Technical Note

The use of mandibular body distraction in hemifacial microsomia

Access this article online
Website:
www.amsjournal.com
DOI:
10.4103/2231-0746.119211
Quick Response Code:

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ABSTRACT

Objective: The goals of treatment for hemifacial microsomia include horizontalization of occlusal plane and acquisition of facial symmetry. Although horizontalization of occlusal plane can be easily achieved, facial symmetry, particularly in relation to mandibular contour, can be difficult to attain. Soft tissue is generally reconstructed to correct facial asymmetry, and no studies have described correction of facial asymmetry through skeletal reconstruction. **Case:** A 12-year-old girl presented with grade IIb right-sided hemifacial microsomia. She was treated using Nakajima's angle-variable internal distraction (NAVID) system for mandibular body distraction. **Results:** Following treatment, appropriate facial symmetry was achieved, and the patient was extremely satisfied with the results. **Conclusions:** Thus, we successfully treated the present patient by our novel method involving distraction osteogenesis. This method was effective and useful for several reasons including; the changes were not accompanied by postoperative tissue absorption, donor sites were not involved, and the treatment outcome could be reevaluated by adjusting distraction while the patient's appearance was being remodeled.

Keywords: Distraction osteogenesis, hemifacial microsomia, mandibular body distraction, mentular distraction

INTRODUCTION

Hemifacial microsomia is a common congenital soft tissue and skeletal craniofacial deformity caused by hypoplasia of the first and second branchial arches.[1] Mandibular hypoplasia is the most obvious skeletal manifestation associated with this deformity. To correct defects of occlusal plane and temporomaxillary junction, Le Fort I osteotomy and distraction of mandibular ramus are performed. However, marked mandibular hypoplasia is often noted on the affected side after operation. In cases of minor mandibular hypoplasia, reconstruction of soft tissue alone may be sufficient to correct the deformity. However, in more severe cases of mandibular hypoplasia, skeletal reconstruction followed by soft tissue reconstruction should be performed to achieve appropriate facial symmetry.

In this report, we describe the use of a new internal distraction device, Nakajima's angle-variable internal distraction (NAVID) system [Figure 1], for mandibular body distraction following maxillary driven simultaneous maxillomandibular distraction.[2] We discuss the system's efficacy in improving mandibular contour of a 12-year-old girl with grade IIb right-sided hemifacial microsomia.

CASE REPORT

A 12-year-old girl presented with grade IIb right-sided hemifacial microsomia. She had already undergone right ear reconstruction for microtia and maxillary driven simultaneous maxillomandibular distraction[2] [Figure 2].

We initially performed a computer-simulated surgery using image processing software (Mimics, Materialise NV, Leuven, Belgium) and a substance model (Kezulex, Ono and Co., Ltd, Tokyo, Japan) as a preoperative simulation. We planned the osteotomy lines to avoid damaging the nerve pathway.

The simulation of surgery indicated that mandibular body on the affected side should be distracted 15 mm to the anterior and 10 mm inferiorly to improve facial symmetry. We proceeded with the surgery based on simulation [Figure 3].

The procedure was performed under general anesthesia with nasotracheal intubation. Incisions were made along the mandibular rim and at the base of gingivolabial groove of canine tooth on right side to canine tooth on left side. Mucoperiosteal detachment was performed from the chin region to mandibular body while avoiding damage to mentonian nerve. The muscle insertion on the mandible's internal cortical bone was preserved to ensure vascularization of osteotomized segment, thus retaining effective traction of genioglossus muscle.

Following these incisions, an osteotomy was performed according to preoperative simulation. Thereafter, two sets of the three-dimensional NAVID system were fixed to ramus and free mandible on the affected side. The front of the system was equipped with a distraction vector in inferior direction, and the rear of the system was equipped with a distraction vector in anterior direction [Figure 3]. The rods of the system were inserted through a small skin incision at the mentum, and hinge plate was attached on unaffected side and served as a pivot point for rotation. The wound was then closed.

After 7 days, the distraction was initiated at a rate of 1 mm per day. This process was continued until desired clinical endpoints were achieved; the process is summarized in Figure 4.

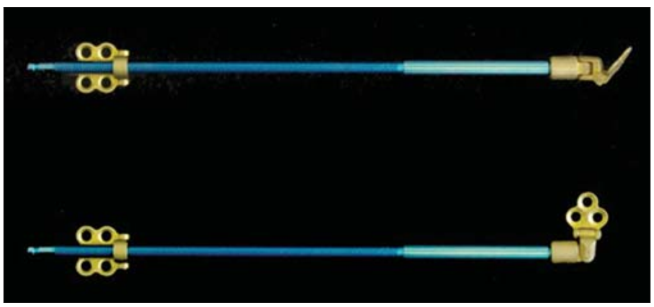

Figure 1: Nakajima's angle-variable internal distraction system: A variable angle internal distraction device

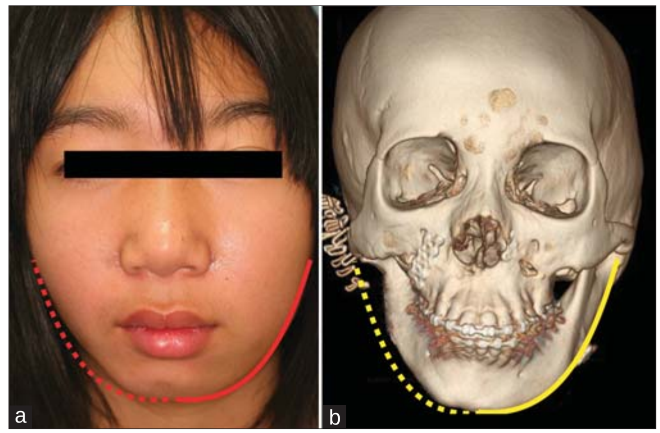

Figure 2: The 12-year-old girl with type IIb right-sided hemifacial microsomia, (a) Frontal view. The dashed red line is a reflected image of solid red line of unaffected side and indicates asymmetry of mandibular contour, (b) Computed tomography (CT) image. The dashed yellow line is a reflected image of solid yellow line of unaffected side

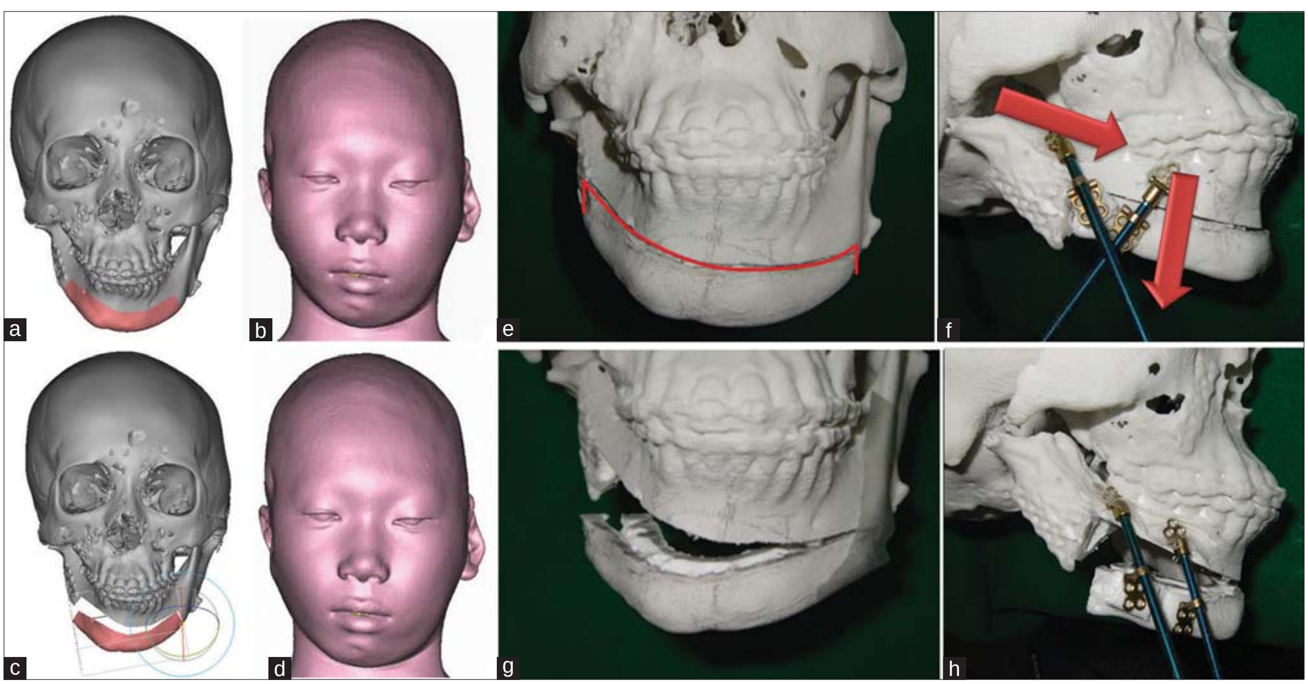

Figure 3: Pre- and postoperative computer simulations (a, b) Preoperative computer-simulated images, (c, d) Postoperative computer-simulated images. The symmetry of facial soft tissue can be improved by distraction of mandibular body, (e, f) Preoperative images of the substance model simulation. The red line indicates osteotomy line, and the red arrows indicate distraction direction of each device, (g, h) Postoperative image of substance model simulation

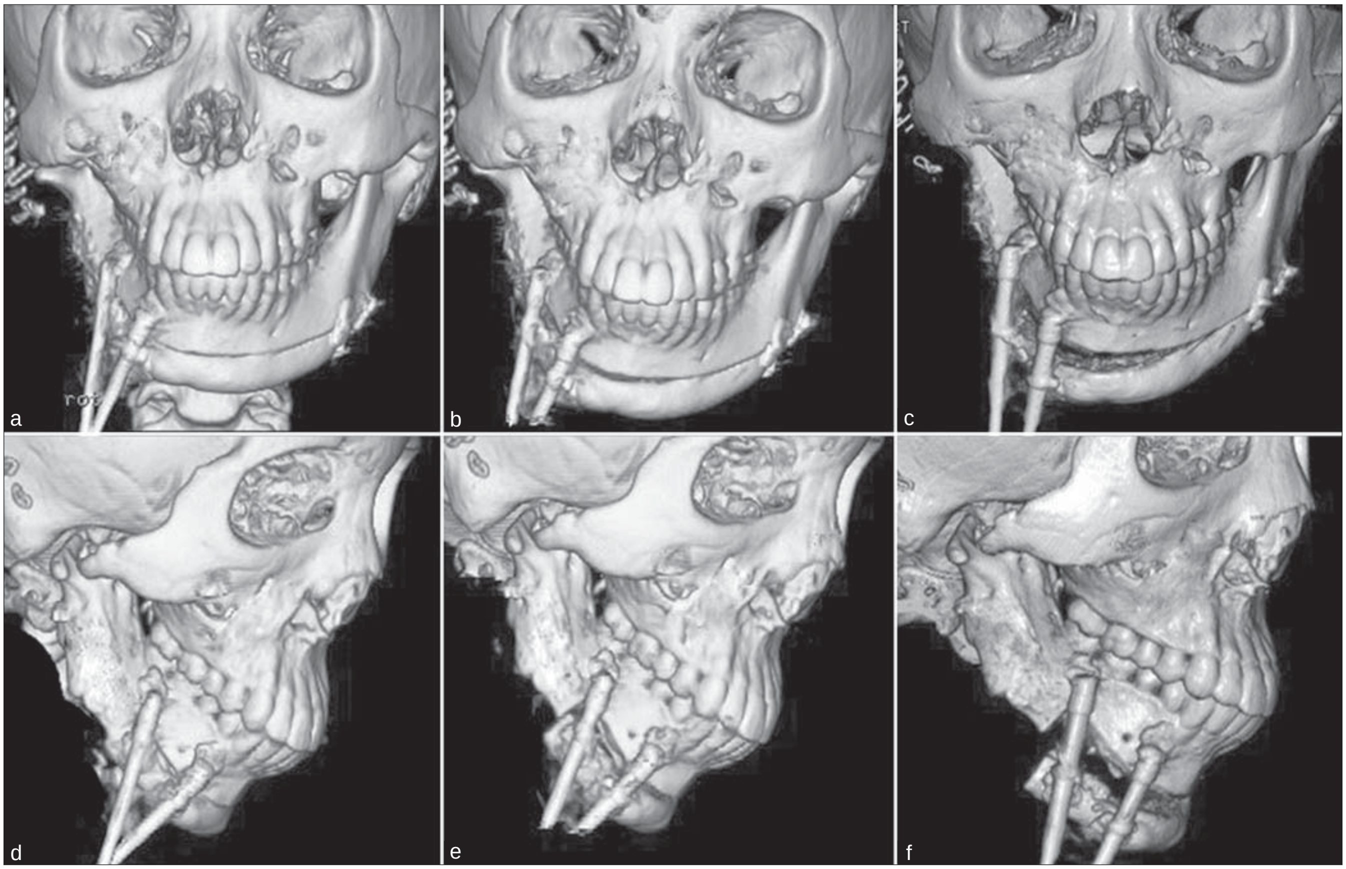

Figure 4: CT images during the distraction period. Note the altered crossing angle of two devices due to neck movement of NAVID system in three dimensions (a, b) Immediately prior to the distraction, (c,d,e) During distraction, (f) Immediately after distraction

Figure 5: The patient's facial contour 6 months after removing the device

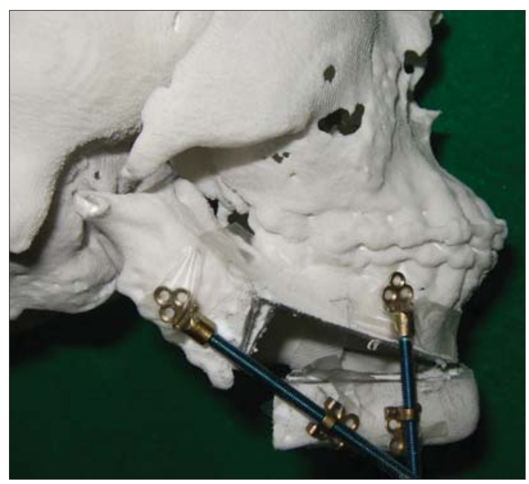

Figure 6: Another simulation showing device attachment

As the distraction continued, there was a change in the angle at which two devices crossed and free mandible extended towards the anterior direction and inferiorly because neck of NAVID system could move in three dimensions. Towards the end of distraction period, we performed a 15 mm distraction with frontal device and a 22 mm distraction with rear device.

When the distraction was completed, externally exposed rods were cut in very close proximity to the skin. After a 3-month consolidation period, the devices were removed under general anesthesia. Both the intraoperative view and preoperative computed tomography (CT) image indicated presence of osteogenesis, and showed a symmetrical improvement of mandibular contour compared with preoperative profile [Figure 5].

DISCUSSION

At present, distraction osteogenesis is an irreplaceable part of surgical armamentarium, and it is used by plastic surgeons to correct craniofacial deformities such as hemifacial microsomia.[3-6]

Although many reports in the literature have described improvement of occlusal plane through osteotomy and distraction, no reports have described skeletal reconstruction for correcting mandibular asymmetry.

According to the surgical simulation, a 1-stage reconstruction required a significant amount of bone grafting; however, there were limitations associated with donor sites. Although a prosthetic device, such as Medpor®, would have avoided donor site morbidity, infections and deviations are associated with prosthetic use. Therefore, we chose the distraction technique. The merits of this method not only relate to donor site morbidity, but also relate to the fact that goal of correction can be reevaluated while facial symmetry is being acquired. A point that should be emphasized is that the device should be attached as shown in Figure 6 to further push the mandibular body forward.

Furthermore, the NAVID system is cosmetically more acceptable to patients because the rods can be cut after distraction period, and because it is not externally visible during consolidation period. Patients can thus tolerate a long consolidation period.

Although we have only investigated one case, we consider that treatment of hemifacial microsomia by mandibular body distraction using NAVID system can be successful and yield excellent cosmetic results. We believe that lack of soft tissue makes skeletal symmetry difficult to attain, leading to adverse effects associated with volume adjustment after reconstruction using free flaps. It appears that only fat or hyaluronic acid injections can achieve contour symmetry.

In conclusion, mandibular body distraction is an efficient and reliable treatment for hemifacial microsomia that achieves facial symmetry.

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Cite this article as: Sakamoto Y, Nakajima H, Ogata H, Kishi K. The use of mandibular body distraction in hemifacial microsomia. Ann Maxillofac Surg 2013;3:178-81

Source of Support: Nil, **Conflict of Interest**: None declared.