Use of orthopedic finger distractor for facial asymmetry correction

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Facial asymmetry after unilateral ankylosis results due to the loss of the condylar growth center on the ankylosed side. This results in the skeletal midline deviating to the affected side, a lack of vertical growth on the same side produces a cant of the occlusal plane and mandibular retrognathism is seen as a result of the hypoplasia. The lower border of the mandibular corpus and angle on the contra lateral side is usually flattened. We report a case of facial asymmetry following unilateral ankylosis, which was treated by a combined approach with distraction osteogenesis and orthodontics. Inexpensive orthopedic finger distractors were used. The facial changes were analyzed using the Grummons facial asymmetry analysis.
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INTRODUCTION

Facial asymmetry after unilateral ankylosis is a problem encountered very frequently in clinical practice. It usually results due to the loss of the condylar growth center on the ankylosed side. This results in the skeletal midline deviating to the affected side, a lack of vertical growth on the same side produces a cant of the occlusal plane and mandibular retrognathism is seen as a result of the hypoplasia. The lower border of the mandibular corpus and angle on the contra lateral side is usually flattened. The problem thus involves the three dimensions of space. The severity of the problem depends on the degree of hypoplasia or agenesis of the tissues involved, and the more severe the deformity, the greater the probability that it will worsen with growth.[1-3]

In growing patients orthopedic treatment with functional appliances is often helpful in correcting deformities or in reducing the worsening of the deformities with growth.[4] If the facial asymmetry develops progressively during orthopedic treatment, mandibular distraction osteogenesis or surgical reconstruction of the temporomandibular joint with a costochondral graft of the remaining ramus tissue may be considered.[5,6] After growth is complete double jaw surgery and/ or genioplasty or unilateral mandibular augmentation may correct skeletal deformity.[7,8] Distraction osteogenesis is the process of generating new bone by stretching, first described in 1905 by Codvilla[9] and later developed by Ilizarov.[10]

New bone can be generated in the gap between two bone segments in response to the application of gradual stretching across the bone gap. This technique of bone expansion utilizes the natural healing mechanisms of the body to generate new bone. The technique has been used in orthopedics for quite some time, but was first applied to the lower jaw in 1992.[11] While, craniofacial distraction osteogenesis does not replace all conventional surgical techniques, it is a less invasive surgery and can benefit children with a variety of disorders including:

- Syndromic craniosynostosis with midface retrusion, such as Apert's, Crouzon's, Pfieffer and Carpenter syndromes
- Hemifacial microsomia and Goldenhar's syndrome
- Cleft lip and palate with associated midface retrusion
- Retrognathia of any etiology
- Obstructive sleep apnea
- Treacher Collins syndrome
- Pierre Robin Anomalad
- Sequelae of TMJ ankylosis like facial asymmetry and retrognathism

The extraoral/intraoral distractors available for use in maxillofacial area are extremely expensive and thus

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Figure 1A. Pre treatment extraoral frontal view showing the retrognathia and deviated chin.

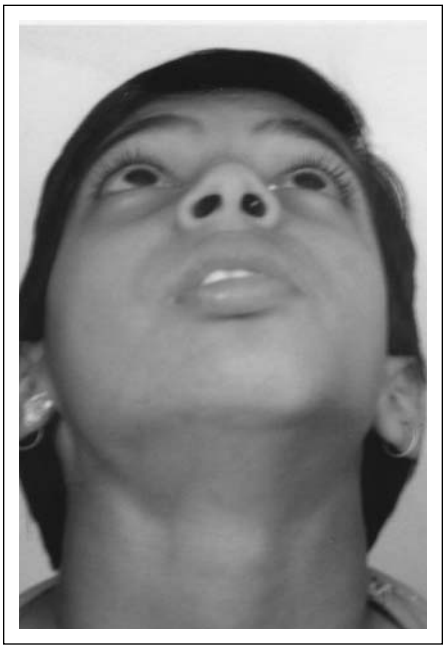

Figure 1B. Pre-treatment birds eye view showing the chin deviation to right side.

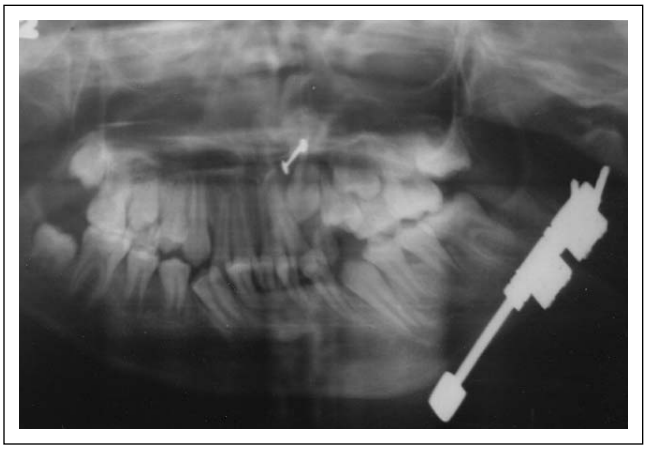

Figure 2. Immediate post-operative panoramic radiograph showing distractor in place.

Figure 3. Panoramic radiograph showing distraction. Note the gap between the two fragments.

are not financially viable to be used in a population of developing countries where there is no medical insurance and the per capita income is far below standard levels. A case of facial asymmetry is reported following unilateral ankylosis, which was treated by using the inexpensive orthopedic finger distractor.

CASE REPORT

A 10-year-old female patient reported with a complaint of facial asymmetry (Figure 1A, 1B). History revealed that a trauma to her left condyle in childhood had resulted in the unilateral ankylosis 6 years ago. Functional mouth opening was restored after a gap arthroplasty of the ankylosed left temporomandibular joint. Prolonged ankylosis had resulted in facial asymmetry. At the initial examination, it was observed that the jaw opening was adequate, whereas, the lateral movements showed restriction. The patient was in mixed dentition stage with a Class II deep bite occlusion with the lower dental midline shifted 7 mm to the left side. She had marked facial asymmetry with an 18-mm deviation of the chin point to the left relative to the craniofacial midline, which was confirmed with the anteroposterior measurements. There was discrepancy of the vertical growth on the left side. As a result of the shortening of the left ramal height, a tilt of the occlusal plane was present. The patient's lower facial height was reduced considerably and the mental muscle was hyperactive during swallowing and speaking. Radiographic findings supported the clinical findings in these aspects.

Figure 4. Extra oral views showing the orthopedic finger distractor at the completion of treatment. Note the correction of chin and facial asymmetry.

Figure 5. Post-treatment. Panograph showing the bone formation in the distracted area.

Figure 6A. Post-distraction extraoral frontal. Note the corrected facial asymmetry.

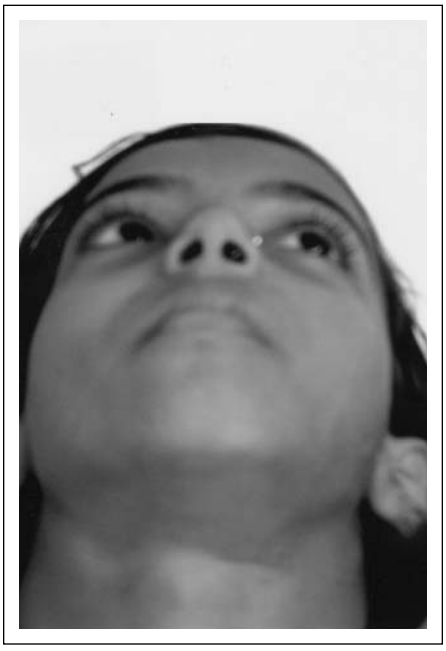

Figure 6B. Post-distraction birds eye view of the patient. Note the chin correction.

The patient was advised orthodontic treatment combined with distraction osteogenesis on the left lower jaw. However, the patient due to financial constraints refused distraction. Considering the financial constraints we planned a uniplanar distraction using orthopedic finger distractors extraorally. The distractor was placed with the corticotomy done in the angle region so as to gain both vertical as well as sagittal lengthening (Figure 2). After the latency period of 5 days, active distraction was started with a rhythm 1 mm per day (Figure 3) until the skeletal midline got corrected. To prevent relapse the skeletal midline was overcorrected by 4 mm. The occlusal cant and the asymmetry improved (Figure 4). The distractor was left in place for consolidation of the newly formed bone for 2 months following, when the appliance was removed (Figure 5). Post distraction settling of occlusion was attempted using Roth 0.22 appliance. The patient was treated as a non-extraction case.

TABLE 1. (a) PA Cephalometric comparison of the effects of the correction of the facial asymmetry

	PRE DISTRACTION			POST DISTRACTION		
	LEFT	**RIGHT**	**DIFFERENCE**	**LEFT**	**RIGHT**	**DIFFERENCE**
Z plane	65	69	4	74	71	3
Occlusal plane	31	25	6	28	25	3
Ag Angle	49	39	10	45	44	1
Ag Plane	109	118	9	110	120	10
Z Distance	49	52	3	60	57	3
Co Distance	42	47	5	49	47	2
ZA Distance	52	63	9	58	60	2
NC Distance	13	16	3	13	15	2
J Distance	37	32	5	31	29	2
Ag Distance	32	30	2	33	32	1
Mand Offset at Me			18			4
A1 Offset			3			3
B1 Offset			3			1
AG Height	20	18	2	18	18	0
Co-Ag	38	52	14	42	52	10
Me-Ag	53	40	13	46	48	2
Co-Me	75	79	4	79	80	1

(b) ESTHETICS:
Upper facial ratio: 43.6% to 44.5%
Lower facial ratio: 52.1% to 57.4%
Maxillary ratio: 43.1% to 36.3%
Total maxillary ratio: 23.4% to 19.8%
Mandibular ratio: 62.7% to 69%
Total mandibular ratio: 34% to 37.6%
Maxillo mandibular ratio: 68.7% to 52.6%

The therapy was ended with molars in Class I molar and skeletal relation. A good occlusal interdigitation was achieved to attain a stable result.

In the present case the lower facial height was restored and the convexity of the soft tissue profile was corrected as planned (Figure 6A, 6B). The planned distraction distance and vector was obtained. The patient did not experience pseudoarthrosis, nerve injury, tooth damage, persistent pain and discomfort or infection. The pre- and post- distraction PA cephalometric measurements are described in Table 1. The superimpositions of the pre- and post-distraction PA cephalogram are illustrated. (Figure7). The patient was followed for 2 years and negligible relapse was noted.

DISCUSSION

Various parameters are necessary for the success of osteodistraction. Preservation of osteogenic tissues during osteotomy as periosteum, nutrient artery, bone marrow is equally important in new bone formation. Latency period is the time from surgery to when the distraction force is applied. This will allow the formation of fibro-vascular bridge. This period is clinically age dependent. In young patients or minimal surgical trauma 2 to 5 days is sufficient. In older patients or increased surgical trauma 7 to 14 days may be required. Rate of distraction less than 0.5mm per day would result in premature ossification. Whereas, more than 1.5mm per day would result in local ischemia in the regenerative zone and delayed ossification or pseudoarthrosis may result. Thus, 1mm per day is recommended. Rhythm of distraction is the number of distraction events per day. Continuous distraction rate is ideal, as maximal new capillary and bone synthesis would occur. A rhythm of four times a day (0.25mm) or twice a day (0.5mm) is clinically acceptable. The fixator frame should be stable enough to

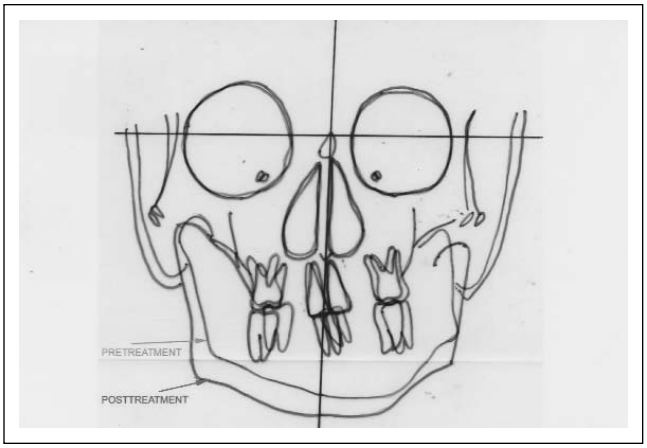

Figure 7. Superimposition of the PA cephalograms of the patient.

support the newly formed micro columns of bone. Bending or shearing of micro columns result in fracture with local hemorrhage and production of fibrocartilage. Consolidation period is required when the distraction device is left in place for maturation and remodeling of the new bone. Usually it is 4 to 6 weeks.[12]

Various advantages of mandibular distraction have been propagated by advocators of distraction,[13] namely simultaneous soft tissue expansion with improvement in neuromuscular function, less invasive procedure and ability to be performed at early age.

Potential limitations of distraction include: pin site infection, which may require its premature removal, nerve and tooth bud injuries, and the control bite occlusion that is still not precise at present. Also, the extraoral scar may result due to pinching the skin prior to pin placement. The scar usually evolves with time. If necessary, scar revision can be performed.[14]

The distractors can be internal or external. Advantages of external devices include ease of placement and removal. In addition, some external devices allow multi-dimensional control. External devices, however, are very conspicuous and are more likely to cause traction scars than internal devices. Internal devices are less visible than external devices, and directly transmit force to the bone. Internal devices require a subsequent surgical procedure for removal.[15] The orthopedic distractors used in the present case satisfactorily distracted the mandible and corrected the facial asymmetry. The success in its use is though limited, but very promising, especially when the elongation is needed in a single horizontal vector. This can thus form an alternative in the treatment especially in the third world countries where sophisticated and expensive treatment is unaffordable.

Orthodontic treatment should be initiated before the distraction, with functional appliances, as the muscle tissues need a longer time to adapt to a new length than bony tissue; during distraction (bite blocks, elastics); as well as post distraction (functional appliances, full orthodontic treatment) to help in bony retention and continue the adaptation of the neuromuscular system.[4,6,8]

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