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SHORT COMMUNICATION

Use of interdental distraction osteogenesis for orthodontic tooth alignment and correction of maxillary hypoplasia: a case report

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INTRODUCTION

The principle of distraction osteogenesis can be applied to the dentoalveolar region. Reported applications include vertical height augmentation of the alveolus and creation of new edentulous alveolar ridge. The newly created ridge can be used for rapid orthodontic movement, to facilitate closure of wide alveolar cleft and reconstruction. The application of interdental distraction osteogenesis to the management of a case of maxillary hypoplasia with severe dental crowding in repaired cleft palate is presented to illustrate the feasibility of utilizing the principle of interdental distraction osteogenesis to create new bone for tooth alignment and simultaneous correction of maxillary hypoplasia.

CASE REPORT

A 15-year-old girl with a repaired cleft palate was referred to our unit for management of secondary cleft deformities. She presented with severe maxillary hypoplasia and malocclusion. Clinical findings included a concave facial profile with little nasal and upper labial support. The mandibular arch was relatively normal while the maxillary arch was hypoplastic in the transverse dimension with palatally standing lateral incisors and second premolars. Crossbite spanned from teeth 16 to 26. Cephalometric measurements confirmed hypoplasia of the maxilla in the antero-posterior direction (SNA 73°). The reverse overjet was 8.5 mm and the overbite was 5.5 mm.

Conventional orthognathic/orthodontic treatment would involve extraction of a number of the grossly displaced teeth (probably at least the second premolars), followed by maxillary advancement with a Le Fort I osteotomy. However, relapse after maxillary advancement in such patients can be appreciable despite rigid fixation, bone grafting and overcorrection. We therefore considered interdental distraction osteogenesis to create new alveolar bone to align the displaced premolars, and at the same time advancing the anterior maxilla to correct the maxillary hypoplasia and to minimise the risk of relapse.

In preparation for the surgical phase of interdental distraction, teeth 14, 24, 16 and 26 were used as anchorage for supporting rapid palatal expansion screws (Ormco). Under general anaesthesia, interdental corticotomies were made on the buccal and palatal aspects of the maxilla between teeth 14 and 15 on the right and between 24 and 26 on the left (Fig. 1). The interdental osteotomies were extended superiorly above the apices of the anterior teeth, then horizontally towards the lateral nasal wall similar to an anterior maxillary subapical osteotomy. We also did osteotomies of the lateral nasal wall and nasal septum. The anterior maxilla was then mobilised, and pedicled on the palatal and labial soft tissues.

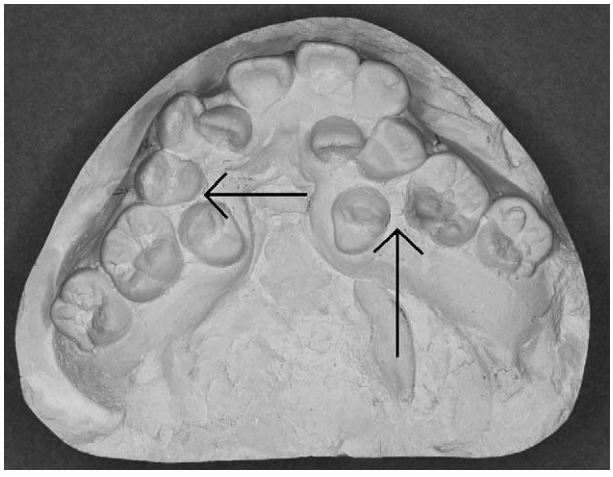

Fig. 1 Upper dental model showing intended positions of interdental osteotomies between the first and second premolars on the right and distal to the second premolar on the left.

Fig. 2 One week after activation of the distraction screws. Edentulous spaces were created at the sites of interdental osteotomies. Healing of the gingival and alveolar mucosal tissue is satisfactory.

After a latency period of 1 week, the screws were activated once a day at a rate of 1 mm/day (Fig. 2). After a period of 10 days, an overjet of 4 mm was achieved. Immediately after interdental distraction, the maxilla was advanced to provide good nasolabial support. A radiograph taken 1 year after interdental distraction showed adequate alveolar bone at the sites of the interdental osteotomies. A Quadhelix appliance was then used to expand the maxilla in the transverse dimension to correct the posterior crossbite. Satisfactory orthodontic tooth alignment was achieved 11/2 years after interdental distraction (Fig. 3). Stability of the distracted anterior maxilla was maintained by the aligned premolars. Orthodontic expansion of the maxilla transversely resulted in the opening of a latent oronasal fistula in the anterior palate. This will be repaired after completion of orthodontic treatment. The palatally displaced tooth 22 will be extracted later.

Fig. 3 Tooth alignment 11/2 years after orthodontic treatment. Expansion of the maxilla in the transverse dimension resulted in opening of a latent oronasal fistula. Tooth 22 could not be aligned as all the newly created edentulous areas on the left side of the maxilla were used for alignment of the premolars. This tooth will be extracted later.

DISCUSSION

Since the introduction of distraction osteogenesis by Ilizarov,[1] and its application to the craniofacial skeleton,[2] refinement in hardware and techniques have resulted in more extensive application of the concept. The principle of distraction osteogenesis has been applied to the dentoalveolar region for vertical ridge augmentation and the creation of new edentulous alveolar ridge.[3] Liou *et al*.[4] first reported the use of interdental distraction and rapid orthodontic tooth movement to approximate wide alveolar clefts and post-traumatic maxillary defects. Interdental osteotomies were done distal to the alveolar clefts or maxillary defects. The anterior segment was then distracted towards the direction of the cleft or defect, resulting in considerable reduction in the width of the cleft. They used custom-made tooth-borne and bone-borne devices for distraction. With this method, combined with rapid post-distraction orthodontic tooth movement, they were able to approximate various alveolar clefts.

Maxillary hypoplasia secondary to cleft palate is traditionally corrected by orthognathic surgery. Long-term stability after maxillary advancement in patients with clefts has improved considerably with bone grafting and rigid fixation.[5] However, depending on the magnitude and direction of the required surgical movements, varying degrees of relapse have been reported.[6] Aggravation of velopharyngeal incompetence is another potential problem. To overcome these difficulties, Molina *et al*.[7] gradually distracted the maxilla after incomplete osteotomies at the Le Fort I level. Distraction force was applied by using a facial mask and an intraoral fixed appliance system as an anchorage. Maxillary advancement between 4 and 12 mm was achieved in 3–4 weeks. Follow-up in their series varied from 6 months to 3 years, and no relapse was seen.

In our patient the principles of interdental distraction and partial osteotomy were combined to create new alveolar bone for simultaneous alignment of teeth and correction of maxillary hypoplasia. Compared with conventional orthodontic and orthognathic surgical treatment, this method has the advantage of producing new bone in the palate and the alveolar ridge. Displaced teeth can then be moved into the newly created bone rather than having to be extracted. The position of the anterior maxilla is then maintained by the aligned teeth and post-distraction retention was achieved. Without the need to overcome the resistance of scar tissue in the soft palate region, stability is improved. With this method,

velopharyngeal competence is maintained. Advancement of the anterior maxilla also results in improved nasal base support and a more pleasing facial profile.

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