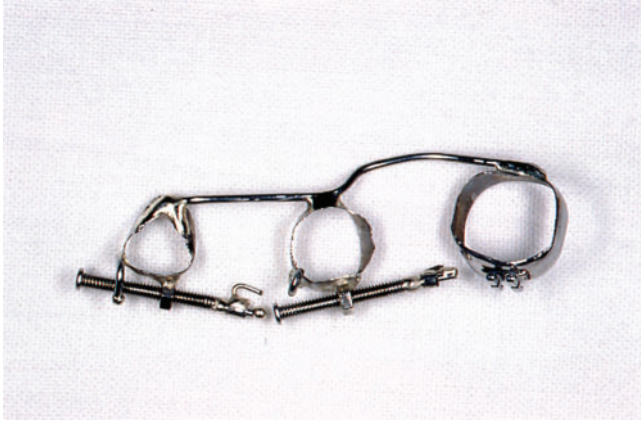


Figure 4 Distraction device consisted of orthodontic bands, wires and screws

Five months after the completion of distraction, the orthodontic brackets were removed and a fixed inter-canine palatal wire was placed on the maxillary dentition (Figure 8a,b). Removable retainers were used simultaneously and dental caries in the left mandibular molars was treated. Eight months after completion of the distraction, prosthetic attachments were fitted to the occlusal surface of the teeth below the occlusal plane (left maxillary premolars and molars, left mandibular first molar and right maxillary first molar). At 3-year follow-up, the occlusion was stable and the patient was

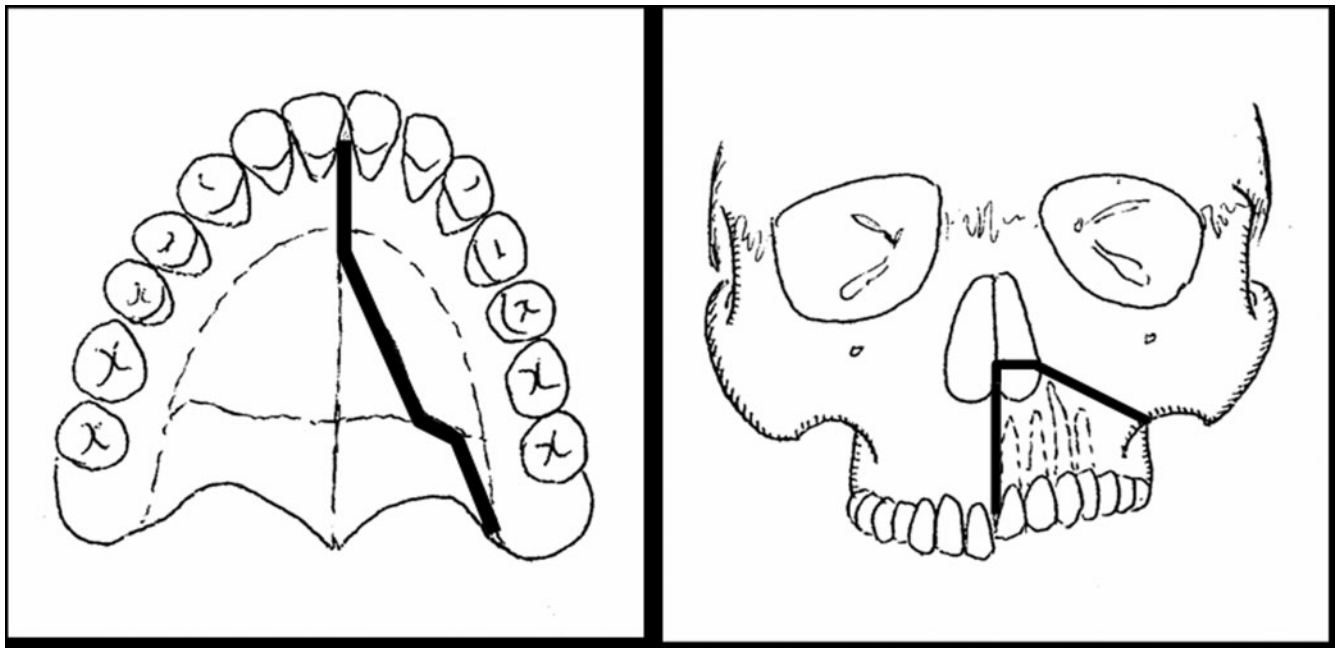
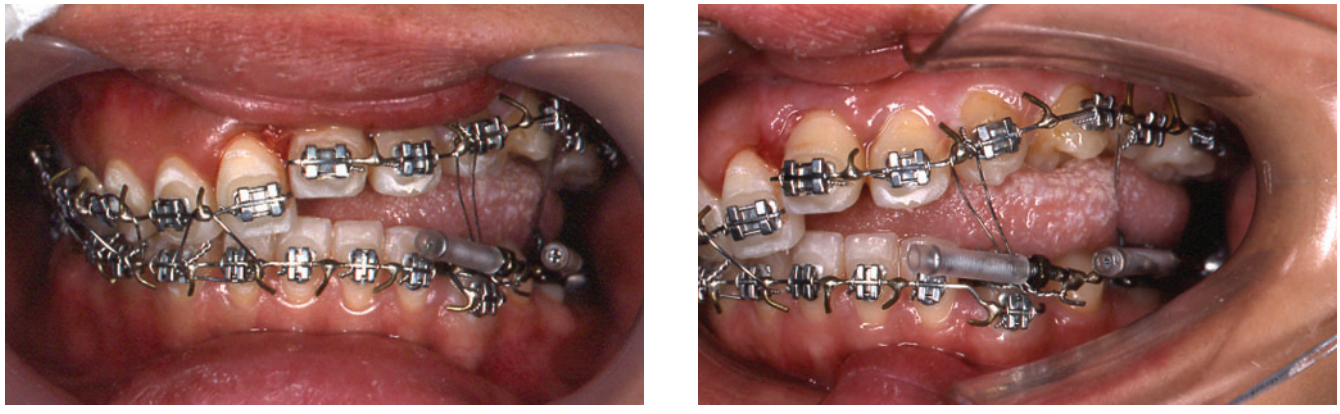
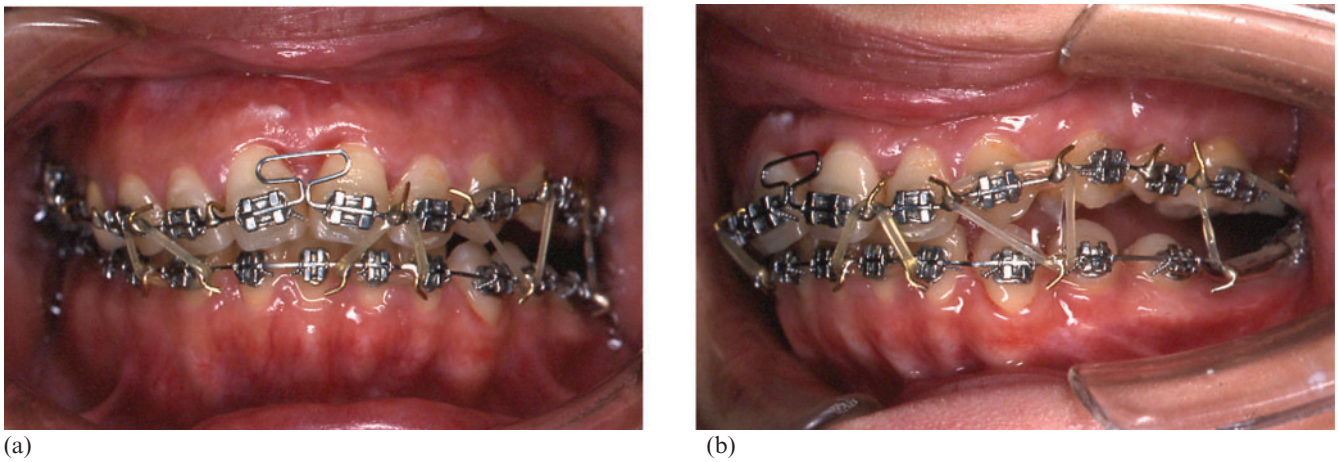


Figure 5 Segmental maxillary osteotomy. Horizontal osteotomies on the maxillary buttress and the palatal alveolar bone were performed in the maxilla, as well as a vertical midline osteotomy, which continued to the cut end of palatal osteotomy



(a) (b)

Figure 6 (a,b) Distraction procedure. The distractor was placed on the left mandibular dentition. Screws were parallel to the occlusal plane. Intermaxillary fixation was placed on the right dentition



(a) (b)

Figure 7 (a,b) At the end of consolidation period. The distractor was replaced with orthodontic brackets and continuous rectangular wires were worn in both maxillary and mandibular dentitions

(a) (b)

Figure 8 (a,b) Five months after the completion of distraction when the orthodontic brackets were removed

(a) (b) (c)

Figure 9 (a–c) Occlusion 3 years after treatment. Eight months after completion of the distraction, prosthetic attachments were fitted to the occlusal surface of the teeth

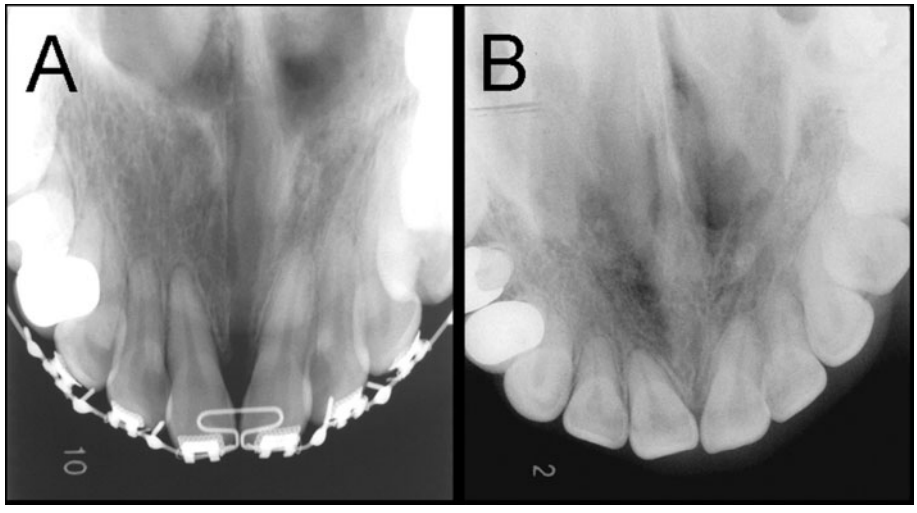


Figure 10 Maxillary occlusal radiographs. (A) Immediately after distraction. Radiolucent area was observed at the midline of the palate. (B) Three years after treatment.

satisfied with the treatment outcome (Figure 9a-c). Bone formation in the area of distraction was satisfactory and the height of the interdental bone between central incisors was good (Figure 10).

Discussion

Partial or complete failure of posterior teeth to erupt produces a lateral open-bite. Proffit and Vig suggested two possible causes of the failure of tooth eruption:

- mechanical interference with eruption;
- failure of the eruptive mechanism of the tooth.[2]

The first possible cause, mechanical interference with eruption, can cause ankylosis of the tooth to the alveolar bone as a result of trauma or by obstacles in the path of the erupting tooth, such as supernumerary teeth or non-resorbing deciduous tooth roots. Pressures from the soft tissues interposed between the teeth (cheek, tongue and finger) can also prevent eruption.

The second possible cause of eruption failure is a disturbance of the eruption mechanism termed 'primary failure of eruption'.[2,22] In this condition, non-ankylosed teeth fail to erupt fully or partially because of malfunction of the eruption mechanism. Patients have no other recognizable disorder and no mechanical interferences with eruption seem to exist. Posterior teeth are involved more than anterior teeth and this may result in a posterior open-bite. Involvement may be unilateral or bilateral, but the condition is rarely symmetrical and frequently unilateral. The age at onset of the condition is not clear and some teeth may erupt normally at first and then stop erupting. Involved teeth tend to become ankylosed, but failure of eruption is usually apparent before definite ankylosis occurs. Application of orthodontic force leads to ankylosis, rather than normal tooth movement.

Pelias and Kinnebrew[3] reported the familial occurrence of the multiple ankylosed teeth. The proband (defined as the first individual chosen from a family who has come to the notice of a researcher, and through whom investigation of a pedigree begins, due to the presence of some trait whose inheritance is to be studied) of their report was a 32-year-old female who had a bilateral lateral open-bite caused by multiple ankylosed teeth. Systematic evaluation revealed simultaneously occurring mild bilateral clinodactyly of the fifth fingers. The family history was positive and 12 affected persons were found in four generations. Dental abnormality and mild mandibular prognathism are found in some affected patients. Pelias and Kinnebrew[3] considered these abnormalities were transmitted in an autosomal dominant manner from pedigree analysis.

The occlusion of our patient was very similar to that in Pelias and Kinnebrew's[3] article. The lateral open bite was caused by multiple ankylosed teeth and maxillary posterior teeth showed a reverse curve of Spee. Open bite was, however, found unilaterally in our case. Our patient had no history of facial trauma and no apparent mechanical interference with eruption was found. The mother and brother of our patient also had multiple ankylosed teeth, and had been treated by overlay prosthetics. Thus, we considered the open bite of our patient was caused by hereditary primary failure of eruption. The ankylosis might have occurred spontaneously or as a result of previous orthodontic treatment in another hospital.

In the treatment of ankylosis, a dento-alveolar osteotomy has often been performed to correct the inferiorly positioned teeth.[4,5] The alternative is prosthetic build-up.[23,24] When ankylosis occurs in multiple teeth, a segmental alveolar bone osteotomy is essential and a bone graft can also be interposed between the segment and the basal alveolar bone.[3] Prosthodontic restorations are sometimes required to establish a satisfactory final occlusion.[2] Recently, bone distraction has became popular in the treatment of craniofacial anomalies[6–13] and alveolar ridge augmentation.[11,14–18] For the treatment of an ankylosed central incisor, a single-tooth osteotomy and subsequent vertical distraction to avoid bone grafting and to stretch soft tissue has recently been reported.[19–21]

In this case, orthodontic tooth movement was considered to be impossible from the clinical examination and treatment history, and a segmental alveolar bone osteotomy was undertaken instead. As a segmental osteotomy in the mandibular alveolar bone carries a high risk to the blood supply and injury to the inferior-alveolar nerve,[25] we performed a segmental osteotomy only in the left maxillary bone. The reverse curve of Spee in the left maxillary dentition and the acceptable curve in the left mandibular dentition supported this treatment plan. However, mandibular segmental osteotomy might have produced a more satisfactory outcome to reduce the need for fixed onlay prosthodontics.

A gradual distraction technique was selected to avoid bone grafting and to stretch the soft tissue, which otherwise is often a limiting factor. As ankylosed teeth act as perfect orthodontic anchorage, the distractor was placed in the ankylosed left lower dentition and the upper dentition was distracted using screws and wires. There are two alternatives to consider for segmental distraction: the use of vertical elastics or the fixed screw type distractor across the osteotomy cuts. With the use of vertical elastics however, control of the distraction rate is difficult. The fixed screw type distractor may avoid inter-maxillary fixation. However, it needs two surgical interventions—at placement and at removal—furthermore, the distraction direction is not flexible. For these reasons, we chose screws and inter-maxillary wires to avoid two surgical episodes, to keep distraction rate constant and to control the distraction direction.

The outcome of the distraction treatment was excellent and the distracted segment was stable more than 3 years post-surgery. The possible complications of the segmental osteotomy are significant periodontal defects at the vertical osteotomy sites and the loss of vitality of teeth adjacent to osteotomy cut. Loss of blood supply to both teeth and alveolar bone in the mobilized segments is rare but teeth and segments of bone may be lost in this circumstance.[25] In our case, a vertical osteotomy was made at the maxillary midline between the central incisors. The interdental bone at this site at 3 years after osteotomy showed good height and no complications were found in the teeth adjacent to the osteotomy cut. Careful surgical procedure seemed to be

able to avoid the complications in the adjacent teeth. Gradual distraction of the segment might be advantageous to the blood supply of the mobilized segment.

Conclusion

A case with unilateral open bite caused by familial multiple ankylosed teeth was successfully treated using segmental alveolar bone distraction. A good occlusion was obtained with final prosthodontic restorations on the occlusal surfaces of the ankylosed teeth. The treatment result was stable after more than 3 years without any complications.

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