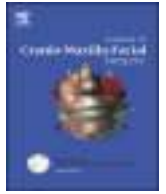




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Rhinofilling with hyaluronic acid thought as a cartilage graft

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ABSTRACT

Introduction: There is great demand for nonsurgical aesthetic procedures. In this case series, the authors describe their stepwise technique of injecting hyaluronic acid (HA) into the nose to yield pleasing, stable results.

Case series: A total of 148 patients underwent minimally invasive rhinoplasty by injection of HA filler. Anatomic contraindications for the procedure were a large dorsal hump, extreme tip projection, or excessive nasal deviation. HA injections were made in a specific order to reshape and stabilize the nose; the surgical plan was conceptually similar to placement of cartilage grafts. Patients indicated their satisfaction with the surgical results on a visual analog scale. Immediately after the procedure, all patients had transient redness and slight swelling at the injection site; this resolved spontaneously by 24 h posttreatment. Vascular impairment developed in 1 patient and was managed with hyaluronidase. In general, patients expressed a high level of satisfaction. Thirty-two patients returned for a "touch-up" filler injection 1 year posttreatment.

Discussion: Nasal reshaping by HA injection can be carried out quickly, safely, and effectively with minimal patient discomfort or downtime. Care must be given to select patients who are indicated for this procedure, and meticulous pretreatment planning is necessary.

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1. Introduction

The demand for noninvasive facial aesthetic procedures has increased dramatically. In 2018, consumers spent more than 1 billion dollars on injectable treatments (ASAPS, 2018). Injection of hyaluronic acid (HA) was the second most popular nonsurgical cosmetic procedure (after injection of botulinum toxin) with over 800,000 treatments performed, an almost 60% increase from 2014 to 2018 (ASAPS, 2018). The increase in popularity of nonsurgical procedures could be explained, at least in part, by the affordability of these treatments and the minimal downtime associated with recovery.

Results of a previous noncomparative, open-label study demonstrated the safety and effectiveness of nonsurgical rhinoplasty with a cohesive, viscous HA filler (Rauso et al., 2017). Surgical rhinoplasty remains the gold standard in aesthetic and functional

reshaping of the nose, but requests for so-called rhinofilling have increased in recent years (ASAPS, 2018). Nonsurgical reshaping of the nose is minimally invasive, has a relatively good safety profile, offers immediately observable results, requires little to no downtime, and is cost-effective (Kontis, 2018). Moreover, rhinofiller can be applied to correct small contour irregularities following surgical rhinoplasty (Kontis, 2018).

Fillers vary in rheology, and there is no commercially available filler specifically formulated for nonsurgical rhinoplasty. HA fillers commonly are used for this purpose because HA can be dissolved easily with hyaluronidase in case of posttreatment deformity or other complications (DeLorenzi, 2014). Deep injections of HA may yield an enduring result, owing to stimulation of periosteum-derived stem cells (Mashiko et al., 2013). Before embarking on nonsurgical nasal reshaping with HA, the surgeon must have expertise in nasal anatomy and filler rheology (Pierre et al., 2015).

Cartilage grafting is an established modality in surgical rhinoplasty. The septum and, less commonly, the cartilages of the ears and ribs constitute the donor sites for grafting in rhinoplasty. These cartilages can be molded and placed to improve the function and

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aesthetic appearance of the nose. In the present study, rhinofilling with HA is conceptualized as a grafting procedure, in which the nasal framework is reinforced and stabilized with filler.

The authors typically perform this technique with 0.01–0.5 mL of filler per nasal region. As depicted in Fig. 1, several maneuvers are used for successful nasal contouring with HA. By applying this filler as a “liquid graft” over the radix, the surgeon can reposition the radix cephalically and anteriorly, ameliorate the nasofrontal angle, and reduce the perceived size of the dorsal hump. These maneuvers can make the nose appear lengthened and can augment an inadequate nasofrontal angle.

HA injection also can be carried out to plump the columella. A cartilage graft to enhance the columella surgically was described for the first time in 1953 (Goldman, 1953) as a means to define the columellar profile or correct a hidden columella. HA filler can produce a similar cosmetic improvement by strengthening the columellar cantilever, and in turn, enhancing the columella and effecting tip projection and rotation.

The spreader graft was introduced in 1984 (Sheen, 1984) to correct “narrow nose syndrome.” Spreader grafts are longitudinally oriented, usually paired, and secured deep within the mucoperichondrium between the nasal septum and the upper-lateral cartilage. These grafts are used in surgical rhinoplasty to correct or prevent collapse of the middle third of the nose and to reconstruct open-roof deformity. HA filler also can be delivered to replicate the results of a spreader graft. In this case, HA is injected in a retrograde manner along the length of the dorsum on either side. This treatment can manage postsurgical dorsal irregularities or improve the appearance of the dorsal nasal bridge.

The alar rim graft originally was described in 1967 (Millard, 1967) with the objectives of preventing or correcting alar retraction and creating a smooth transition along the alar rim. To mimic this effect with HA, the filler is injected deeply, touching the alar rim. This maneuver can correct alar flaring and contour irregularities as well as reshape the tip and create a supratip break.

To manage an acute columellar-lip angle, Guerrero-Santos (1973) first described a technique of grafting cartilage harvested from the septum, upper-lateral cartilage, or alar cartilage. A laminated piece of diced or morselized cartilage is prepared to support

the columella and lip in the new position. This procedure can be reproduced with HA filler to achieve results similar to a plumping graft over the anterior nasal spine. Specifically, in patients with maxillary or anterior nasal-spine retrusion or a drooping tip, the nasolabial angle and surrounding areas are filled with a bolus of HA.

The first onlay tip cartilage graft was described by Peck (1983) and consisted of a small graft placed between the nasal domes. This graft increased projection of the tip, camouflaged irregularities, and slightly adjusted tip rotation, depending on its cranial or caudal placement. To achieve a similar effect, the authors subcutaneously inject HA into the midline of the domal area, thereby increasing the angle of divergence and widening the distance between tip-defining points.

1.1. Indications

In nonsurgical rhinoplasty, careful selection of patients is crucial. In general, patients most suitable for HA rhinofilling present with minor imperfections in dorsal contour or with nasal crookedness, depressions, notching, and/or asymmetry. More specifically, HA can be applied to enhance the nasal radix or base or to correct a minor dorsal hump, congenital furrows, small asymmetric dorsal lines, a mild deficit in tip projection or rotation, a bifid tip, or tip roundness or asymmetry. In patients with nasal defects secondary to rhinoplasty or trauma, HA can be applied for minor aesthetic refinements, including reducing or eliminating skin depressions. Patients who desire a subtly shortened nose also may achieve this with HA injection to rotate the nasal tip.

Rhinofilling also can be performed in place of augmentation rhinoplasty in certain patients with moderate deformities, including an acute nasolabial angle, hyperconvex nasal dorsum, depressed nasofrontal angle, columellar show, and/or a drooping nasal tip. Conversely, if the nose requires significant shortening or narrowing (eg, in patients with a large dorsal hump, excessive tip projection, or major nasal deviation), this procedure is not indicated.

In patients native to Western countries, HA rhinofilling also could be applied to improve signs of aging, such as reabsorption of the caudal septum, radix, and anterior nasal spine; reduction of the

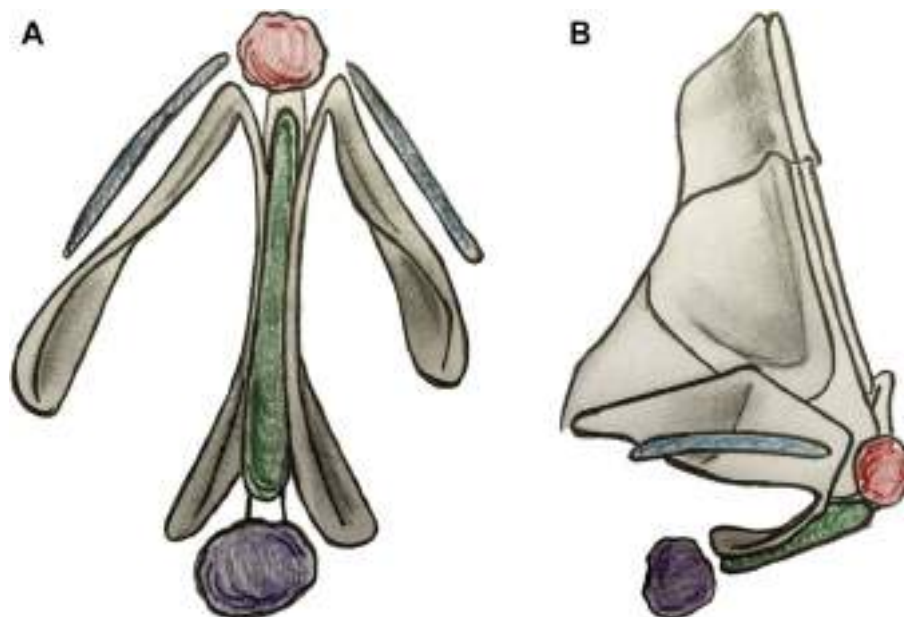


Fig. 1. Basal (A) and three-quarter (B) orientations of sites that were injected with HA by an approach similar to cartilage grafting. Placement of a so-called liquid graft above the anterior nasal spine is represented in purple, columella plumping in green, onlay tip shaping in red, and alar rim contouring in blue.

nasolabial angle; overgrowth of the lower-lateral cartilage; skeletonization of the nasal frame; and drooping tip. Furthermore, rhinofilling is indicated for patients who desire increased nasal volume, including for augmentation of nasal height; to increase the nasolabial, nasofrontal, and/or nasomental angles; or to decrease the nose length and/or the nasofacial angle. In addition, injections of HA gel can stabilize the height of the nose, which can be challenging in surgical reshaping rhinoplasty. The aim of this case report is to illustrate the enduring, aesthetically pleasing results that can be achieved by rhinofilling with HA. The authors utilize a precise stepwise process to stabilize and contour the nasal framework with filler.

2. Case Series

2.1. Patients and Study Design

From January 2014 to January 2018, 148 patients (112 women, 36 men; mean age, 27.8 years; age range, 16–61 years) underwent nonsurgical nasal reshaping by injection of 1 of 5 brands of HA filler (Allergan, Dublin, Ireland; Nyuma Pharma, Arona, Italy; Merz Aesthetics, Raleigh, NC; Neauvia, Lugano, Switzerland; Teoxane, Geneva, Switzerland). Exclusion criteria were pregnancy, breastfeeding, any preexisting condition that might affect patient safety (eg, active inflammation, infection, cancerous or precancerous lesions), a history of connective tissue disease or bleeding disorders, and known hypersensitivity to lidocaine, HA, and/or gram-positive bacterial proteins. Patients also were excluded who had the following anatomic contraindications: large dorsal hump, excessive tip projection, or extreme nasal deviation. Ultimately, the senior author (R.R.) determined whether each presenting patient was a candidate for the treatment.

This study was performed in accordance with guidelines set forth in the Declaration of Helsinki. All included patients provided written informed consent, which included a photo release form. Each procedure was performed in the office by the senior author (R.R.), and the treatment time was approximately 20 min.

Twenty-two of the 148 patients had previously undergone other nasal aesthetic procedures (16 patients, surgical rhinoplasty; 6 patients, injected HA treatment of the nose); these were performed at least 12 months before patients received the current study treatment. The 6 patients who had received nasal HA injection underwent pretreatment with hyaluronidase (300 U/mL) at least 15 days before receiving the study treatment. The remaining 126 patients had no prior nasal procedures.

2.2. Treatment Procedures

After careful disinfection of the nose, HA filler was administered. Each patient received HA injection with the needle provided by the manufacturer. No local anesthesia was given, except in filler

formulations that were premixed with lidocaine. The filler volume ranged from 0.4 to 1.2 mL (average, 1 mL). The mean volume of HA injected per site is summarized in Table 1.

For all procedures except for columella plumping and onlay tip graft, the injections were performed deeply, touching the bones or the cartilages to avoid intravascular injection. HA was injected subcutaneously for columella plumping and onlay tip graft. For all patients who had not undergone previous nasal surgery, injections were made in the following sequence, with HA volumes tailored to each patient. First, filler was delivered as a plumping graft above the anterior nasal spine to give support to the tip of the nose and modify the labionasal angle. When needed, columella plumping was carried out as the following step and then onlay tip grafting and rim grafting were performed to reshape the tip of the nose and create a supratip break. Radix grafting, when necessary, was conducted as the fifth step to ameliorate the nasofrontal angle and reduce the appearance of the dorsal hump. The last step, when needed, reproduced the effect of a spreader graft and addressed deficiency of the upper-lateral cartilage.

The patients who received HA injection as secondary or revisional treatment were cared for on a case-by-case basis. Most frequently, HA was delivered to address a drooping tip, deficient upper-lateral cartilage, and asymmetry of nasal bones secondary to osteotomy. Fig. 2 is a representative case of the treatment.

2.3. Posttreatment Monitoring

Patients were monitored for an average of 4 months (range, 8–30 months). Thirty-two patients (29 women, 3 men) presented for a revisional “touch-up” an average of 1 year posttreatment to address partial absorption/biodegradation of the filler. The touch-up volume needed was approximately one-third of the initial volume injected.

At the end of the procedure, all patients had minor redness and swelling at the injection site that resolved spontaneously by 24 h. One patient who underwent HA injection to mimic the effect of a rim graft on the left side of the nose experienced vascular impairment involving the left ala and the mid-third of the vault on the left side. This patient was treated with hyaluronidase, and small scabs formed at the site. The area was completely healed by 1 week. The patient was advised to avoid antibiotics, aspirin, or others drugs during the first postinjection week. In 2 other patients, transient blanching of the skin developed at the tip of the nose after the peak injection volume; this effect self-resolved in less than 5 min.

2.4. Patient Satisfaction

Patient satisfaction was evaluated on a visual analog scale (VAS) in which 0 represented the worst possible aesthetic outcome and 100 was the best. No patient indicated a score of <75. Ninety-six patients gave scores of 100, 29 patients rated the effect from 90

Table 1
HA rhinofilling procedures in the case series.

Intended Effect of HA Injection	Primary Surgery ^a , No. of Patients	Secondary Surgery ^b , No. of Patients	Volume Injected, mL
Columella plumping	42	12	0.05–0.2
Spreader graft	38	15	0.05–0.15, per side
Alar rim contouring	37	3	0.01–0.02, per side
Plumping of the anterior nasal spine	132	12	0.2–0.5
Radix graft	118	3	0.05–0.2
Onlay tip graft	112	9	0.01–0.02

HA, hyaluronic acid.

^a Patients had no history of nasal treatment.

^b Patients had undergone a surgical or nonsurgical nasal treatment, no less than 12 months before receiving the current study treatment.



Fig. 2. This 16-year-old female patient underwent HA rhinofilling in the anterior nasal spine (0.3 mL), tip (0.02 mL), radix (0.05 mL). (A–C) Pretreatment, (D–F) immediately after treatment, (G–H) 1 year posttreatment.

to 100, and 25 patients indicated a score of 80–90. The remaining 8 patients gave a score of 75–80 (Table 2). When the procedure was carried out with fillers not containing local anesthetic, patients indicated more pain and discomfort than did patients who received fillers premixed with local anesthetic.

2.5. Limitations of the study

The present study is a case series regarding the experience of the senior author (R.R.) with the use of HA in non surgical nose reshaping. The main limitations of the study are represented by the evaluation of the results done comparing pre and post treatment photos and a VAS scale fulfilled by the patients.

Clinical photographs are useful for scientific records and research. The standardization of the framing, spotlights, distance and height of camera are fundamental in case management documentation, and standardized clinical photographs should be taken in dedicated photographic studios by medical photographers using professional grade photographic equipment (Henderson et al., 2005). Nevertheless, surgeons who personally take patient photographs do not always have immediate access to a photography service. In addition, not all physicians may have access to trained clinical photographers or have the appropriate photographic equipment or 3Ds scanners and light diffusers.

Table 2
Patient satisfaction.

VAS Score	0–74	75–79	80–89	90–99	100
No. of Patients	0	8	25	29	96

Patients were asked to rate their satisfaction from 0 to 100, with 0 representing the worst possible aesthetic outcome and 100 representing the best. VAS, visual analog scale.

Moreover, in standardization and systematization of photographic positions for the reliability and reproducibility of clinical evaluation, the variability is still a matter of fact (Parker et al., 2007).

Regarding patient evaluation of the results, self-perceived aesthetical improvement is one of the most debated issues in aesthetic surgery and patient satisfaction has an important role in performance evaluation, especially for value-based purchasing (VBP) treatment (Başer et al., 2016).

Patient satisfaction assessment is challenging because of the difficulty to define this complex concept and the large number of potential confounders that could cause valuation error.

The VAS evaluation, widely used in literature and clinical practice, was used for this purpose, due to its simplicity, quickness, smartness and adaptability. VAS is more sensitive to small changes than simple descriptive ordinal scales as mild-moderate-high. Moreover, it is paramount that its ability as a qualitative method to detect variation in patient satisfaction is near the upper end of the range, especially for patients highly satisfied after treatment.

However, the control for measurement bias is crucial, principally when patient satisfaction is taken as an outcome (Svensson, 2012). Thus some caution is required: assessment is clearly highly subjective; VAS data of personal values could be replaced by an established validated questionnaire submitted to the patient during the follow up.

3. Discussion

The popularity of nonsurgical aesthetic treatments has surpassed that of surgical procedures (ASAPS, 2018). Nonsurgical treatments involve shorter recovery time and less pain (Rohrich et al., 2003, 2007; Monstrey et al., 2007). HA injection is a well-accepted alternative to surgical rhinoplasty for patients who wish to reshape the nose in a minimally invasive manner, with short

treatment time, low cost, no need for general anesthesia, and no downtime (Heden, 2016). Moreover, HA can be applied to ameliorate minor irregularities secondary to surgical rhinoplasty and to preserve the height of the nose, which is difficult to achieve surgically.

Generally, HA is considered to be a nonpermanent substance that can be reversed readily with hyaluronidase (Brenner and Hilger, 2009). However, Mashiko et al. demonstrated that semi-permanent volumizing effects can be achieved with HA if the target area has an underlying bony floor; the authors hypothesized that periosteal stem cells, activated by HA, potentiate the volumizing effect (Mashiko et al., 2013). Enduring results of HA rhinofilling also have been confirmed by others (Heden, 2016; Rauso et al., 2017). In our case series, 32 of the 148 patients returned at approximately 1 year for a touch-up but required only one-third of the volume injected in the first session. Because we injected HA filler deep beneath the bone, it appears that our results support the hypothesis that HA filler can be semipermanent.

Surgical rhinoplasty traditionally involves resection of the nasal osseocartilaginous framework to achieve aesthetic or functional objectives. Often, successful aesthetic results of surgery deteriorate over time because the postsurgical nasal scaffold has inadequate strength to withstand the contractile forces of healing; this poor durability also results in progressive functional impairment. These limitations of reductive surgery encouraged a shift in the field of rhinoplasty toward framework-building techniques, such as cartilage grafting or rhinofilling (Brenner and Hilger, 2009). For many years, surgeons have performed grafting to address aesthetic and functional concerns of the face, including deformities of the nose (Goldman, 1953; Millard, 1967; Peck, 1983; Sheen, 1984; Brenner and Hilger, 2009). The senior author (R.R.) has applied his surgical expertise with cartilage grafting to precisely deposit and arrange HA filler to contour the nose without compromising its structural integrity. For instance, Flowers described a suborbital malar implant for treatment of tear trough deformity in 1993 (Flowers, 1993); we have found that HA can manage this deformity when the filler is delivered at the intended insertion site of the Flowers suborbital malar implant.

HA rhinofilling has a generally good safety profile, especially when the filler is injected deeply, away from the vasculature. However, a devastating complication of rhinofilling is blindness (Cohen et al., 2016). In a recent review of 75 cases of visual loss secondary to facial filler injection (Li et al., 2015), 34 (45%) received injection in the glabella, 19 (25%) in the nasal dorsum, and 14 (19%) in the nasolabial fold. Vascular complications can be divided into 2 categories: those resulting from direct intravascular injection and those caused by compression of local vessels. To avoid blindness as well as nasal skin necrosis, it is imperative that the surgeon be well accustomed with standard and variant patterns of nasal vascularization prior to performing rhinofilling with HA (Chen et al., 2016).

In the current study, the authors attributed the depth of the filler injections to the good safety results obtained; however, 1 patient did have vascular impairment after filler injection to reproduce a rim graft. In general, surgeons should exercise extreme care when treating the tip and columella because the filler is injected subcutaneously in these regions. We recommend aspirating with a syringe before injecting to ensure the injection will not be made intravascularly. Hyaluronidase should be readily available to reverse erroneous injection placement during the procedure. However, in case of direct injection into the supratrochlear artery—such as during augmentation of the nasal root—retrobulbar injection of hyaluronidase is not effective in reversing visual loss, as shown clinically and preclinically (Zhu et al., 2017; Hwang et al., 2019). If selecting among various fillers, the surgeon also should

carefully consider filler rheology because certain filler materials can compress the vasculature.

For primary cases of nasal reshaping, the authors propose a stepwise “bottom-up” approach. Specifically, HA first is delivered over the anterior nasal spine—as well as the columella, if needed—to reproduce a plumping graft, thereby projecting the nasal tip and correcting an acute nasolabial angle. Subsequently, filler injections proceed to the tip of the nose, mimicking an onlay tip graft and an alar rim graft. The radix next is addressed to reduce the perception of hump projection. Finally, the mid-vault of the nose is managed with HA delivery to replicate a spreader graft, if necessary. This bottom-up plan was designed to minimize the volume of filler injected over the radix. When tip projection and rotation is addressed as the first step of the procedure and the radix is treated subsequently, less HA is needed over the radix. This approach avoids an overfilled nasal dorsum and consequent flattening of the frontonasal angle. In addition, this order of injections has a safety benefit; as shown by Tanaka, a larger volume of HA injected over the radix is associated with a higher risk of vascular compression (Tanaka, 2014).

There are numerous surgical and nonsurgical modalities for nasal reshaping. The authors drew from their expertise with placement of cartilage grafts to develop a stepwise procedure for delivering HA. This “liquid grafting” technique yields pleasing, enduring results and is indicated both in primary cases and in patients who have previously undergone surgical and/or nonsurgical nasal treatments.

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Declaration of Competing Interest

The authors have no competing interests to declare.

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