Nasal Base Skeleton Augmentation in Binder and Binder Like Deformity

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ABSTRACT

Premaxillary hypoplasia is commonly associated with cleft lip deformities, postraumatic defects, and Binder syndrome. In the more localized form, with retrusion limited to the premaxilla or around the pyriform aperture, premaxillary augmentation as an adjunct to rhinoplasty is sufficient. There are many surgical techniques reported for the correction of the premaxillary depression, making use of either autografts or allografts. This study evaluated the correction of the nasal and premaxillary areas in six patients with single rib bone and costal cartilage combination graft. A technique described to maximize the use of the graft for dorsal nasal augmentation, columellar lengthening, and premaxillary augmentation.

Patients and surgical technique: Six patients with Binder’s syndrome and Binder like deformity treated by the author from 2004 to 2010 and followed-up for at least 6 months. All cases presented for rhinoplasty. None of the patients presented with class III malocclusion. The detail of surgical technique is described in four steps.

Results: Four females and two males were treated using this technique. The patients were 16-22 years of age (mean, 18.7 years), while the follow-up period ranged from 7 months to 7 years (mean, 24 months). During the follow-up period no complications were recorded. Two cases developed paraesthesia, numbness and sense of tightness in the upper lip and over the malar area resolved spontaneously within three months. All patients were satisfied by the results achieved.

Conclusion: Rib bone and cartilage is a suitable material for both premaxillary and nasal augmentation in cases of Binder’s syndrome and Binder like deformity due to its amount, thickness, easily modifiable, and with low infection and extrusion rates. There are a few possible disadvantages to this procedure.

INTRODUCTION

The premaxilla, one of the cranial bones, is found between the two maxillary incisor fissures. It plays an important role in the palatine closure during facial development, is closely related to the development of the nasal septum and acts as a stabilizing element within the facial skull [1]. A congenital hypoplasia of the premaxilla engenders inadequate projection of this area in adulthood. This condition is accompanied by certain characteristic features, including an acute nasolabial angle, nasal tip ptosis, and, to a lesser extent, incompetence of the labia at rest. The defect is more frequent in certain ethnic groups, including African-American, Asian, and certain Latino populations, but may also be seen occasionally in the Caucasian community [2]. In addition, premaxillary hypoplasia is commonly associated with cleft lip deformities, postraumatic defects, and Binder syndrome [3]. The essential features of maxilla-nasal dysplasia were initially described by Noyes [4] and was described as a “dish face” by Allan Ragnell and by Binder 10 years later [5,6]. The deformity in Binder syndrome is structural, with inhibition of bone growth, especially in the subnasal area, where small excavations are found on each side of the retruded nasal spine [7]. Hypoplasia in the area of the alar-facial junction may also occur and was defined by Byrd and Hobar as a deficiency of the nasal base skeleton. This deficiency results in ptosis and a diminished projection of the nasal tip, with an acute columella-labial angle, an edentulous appearance with deepening of facial folds and posterior displacement of the alar base in relation to the cheek [8]. There is clinical evidence which suggests that the nasal profile may change secondary to underlying bony remodeling [9], and that facial appearance is largely determined by the morphology and relative prominence of areas of the underlying skeleton. Accordingly, surgical augmentation of the skeleton significantly enhances a person’s facial appearance and provides a more youthful look [10]. Several authors have proposed various modalities for the correction of premaxillary retrusion [3]. In cases exhibiting retrusion of the whole maxilla, or class III malocclusion, a Le Forte I osteotomy is indicated to move the entire maxilla forward and/or orthodontic therapy, preferably before midfacial reconstruction [7]. However, in the more localized form, with retrusion limited to
the premaxilla or around the pyriform aperture, premaxillary augmentation as an adjunct to rhinoplasty is sufficient \(^{11,12}\). There are many surgical techniques reported for the correction of the premaxillary depression, making use of either autografts or allografts. Surgeons have performed premaxillary augmentation using Proplast implants, sialastic implants, Mersilene mesh or bony segments obtained from an autologous mandible \(^{2,11-13}\). There many advantages to the above procedures, including predictable results, ease and accuracy. Various complications have been reported including extrusion and displacement of the implant, wound infection or wound disruption, as well as sense of reduced lip mobility \(^{14}\). In the present study, we evaluate the correction of the nasal and premaxillary areas in six patients with Binder and Binder like deformities with single rib bone and costal cartilage combination graft. We also describe a technique to maximize the use of the graft for dorsal nasal augmentation, columellar lengthening, and premaxillary augmentation.

**PATIENTS AND METHODS**

Our study is based on 6 patients with Binder's syndrome and Binder like deformity treated by the author in Bani Suef University Hospital and in the private practice from 2004 to 2010 and followed-up for at least 6 months. All cases presented for rhinoplasty. Physical examination findings included midfacial hypoplasia, flattened nose, short columnella with acute nasolabial angle, and retrusion limited to the premaxilla and around the pyriform aperture. None of the patients presented with class III malocclusion (according to Angle \(^{18}\)) requiring maxillary advancement by Le Forte osteotomies but all of them finished their orthodontic treatment before. After examination drawings for the grafts needed with exact measures and shapes were done. Preoperative and postoperative photographs in standard positions were taken. Before the operation, we listened carefully to the patient's request, and we obtained informed consent after explaining the risks and possible outcomes of the operation.

**Surgical technique:**

The procedures were performed under general anesthesia with systemic antibiotic coverage in 4 steps:

**First step: The anterior segment of the sixth rib bone and costal cartilage harvesting:**

The Grafts were harvested from the right side of the chest through a small submammary incision in females and a lower transverse incision over the rib in males. When harvesting the rib graft careful dissection allowed preservation of the superficial surface periosteum but the periosteum on the deep surface of the rib was not included in the graft as this would have increased the risk of a pleural tear. The costal cartilage was included with the rib bone and dissected free on a side table. The wound was closed in layers after meticulous hemostasis.

**Second step: Grafts preparation according to preoperative measurements:**

The bone graft: We cut the upper 3 mm of the sharp edge of the rib with osteotome and this part was used to augment the dorsal bony part of the nose. The rib after that was splitted to get two pieces (Fig. 1). The convex piece with the overlying superficial periosteum was used to augment the premaxilla. While the concave part cut in two quadrangular pieces to augment the paranasal areas (Fig. 2).

The cartilage graft: The dorsal cartilaginous augmentation graft and the columellar lengthening graft were carved from the central part of the costal cartilage and were dipped in 0.9% NaCl and gentamicin solution for 30 minutes. A long thin strip from the cartilage was taken and diced properly to be laid over the bony and cartilaginous dorsal augmentation grafts. Spreader grafts were also prepared if needed from the outer parts of cartilage graft.

**Third step: Premaxillary augmentation:**

Through an oral vestibular approach dissection proceeded in the subperiosteal plane creating periosteal flap tunnels to insert the grafts needed. The dissection in the midline reached the nasal spine, while in the paramedian plane dissection was advanced to below the nasal alae and the paranasal area where the quadrangular bony grafts were inserted to augment the paranasal areas. The lateral dissection extended just behind the nasolabial folds to accommodate the transverse rib graft with the convexity outwards. No fixing sutures were needed since the tunnels were adequately designed to tightly secure the graft materials. The wound was closed in layers with interrupted absorbable sutures.

**Fourth step: Open augmentation rhinoplasty:**

Open rhinoplasty through V-shaped columellar incision was done. Subperiosteal tunnel dissected over the bony vault and rasping of the dorsum was done, a non-absorbable monofilament stitch was passed through the glabella and in the tunnel to be secured in the cephalic end of the dorsal bone graft to come out again through the glabella. The overlay bone graft was secured in place over the previously...
rasped area, and the non-absorbable monofilament stitch was tied over gauze from outside. Another dorsal cartilaginous graft is secured over the cartilaginous septum with absorbable suture and to the bone graft with non-absorbable suture while the caudal end is sutured to the columnellar lengthening strut inserted between the medial crura of the lower cartilage and supported with two transfixing absorbable sutures. A long segment of thin diced cartilage graft is laid over the whole dorsum and continued caudally over the tip area as a shield graft. External nasal splint was applied and secured over the dorsum of the nose with tape.

In the postoperative period the patients were instructed to minimize talking or laughing and were maintained on semisolids diet for one week. After two weeks the stitch over the gauze in the glabella was removed, while the external splint was kept for one month.

RESULTS

Six patients, including four females and two males were treated using this technique. Two patients had Binder’s syndrome, two patients had previously repaired bilateral complete cleft lip and palate treated at the age of two years old, one case had previously treated unilateral complete cleft lip and palate treated at the age of two years old and she did closed rhinoplasty at the age of 16 years old. The sixth case had trauma three years ago and did not receive any treatment and developed a post-traumatic Binder like deformity (Table 1). The patients were 16-22 years of age (mean, 18.7 years), while the follow-up period ranged from 7 months to 7 years (mean, 24 months). All patients finished their orthodontic treatment before the operation and none of them presented with severe degree of malocclusion indicated for Le Forte osteotomies. There were no intraoperative complications and during the follow-up period no complications were recorded in the form of infection, displacement, warping of the cartilage, or donor site morbidity. Two cases developed parasthesia, numbness and sense of tightness in the upper lip and over the malar area resolved spontaneously within three months. All patients were satisfied by the results achieved (Fig. 3 A,B). The degree of augmentation was maintained, and clinically there were no evidence of major graft resorption or warping necessitating reoperation (Fig. 4 A,B,C,D). The scar in the columella and over the donor site was accepted by all patients, especially after six month postoperatively (Fig. 5 A,B).

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Table (1): Patient Data.
Fig. (1): The bony segment of the rib after splitting.

Fig. (2): The parts of the bone in places to be implanted.

Fig. (3): Male patient, 20 years old with binder like deformity after bilateral complete cleft repaired during childhood. (A) Preoperative lateral view. (B) Early postoperative lateral view.

Fig. (4): Female patient, 18 years old with Binder’s syndrome. (A) Lateral preoperative view. (B) Front preoperative view. (C) Lateral postoperative view after 6 years. (D) Front postoperative view after 6 years.
Fig. (5): Female patient, 19 years old with Binder's syndrome. (A) Basal view, preoperative. (B) Basal view, late postoperative.

Fig. (6): Same patient in Fig. (5). (A) Front preoperative view. (B) Lateral preoperative view. (C) Front postoperative view after 3 years. (D) Lateral postoperative view after 3 years.
DISCUSSION

The unique form of the projection of the face determines the extent of a person’s attractiveness [16]. Accordingly, the aesthetic outcome is ultimately determined by the facial soft tissue being well supported by a skeletal foundation [10]. In Binder’s syndrome and Binder like deformities the hypoplasia of the nasal floor and adjacent part of the maxilla mainly due to a deficient horizontal growth of the maxilla produces the characteristic anomaly and the flat nose [17]. In such cases premaxillary augmentation is necessary to correct the acute nasolabial angle, forward advancement of the nasolabial junction, and restore the nasal tip support to allow adjustment of the under projected nose [11]. Even in its mild, more common form, premaxillary recession can have a negative impact on the facial and nasal appearance. Correcting it by augmentation of the nasal spine and alar base areas produces a subtle but noticeable aesthetic improvement [2].

There are many surgical techniques reported for the correction of premaxillary recession, making use of either autografts or allografts [14]. Many types of implants have been recommended for premaxillary augmentation. Sialastic was one of the first implants to be used in the premaxilla [18]. However, because of its smooth surface it does not adhere to the surrounding tissues and thus is associated with a high incidence of migration and extrusion [2]. Proplast [19] and Gore-Tex® [20] are highly porous inviting early tissue ingrowths and stabilization. Although these implants provide good success, they are more difficult to carve, shape, and insert. They leave the patient with a rigid unnatural feeling from the solid implant. These implants, as well as Mersilene mesh [11], if infected removal is very difficult [2,12,21]. The use of hydroxyapatite has also been described [10], but the granular form of the implant makes it susceptible to compression forces, thus failing to provide adequate structural support at the premaxilla. While in its dense form, hydroxyapatite is difficult to shape [12]. Despite many advantages of these procedures, their higher success rates are limited to the premaxillary region augmentation. The problem in Binder’s syndrome and Binder like deformity affects different planes, tissues, and vectors. Thus, using different materials, with different behaviors, to augment the maxilla and nose will eventually lead to long-term asymmetrical results. This made us consider autologous tissue grafts, which have low rejection and infection rate with the same long-term behavior. Bone and cartilage grafts have been traditionally used to straighten out the maxillonasal hypoplasia. Ragnell described the application of iliac cancellous onlay bone chips to the anterior surface of the maxilla through median incision at the columellar base [22]. Converse used the oral vestibular approach to insert a shell-like segment of iliac bone [23]. Later he proposed using an L-shaped bone graft to reconstruct the dorsum of the nose and the shortened columella [24]. To raise the nasal contour, Holmström [25] as well as Losken [26] and Rune [27] later on used L-shaped bone grafts taken from iliac and skull, respectively. They also augmented the premaxillary region with bone chips [25] or a U-shaped bone segment [26] through an oral vestibular approach [25], perialar crease incision, or one just below the columella [26]. Banks and Taner developed a technique that they called “mask rhinoplasty", used in the treatment of ten patients with Binder syndrome. They made a coronal incision and an approach through the upper buccal sulcus of the nose. With this method, nasal lengthening and improved nasal tip projection were easily achieved, supported by a cantilevered graft of lyocartilage [28]. Among autogenous material, septal and auricular cartilages are commonly used for septorhinoplasty, being easily accessible with little morbidity. Unfortunately, both have limited material for reconstruction and are commonly unavailable in revision cases [14]. The limited thickness of septal and conchal cartilage requires that it be stacked in layers, which are technically difficult to stabilize [11].

In this study, the rib bone and cartilage was used, because a large amount of grafts are required to provide adequate premaxillary and nasal support and augmentation. The free rib bone and cartilage graft is an excellent alternative graft choice. The advantages include a shorter operative time and a greater abundance of graft material. They are more pliable and the cartilage is easier to carve.

The disadvantages of rib grafting are donor site morbidity, increased postoperative pain, higher resorption rates, warping, and the risk of pneumothorax [14]. In order to decrease the resorption rate in this study, and to facilitate easier neovascularization of the bone graft, the technique of splitting the rib was used [29] while the superficial periosteum was preserved to allow osteogenesis aided by the differentiation into osteoblasts and osteoclasts of cells in the surrounding bone and soft tissues [30]. A process of “creeping substitution” could be initiated, so that the free bone grafts may act as template for new bone formation [31]. Even if some degree of resorption occurs by time, the shape of the nose and maxilla will not deteriorate, as it has been secured by fibrosis occurred in the
surrounding tissue and the symmetry will be respected. In this study, there was no significant postoperative pain from harvesting the, because of careful dissection to keep the intercostals nerve unharmed. Also there was no case of pneumothorax confirmed by routine postoperative chest X-ray. There was no decreased postoperative mobility, and all the patients were discharged the second day postoperative.

Costal cartilage grafts, on the other hand, maintain its volume and produce a more natural feeling of the nose making it the ideal material for nose augmentation. To prevent warping of the large grafts required, they were carved from the central part of the costal cartilage and dipped in 0.9% NaCl solution for at least 30 minutes, which is the time for maximum deformation [32]. So far, in our patients we have not seen major problems with cartilage warping. In cases of Binder like deformities secondary to cleft or trauma, the deficiencies are asymmetrical and could not be corrected by prefabricated implants. The abundance of graft material after harvesting rib bone and cartilage gave us a great opportunity to shape the grafts according to the individual defects. In a recent study, they found that remodeling of bone graft was significant, but they noted that no bone graft was lost. Furthermore, remodeling of bone grafts may be a positive factor by slimming and smoothing the shape. Also they abandon the L-shaped cartilage graft, because of unpredictable warping and lack of positive remodeling [7]. In our study, the augmentation of the cartilaginous dorsum, columella and tip was done by separate pieces of cartilage and not one continuous segment. Since the degree of malformation in Binder’s syndrome and Binder like deformity varies significantly, surgical correction needs to be tailored for each case.

We believe the most important key to a successful outcome in such cases is the design, size, and shape of the graft, rather than the material. All the patients in this study were satisfied with the results of both the premaxillary augmentation and the augmentation rhinoplasty, with a natural appearance for the midface and a more pronounced nasal tip augmentation and definition (Fig. 6 A,B,C,D).

Conclusion:

One solution rarely fits all problems. Rib bone and cartilage is a suitable material for both premaxillary and nasal augmentation in cases of Binder’s syndrome and Binder like deformity due to its amount, thickness, easily modifiable, and with low infection and extrusion rates. There are a few possible disadvantages to this procedure, as bone resorption, cartilage warping, and it could be time consuming in carving and contouring of the grafts. However, having no additional costs and yielding good aesthetic results, while minor secondary corrections are available option at any time needed, we believe this technique provides substantial benefits to patients with Binder’s syndrome and Binder like deformity.

REFERENCES


