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Assisted eruption of impacted teeth into an alveolar bone graft in a patient with cleft lip and palate

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Aims: To assist the eruption of impacted upper teeth into an alveolar bone graft in a patient with a unilateral cleft lip and palate.

Methods: An 8 year-old Thai boy with left unilateral complete cleft lip and palate had the chief complaint of anterior crossbite. He presented with a mild skeletal 3, dental Class III subdivision malocclusion, anterior crossbite, left unilateral posterior crossbite, moderate crowding in the upper arch with impaction of upper the left lateral incisor (tooth 22) and canine (tooth 23). In the first phase of treatment the posterior crossbite was corrected with a removable appliance with a 3-way screw. In the second phase the impacted teeth were surgically exposed, moved into the alveolar bone graft and the teeth aligned with fixed appliances. The upper left lateral incisor was extracted because of its questionable longevity.

Results: The orthodontic treatment resulted in normal overjet, overbite and an acceptable facial profile. A prosthesis replaced tooth 22.

Conclusions: Forced eruption of impacted teeth can be carried out successfully in the cleft patients after an appropriate treatment plan has been formulated and following preparation of alveolar bone graft in the cleft site.

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Introduction

Patients with clefts of the lip and alveolar process usually need an alveolar bone graft. The benefits and purposes of bone grafting in this group of patients are: to provide bone matrix to facilitate tooth eruption into the cleft site and support the permanent teeth after completion of orthodontic treatment; to stabilise the maxillary segments after orthodontic treatment, especially the mobile primary palate in bilateral clefts; to close an oronasal fistula that may cause discomfort or embarrassment for affected patients and prevent anterior nasal air escape during speech and oral fluid escape via the nose, and to improve nasal health by separating the nasal cavity from the oral cavity; to support the nasal sill and alar base; to maximise the periodontal health of the teeth adjacent to the cleft by providing adequate bone support; and to establish ideal alveolar morphology.[1–11] A sound and well-contoured alveolar process will provide support for the teeth and periodontium and, thus, will benefit orthodontic treatment. It will also provide bony support and attached soft tissue if an implant is required.

The alveolar bone graft may be primary or early or late secondary, depending on timing. An early secondary bone graft is carried out during the mixed dentition period, at 8–11 years of age. This has become the preferred timing since it has been shown to result in a successful graft, and provide alveolar bone into which the permanent canine and lateral incisor (if present) can erupt. Late secondary bone grafting is the term used for cases where the canine is already erupted. Periodontal conditions of an already erupted canine are usually less satisfactory, and are more likely to result in a deficient graft and inadequate alveolar bone height.

Numerous studies have reported that following alveolar grafting between 27 and 97 per cent of the

Figure 1. Pretreatment extra-oral photographs.

canines in the cleft site spontaneously erupt.[10] El-Deeb et al.[4] found that the mean length of time required for canines associated with a unilateral alveolar cleft to erupt after bone grafting was 3.4 years, which was significantly longer than the 2.2 years taken for eruption of the contralateral canines in the same subjects. They suggested that if the unerupted teeth in a cleft site did not erupt spontaneously, the teeth should be surgically exposed and eruption assisted with an orthodontic appliance.

Case report

An 8 year-old Thai boy with repaired left unilateral complete cleft lip and palate complained about his upper anterior teeth, which were 'locked behind his lower front teeth'. He attended the Cleft Palate Clinic for comprehensive care.

Extra-oral examination

The patient had no general physical deformity. He had a mesomorphic body type, an ovoid, slightly asymmetrical face, and a medium-size nose with asymmetrical alar bases due to the unilateral alveolar cleft and repaired lip and nostril. The lips were incompetent at rest, with a short upper lip and a protrusive lower lip. He had a low smile line and displayed 60 per cent of the upper incisors. His chin deviated 2 mm to the left of the facial midline due to a functional shift of the mandible. The patient's facial profile was concave with an acute nasolabial angle (Figure 1).

Intra-oral examination

The patient's main problems were an anterior crossbite with a left side, unilateral posterior crossbite. When he presented for orthodontic treatment, he was in the early mixed dentition stage with a Class III molar occlusion on the right side, and a Class I molar occlusion on the left side and unclassified canine relationships on both sides. The overjet was –1.5 mm and the overbite 4 mm. All primary canines, and first and second primary molars were still present. We estimated there a dental arch space deficiency of 4 mm in the region of the alveolar cleft, and there was insufficient space to accommodate the unerupted lateral incisor and permanent canine. His oral hygiene was fair and he had a mild, marginal gingivitis. His tongue was normal in size and position, and he had an adaptive tongue-thrust when swallowing. The upper dental midline coincided with the midsagittal plane, while the lower dental midline deviated 2.0 mm to the left. The occlusal plane was not canted and the curve of Spee was 2.5 mm on both sides. There was an amalgam restoration in tooth 54 (Figure 2). There were CR-CO discrepancies of 2 mm anteriorly and to the left side. There were no

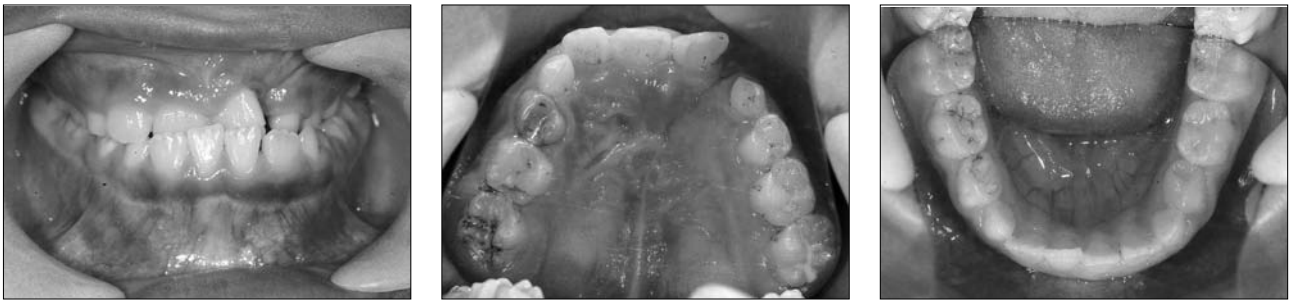

Figure 2. Pretreatment intra-oral photographs.

Figure 3. Pretreatment panoramic, lateral cephalometric, and periapical radiograph.

signs or symptoms of temporomandibular joint dysfunction. His speech was unclear due to hypernasality.

Radiographic findings

A lateral cephalogram and panoramic radiograph were taken when the patient was 8 years of age. The panoramic film showed that tooth 23 was impacted, and there was a peg-shaped left lateral incisor (tooth 22) in the cleft site. The crown of tooth 23 was completely formed, the root partially formed and it was above the position of the developing tooth 24. No supernumerary teeth were present and there was no bone pathology. There appeared to be no bone at the level of the nasal floor in the cleft site (Figure 3). The cephalometric analysis revealed that the patient had an orthognathic maxilla and mandible in relation to the anterior cranial base. The maxillary incisors were retroclined while the mandibular incisors had a normal inclination. The cephalometric measurements are given in Table I.

Diagnosis

Dental Class III subdivision (RHS) on mild skeletal 3 base with a left, unilateral complete cleft of the lip and palate.

Treatment plan

The treatment was divided into two phases: in the first phase the principal objectives were to prepare space for the impacted teeth and to correct the collapsed left maxillary dentoalveolar segment. The intentions were to expand the upper arch to provide adequate access for the alveolar bone graft; to provide space for the impacted teeth; to eliminate the

Table I. Comparison of the pretreatment and post-treatment cephalometric measurements.

Measurement	Standard norm*	Pre-treatment	Post-treatment
Cranial base			
SN-FH	5 ± 6	4	6.5
Maxilla to cranium			
SNA	82	81	81.5
FH-NA	90 ± 3	85	88
A-N perp (mm)	1.1 ± 2.7	-4.5	-2.5
Co-A (mm)	100 ± 6	80	92.5
Mandible to cranium			
SNB	80	80	80
FH-NPog	87 ± 3	84	88
Pog-N prep	-0.3 ± 3.8	-10.5	-5
Co-Gn (mm)	134 ± 7	116	132
Maxilla to mandible			
ANB	2	1	1.5
Wits appraisal (mm)	0.5 ± 2	-7.5	-3
Vertical analysis			
SN-PP	7 ± 3	8	10
SN-MP	32	34	31
FH-MP	25	30	25
PP-MP	23 ± 2	26	20
ANS-Me	74.6 ± 5	67	80
Dental analysis			
U1-SN	102 ± 2	93	109
U1-NA (deg)	22	11.5	28
U1-NA (mm)	4	1	7
IMPA	91.4 ± 3.8	89	90
FMIA	65	61	64
L1-NB (deg)	25	24	23
L1-NB (mm)	4	4.5	5
U1-L1	131	143	128
Soft tissue analysis			
Profile angle	168.7 ± 4	182	186
Nasolabial angle	102 ± 8	86.5	67
UL-E line	-2.5 ± 1.5	-1	-2.5
LL-E line	1 ± 1	4.5	4
U lip length	23.8 ± 1.5	19	22
L lip length	49.9 ± 4.5	48	63

* From 'Standard norms' in the Khon Kaen University analysis
Pretreatment: October 2001
Post-treatment: August 2007

functional shift in the mandible; and to correct the anterior crossbite. The objectives of the second phase of treatment were to disimpact tooth 22 and tooth 23, move them into normal alignment, and align all the permanent teeth.

Treatment

To correct the anterior and posterior crossbites and relieve the crowding, the upper arch was expanded with a removable plate with 3-way screw and posterior bite planes. The screws were activated twice a week until an edge-to-edge relationship was reached. A second plate was used because of the need for further sagittal and transverse expansion. At 10 years of age, a third plate was used to obtain more transverse expansion because the posterior crossbite was not fully corrected. The total active treatment time for the first phase of treatment was 13 months. At the end of this phase of treatment the anterior and posterior overjet had been overcorrected, the overbite was normal, and the patient was in the early permanent dentition with tooth 14 partly erupted. After the third expansion plate, a quad-helix appliance was inserted to maintain the arch expansion during and immediately following the alveolar bone grafting procedure. Although a quad-helix appliance is not normally used for this purpose the surgeon had no difficulty in gaining access to the cleft site. Ordinarily, a bi-helix appliance or a plain W-arch would be used for retention, since flexibility is not needed. A bi-helix appliance could have achieved all the expansion needed in phase one.

In the second phase of treatment, a principal objective was to create space for the impacted teeth 22 and 23. A fixed appliance was used and the initial archwire was 0.016 inch NiTi, followed by a 0.016 x 0.022 inch NiTi archwire, and then a 0.016 x 0.022 inch stainless steel archwire. The upper left canine was surgically exposed and a bracket bonded to the tooth. The impacted canine was then extruded using ligature thread and wire connected to a 0.018 x 0.025 inch stainless steel archwire. When the canine was close to normal alignment, it was ligated to a 0.016 inch NiTi archwire and then a 0.016 inch stainless steel archwire. The last archwire also assisted tooth 23 to erupt. The upper left lateral incisor was extracted at this stage because it was peg-shaped with a short root. Because the space left after removal of the lateral incisor was considered too large to be

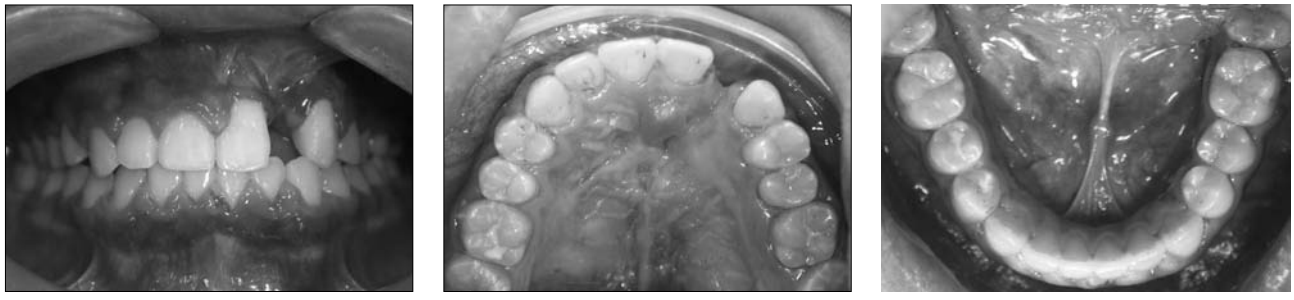

Figure 4. Post-treatment intra-oral photographs.

Figure 5. Facial photos show an acceptable facial profile.

closed by moving the erupted canine mesially, it was retained for a prosthetic substitute. The upper and lower arches were levelled and aligned simultaneously (Figure 4).

Result

At the end of phase one the patient had normal overbite and overjet, and an increased curve of Spee (4 mm). The functional shift had been eliminated and the upper dental midline had corrected. The buccal crossbite was overcorrected in anticipation that some of the transverse expansion would relapse. The duration of treatment in phase one was longer than expected for two reasons: the patient's mother had initially turned the expansion screw in the second removable appliance in the wrong direction, and the upper first premolars had not erupted sufficiently for the quad-helix appliance to be placed. The quality of the alveolar bone graft was acceptable, and the crestal bone was approximately level with the cemento-enamel junctions of the teeth bordering the cleft.

During treatment the upper incisors were proclined, while the lower incisors were retracted bodily. Although the patient had a slightly concave profile his facial aesthetics were considered acceptable (Figure 5). The extended treatment time included the time waiting for the alveolar bone graft operation, for the grafted bone to consolidate and for the second molars to erupt so that they could be aligned. After active treatment the fixed appliances were removed and upper and lower wraparound retainers placed. The upper retainer included a replacement for the extracted upper left lateral incisor. The option of a permanent prosthesis will be considered when the patient is older.

The cephalometric findings and a summary of the changes are shown in Figure 6 and Tables I and II. The cephalometric measurements and super-

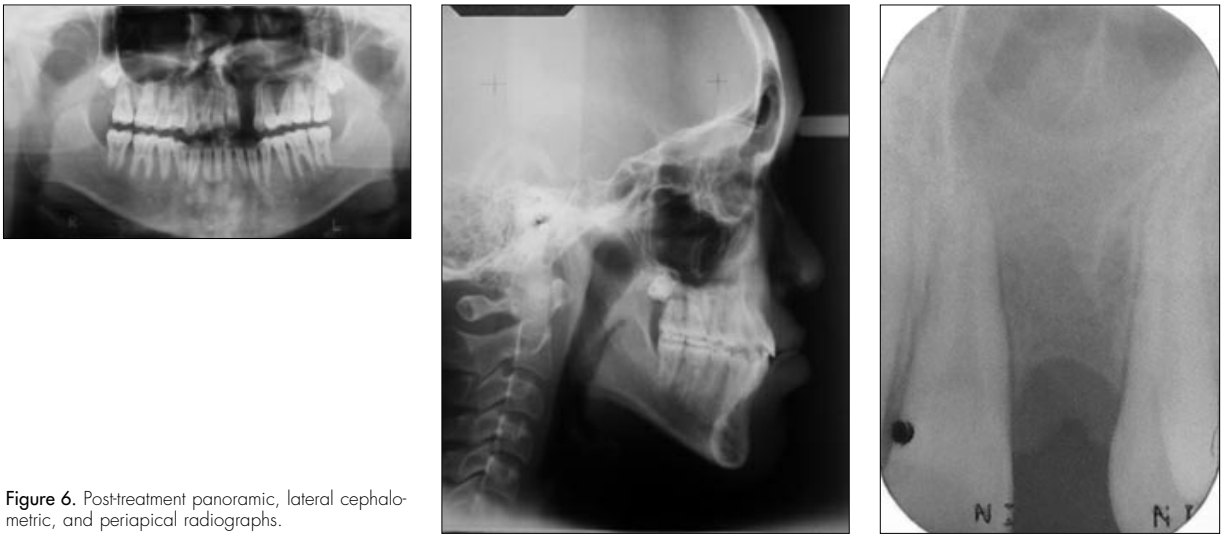

Figure 6. Post-treatment panoramic, lateral cephalometric, and periapical radiographs.

Table II. Summary of the pretreatment and post-treatment conditions.

Region		Pretreatment	Post-treatment
Skeleton	Antero-posterior	Mild skeletal Class III	Skeletal Class I
	Vertical	Skeletal tendency openbite	Normal vertical skeletal relationship
Dental arch	Alignment	Mal-aligned, mild crowding, negative overjet	Well-aligned, no crowding, normal overjet
	Arch form	Parabolic maxillary and mandible arches	Parabolic maxillary and mandible arches
Dental	Canine relation	Unclassified both sides	Class I on both sides
	Molar relation	Class III on right side Class I on left side	Class III on right side Class I on left side
	Overjet	-1.5 mm	2 mm
	Overbite	4 mm	2 mm
	Maxillary incisor	Retroclination	Proclination
	Mandibular incisor	Slight retroclination	Normal inclination
	Midline	Mandibular dental midline shifted to left 2 mm	Maxillary and mandibular dental midlines coincide with the facial midline
Soft tissue	Upper lip	Normal position	Normal position
	Lower lip	Protrusion	Protrusion
Face	Frontal	Symmetry	Symmetry
	Profile	Concave	Concave

impositions show that the maxilla and mandible moved forward and downward due to growth (Figure 7). The upper incisors proclination was accompanied by forward movement of the upper lip and a reduced nasolabial angle (Table I).

Discussion

Alveolar bone grafting is a mandatory procedure in the treatment protocol for the patients with an alveolar cleft. Pre-graft orthodontic treatment is usually required to provide access for the surgeon to repair the nasal floor and place bone in the cleft site, and to provide sufficient space in the arch for unerupted teeth. In the present case, the presurgical orthodontics also corrected a posterior crossbite. Thus, the aims of the pre-graft maxillary expansion were to provide better surgical access and to correct the upper and lower posterior arch width relationships.

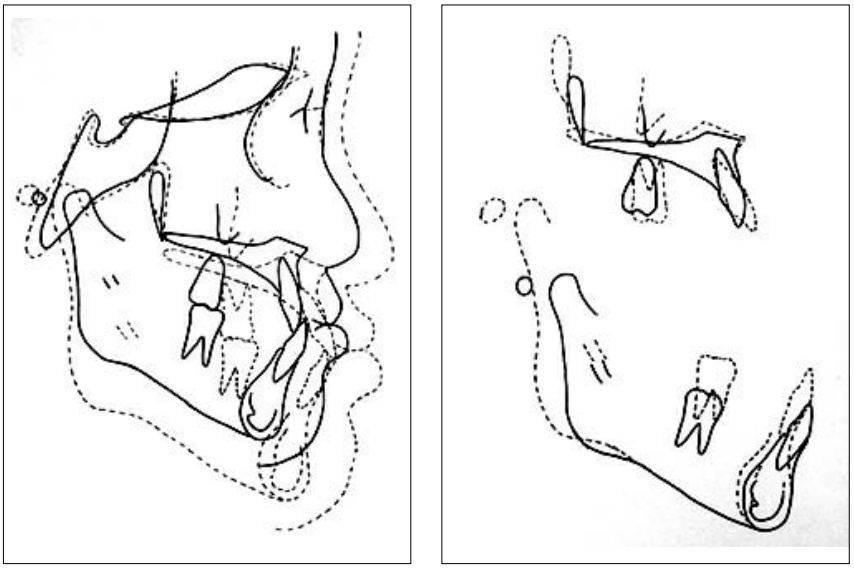

Figure 7. Cephalometric superimpositions of pre-treatment (solid line) and post-treatment (dotted line) tracings.

Although an alveolar bone graft may shorten the time taken by unerupted teeth to emerge in a cleft site, unerupted canines in a cleft take longer to emerge than non-affected canines.[4] In our patient, the upper left canine erupted slowly through the grafted bone. On the panoramic radiograph taken one year after completion of the first phase of treatment the canine was still in the alveolar bone above tooth 63 and tooth 14. It was decided to surgically expose and apply traction to this tooth to avoid extended treatment. As a result of this procedure the upper left canine was guided into normal alignment within 8 months. The duration of all orthodontic treatment, including the alignment of the permanent second molars, took 2 years and 2 months.

Conclusion

Alveolar bone grafting in the patients with cleft lip and palate may allow teeth in the cleft site to erupt unassisted through the grafted bone. In spite of this some teeth remain impacted and require surgical exposure and assisted eruption so that treatment can be completed in an acceptable time.

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