

Surgical Correction of Unilateral Nasal Bony Deformity Using Nasal Septum Cartilage Following Treatment for Naso-orbital-ethmoid Fractures: A Case Report

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Naso-orbital-ethmoid (NOE) fracture is relatively common in midfacial regions, but management remains challenging. Here we report a novel technique using nasal septal cartilage to correct para-nasal soft tissue asymmetry in a 17-year-old Japanese male 6 months after surgical treatment of fractures in the NOE complex. An otorhinolaryngologist harvested the septal cartilage during nasal septoplasty to correct a deviated septum that was planned to coincide with removal of the plates 6 months after the primary surgery. The maxillofacial surgeons then grafted the septal cartilage into the concave area in the right para-nasal region and fixed it with a bioresorbable screw after removal of the right plate via a transconjunctival approach. The postoperative course was uneventful and the patient was satisfied with the cosmetic outcome after 9 months postoperatively. Septal cartilage could be an effective grafting material for correction of postoperative midfacial concave deformity following repair of an NOE fracture.

Keywords: naso-orbital-ethmoid fracture, open reduction and internal fixation, midface fracture, nasal septal cartilage, septoplasty

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INTRODUCTION

Naso-orbital-ethmoid (NOE) fractures are fractures that occur in the midface area, at the confluence of the nose, orbits, ethmoid and frontal sinuses, and floor of the anterior cranial base. These facial fractures are common because of the exposed position and thin bony walls of the midface area, and they are frequently encountered by oral and maxillofacial surgeons [1, 2]. Treatment of an NOE fracture is challenging and requires a thorough knowledge of central midfacial anatomy and surgical technique, as well as access to specific tools, to obtain optimal restoration of esthetic form and function [3, 4].

If not correctly diagnosed and treated, these fractures may have serious complications, including morphologic disharmony affecting the midface and functional deficits such as diplopia, enophthalmos, restriction of eyeball mobility, disturbance of sensory innervation, and reduced globe motility [5, 6].

Secondary or late reconstruction surgery in a patient with an NOE fracture is more difficult than the primary treatment [7], so early evaluation using computed tomography (CT) is important when such an injury is first suspected [3]. However, even if an NOE fracture is correctly diagnosed and appropriately treated using state-of-the-art surgical instrumentation, we occasionally encounter patients who require further surgery to improve morphologic disharmony in the midface and to treat functional disturbance at the skeletal and/or soft tissue level.

Here we report on use of a novel secondary surgical correction technique that included augmentation of the para-nasal soft tissue using septal cartilage as a grafting material in a patient with facial asymme-

try following repair of fractures in the NOE complex

CASE REPORT

A 17-year-old Japanese male was referred to the Department of Oral and Maxillofacial Surgery from the Emergency and Critical Care Center at our institution with complaints of periorbital pain, epistaxis, diplopia, and acute throbbing pain following an accident while playing baseball. He was noted to have a right midfacial concave deformity (Fig. 1A). His sensorium was grossly intact, vital signs were stable, and there were no abnormal neurological findings. Physical examination revealed an upper eyelid abrasion, ecchymosis, epistaxis with nasal deviation and deformation, and periorbital edema in the right eye, with diplopia and limited upgaze. Examination by an ophthalmologist revealed limited eye movement and double vision in the right eye but no retinal breaks or bleeds. Radiographic evaluation including CT revealed fractures of the nasal and ethmoid bones and of the right orbit. The clinical diagnosis was Markowitz type II NOE fracture with deviation of the nasal septum (Fig. 1B-1D).

Six days later, we put him under general anes-

thesia with intraoral intubation and then performed open reduction and internal fixation of the severely displaced bony segments and orbital reconstruction surgery using a navigation system with the assistance of an otorhinolaryngologist. The maxillofacial surgery was performed first. This involved open reduction of the NOE fracture segments via transconjunctival and intraoral vestibular incisions and stable fixation of the segments using titanium miniplates (MatrixMidface®, DePuy Synthes CMF, West Chester, PA) together with reconstruction of the orbital floor using a bioactive/bioresorbable osteoconductive sheet with tacks (C.I. Takiron Corp., Osaka, Japan) for fixation of the orbital wall defect (Fig. 2A-2C). An intraoperative navigation system (BrainLab, Feldkirchen, Germany) was used to confirm reduction and fixation of the NOE bony segments and to determine accurate reconstruction of the orbital wall, as reported previously [4]. The otorhinolaryngologist then performed the closed reduction for the severely displaced nasal bone (Fig. 2D, 2E).

Postoperatively, there was prompt symptomatic improvement and no limitation of eye movement or diplopia in any direction of gaze during 7 days of hospitalization. The postoperative clinical course was uneventful. Progressive bone healing with union of

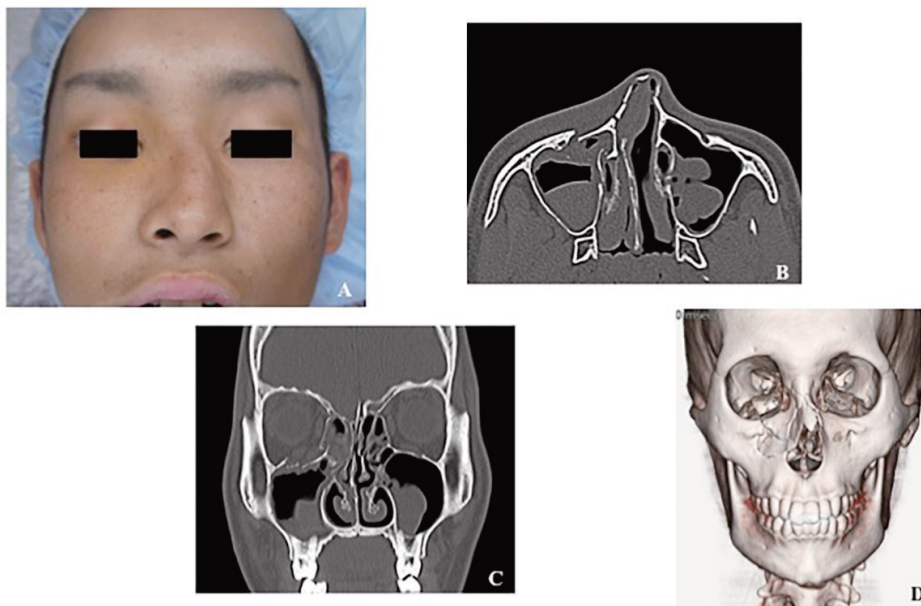


Fig. 1. (A) Preoperative photograph of the face showing a right midfacial concave deformity subsequent to comminuted fractures in the naso-orbital-ethmoid complex. (B, C) Preoperative computed tomographic images of the face (B, axial view; C, coronal view) showing the naso-orbital-ethmoid fractures. (D) The aforementioned fractures as seen on three-dimensional computed tomography.



Fig. 2. (A) Intraoperative image showing reconstruction of the naso-orbital-ethmoid segments via an intraoral approach. (B) Reconstruction of the floor and medial wall orbital fractures using a bioresorbable mesh plate (Super-Fixsorb MX[®], Takiron Co., Ltd., Osaka, Japan). The mesh is secured with bioresorbable screws at the infraorbital rim. (C) The metal plate fixation of the para-nasal buttress. (D) Closed reduction for the nasal-ethmoid bone performed by an otorhinolaryngologist. (E) Postoperative facial photograph showing symmetry obtained by nasal bone reduction.

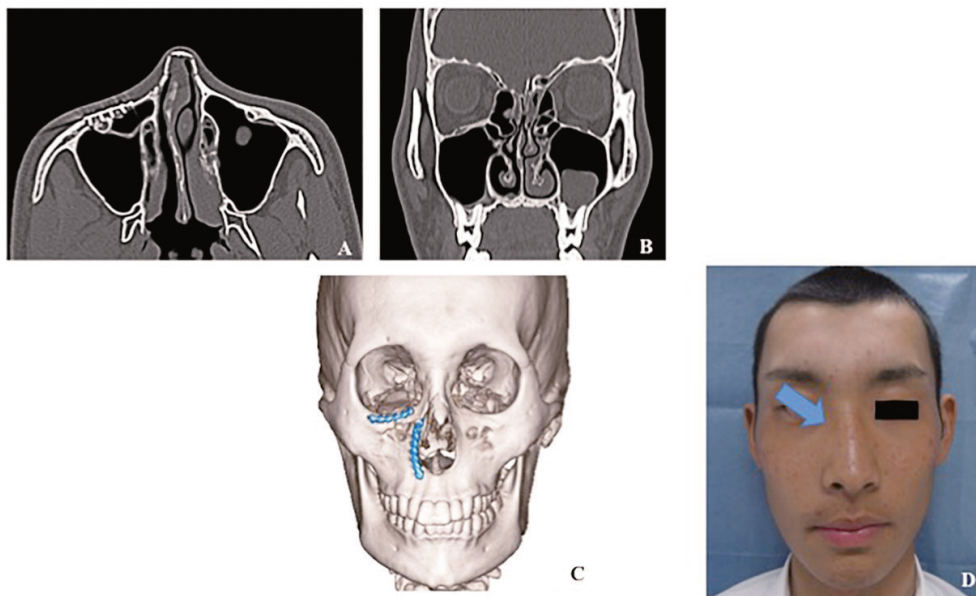


Fig. 3. (A-C) Computed tomographic images taken 6 months after the initial surgery. (A, axial view; B, coronal view; C, three-dimensional view). (D) Photograph of the face.

the NOE segments and successful orbital reconstruction were confirmed by follow-up radiographic examinations in the 6 months after surgery (Fig. 3A-3C). However, although the nasal bony roof was

adequately reduced at this time, the patient's para-nasal soft tissue remained asymmetric and he also complained some sensation of nasal obstruction in the right nose after the fracture (Fig. 3D). Then,

his family wanted him to undergo soft tissue augmentation surgery to correct the concavity in the para-nasal region and treat his nasal obstruction. In the meantime, otorhinolaryngology consultation noted a deviated nasal septum that had been noticed at the time of the primary surgery. A corrective para-nasal soft tissue augmentation was suggested, using septal cartilage harvested during an endoscopically assisted septoplasty as the graft material. This corrective procedure was planned in advance to take place at the same time as removal of the titanium miniplates at 6 months after the original surgery to repair the NOE fractures. Informed consent was obtained from

the patient and his family.

With the patient under general anesthesia via intraoral intubation, the otorhinolaryngologist performed a conventional nasal septoplasty and resected the septal cartilage together with the submucosal turbinectomy of right inferior nasal concha under endoscopic guidance (Fig. 4A, 4B). The maxillofacial surgeons then grafted the harvested septal cartilage into the concave area of the right para-nasal region, from the upper piriform aperture to the nasal root, and fixed the cartilage in position using a bioresorbable screw (Biomet Inc., Jacksonville, FL) after removal of the titanium miniplate via a transconjuncti-

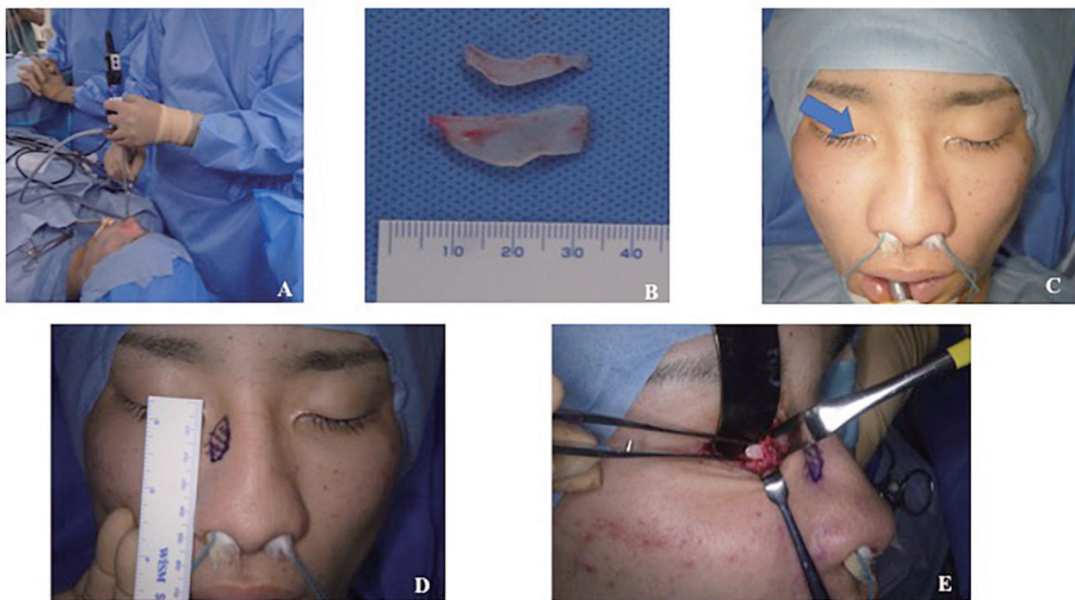


Fig. 4. (A, B) Septoplasty for the deviated nasal septum performed under endoscopic guidance by an otorhinolaryngologist. (C) Preoperative midfacial photograph showing excavation of the nasal root. (D) Design of the nasal root excavation area. (E) Grafting of nasal septal cartilage into the concave area.



Fig. 5. (A) Postoperative photograph of the face showing good symmetry and a successful postoperative course at 6 months. (B, C) Six-month postoperative computed tomographic images (B, axial view; C, coronal view).

val approach (Fig. 4C-4E). The other miniplate was removed via an intraoral vestibular incision.

Following an uneventful immediate postoperative course, the patient was discharged home the day after surgery. He made an uneventful recovery and his pre-accident maxillofacial function and facial appearance were completely restored. After 9 months postoperatively, he has been satisfied with his cosmetic outcome (Fig. 5A-5C).

DISCUSSION

Several surgical augmentation techniques can be used to correct a defect in the NOE complex. Among these, cartilage grafting is a more viable option. Surgeons need to weigh concerns about nasal growth in the longer term and consider other potential options, such as resorbable plates or even delaying rhinoplasty until the patient is older, before concluding that using a septal graft is the best long-term solution [8]. Other variables, such as the nasal shape, surgical technique, and possible repositioning of the septum after harvesting of the septal cartilage may influence the results.

Several materials can be used to reconstruct the defect, including an autograft, allograft, xenograft, resorbable plate, and metallic alloplastic bone substitute, all of which are gaining in popularity because of their clinical effectiveness and usefulness [9, 10]. Bone grafts have some disadvantages, such as a variable degree of resorption and donor site morbidity. The advantages of autogenous bone are its relative resistance to infection, incorporation into new bone by the host, lack of a host response to the graft, and no need for concern over late extrusion [3, 10]. Multiple useful donor sites for autogenous grafts have been reported, including the anterior iliac crest, ribs, mandibular symphysis, coronoid process, and nasal septum [10, 11]. The potential disadvantages of autogenous bone grafting include donor site morbidity, characterized by nerve and blood vessel injuries, chronic donor site pain, gait disturbance, and cosmetic disturbance in another surgical field [12, 13].

Preliminary clinical reports have suggested that using septal cartilage as a grafting material may offer better support and improve the long-term results

[14, 15]. Septoplasty is one of the most commonly performed procedures in otorhinolaryngology and is a well-established treatment for nasal obstruction. Septoplasty has traditionally been performed under direct visualization with a headlight [15]. However, endoscopic septoplasty was introduced in the 1990s [16] and has become very popular. Endoscopy allows for better visualization and magnification and permits precise handling [15, 17].

In many cases, harvesting of septal cartilage as a grafting material would not be necessary for treatment of a fracture in the NOE complex, however, our patient had a deviated nasal septum prior to sustaining his NOE injuries. The potential disadvantages of using septal cartilage as the bone donor site could be persistent nasal obstruction, bleeding, septal hematoma, and septal perforation. Consequently, long-term follow-up of the septal cartilage donor site by an otorhinolaryngologist would be needed [17].

We also used a bioresorbable screw for fixation of the segment of cartilage. Absorbable implants do not require removal or produce artifacts on postoperative CT scans or three-dimensional CT images, permitting excellent analysis of the postoperative outcome [3, 18]. Resorbable materials may be more reliable for reconstruction of the orbit [9]. When used in the maxilla and orbital floor, biodegradable materials are associated with a 5%-10% incidence of mild foreign body reaction [3, 10]. These reactions are the second most common complications when comparing all classes of orbital implant materials, so these materials should be used with caution [9]. Safer biodegradable implant materials are being developed, and the limited clinical literature available suggests that good results can be achieved by experienced maxillofacial surgeons [18].

Our experience with this patient suggests that use of septal cartilage harvested by an otorhinolaryngologist as a graft for reconstruction after NOE fracture is feasible. A septal cartilage graft may be useful for reconstruction of a postoperative midfacial concave deformity.

DECLARATIONS

Conflicts of interest
None

ETHICS STATEMENT

/confirmation of patient permission

Informed consent was obtained from the patient and his family.

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