Simple Implant Augmentation Rhinoplasty

Anh H. Nguyen, MD¹ Erica L. Bartlett, MD¹ Katarzyna Kania, MPH² Sang Mo Bae, MD³

¹ Division of Plastic Surgery, Baylor College of Medicine, Houston, Texas

² Division of Plastic Surgery, Indiana University, Indianapolis, Indiana

³ Private Practice, Ansan, South Korea

Address for correspondence Anh H. Nguyen, MD, Division of Plastic Surgery, Baylor College of Medicine, 1977 Butler Blvd, Suite E6.100, Houston, TX 77030 (e-mail: anhplasticsurgery@gmail.com).

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Abstract

Keywords

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- tip rhinoplasty
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- Gore-Tex implants
- Sili-Tex implants
- L-shaped implants
- I-shaped implants

Augmentation rhinoplasty among Asian patients is often performed to improve the height of the nasal dorsum. As the use of autogenous tissues poses certain limitations, alloplastic materials are a viable alternative with a long history of use in Asia. The superiority of one implant prosthesis over another for augmentation rhinoplasty is a matter of debate, with each material representing varying strengths and weaknesses, indications for use, and precautions to consider in nasal implant placement. An implant prosthesis should be used on a case-by-case basis. Augmentation rhinoplasty requires the consideration of specific anatomical preoperative factors, including the external nose, nasal length, nasofrontal angle, humps, and facial proportions. It is equally important to consider several operative guidelines to appropriately shape implants to minimize the occurrence of adverse effects and postoperative complications. The most common postoperative complications include infection, nasal height change, movement of implant prosthesis, and silicone implant protrusion. In addition, the surgeon should consider the current standards of Asian beauty aesthetics to better understand the patient's desired outcome.

Augmentation rhinoplasty among Caucasians is rare, and the amount of nasal dorsum to heighten is modest in most routine cases; as such, small amounts of cartilage are needed. On the contrary, dorsal augmentation among Asian patients is considerably more extensive compared with Caucasians. In augmentation rhinoplasty among Asian patients, a variety of implants to improve the nasal dorsum is often needed because certain limitations exist in Asian rhinoplasty with the use of autogenous tissues. Silicone, Gore-Tex, and Silitex are commonly used for augmentation rhinoplasty.^{1–4} Although the ideal material is not found as yet, each nonautologous material has its pros and cons. Therefore, it is impossible to argue which material is superior. Different plastic surgeons have varying claims with regard to the applicability of specific materials, and patients have different requests and needs.

Currently, requirements and exacting demands for nasal tip configurations have been growing, so changes in this anatomical area of surgery are required.⁵ This topic, however, is beyond the focus of this review in which we discuss augmentation rhinoplasty only with implants.

Augmentation Rhinoplasty

Augmentation rhinoplasty refers to the surgery that uses autogenous tissues or implants for the patients who have low nasal height due to congenital defects, trauma, infection, excessive reduction rhinoplasty, or submucosal resection.⁶

Limitations of Autogenous Tissues

Recently, the efforts to perform augmentation rhinoplasty using autogenous tissues have been increasing, where dermofat, rib cartilage, and diced cartilage are used.^{5–7} Dermofat and diced cartilage, however, fail to reach the target level of elevation due to absorption or are less able to consistently predict the elevation. Rib cartilage can produce a hard texture; for patients who have a thin soft tissue envelope, sharp margins are formed outside of the nasal dorsal width perimeter, so rib cartilage becomes more strongly noticeable than implants. Curves and deviations also can result from warping. Thus, it is actually difficult to give up the merits of

implants. It is generally acknowledged that autogenous tissues are safe once revascularized and integrated, and should be given top priority.^{1,3,4} Nevertheless, autogenous tissues do not always fit the conditions for Asian noses. Rather, because of patient dissatisfaction, there have been many cases of a secondary surgery after an augmentation rhinoplasty in which autologous grafts were used.⁸

Implant Types

Silicone Material

Silicone implants that are used in rhinoplasty consist of two types: the sculpted block-type silicone implants (►Fig. 1) and the liquid type that is poured directly on a cast to mold into the desired shape. For shorter operating times, most clinics use manufactured implants rather than the block-type.

Silicone implants are classified into boat-shaped (►Fig. 2) and L-shaped (►Fig. 3), depending on their outward appearance. The boat-shaped implants are used typically for dorsal augmentation, whereas the L-shaped implants are used for procedures that involve both the dorsum and tip-plasty.⁶

One of the main advantages of L-shaped implants is that the continuity between the dorsum and lobule is excellent; therefore, it is possible to enlarge both the nasal dorsum and the lobule. However, when the strut of the L-shaped silicone implant comes into contact with the nasal spine or upper maxilla, a tent-pole effect occurs. Depending on the patient's predisposing skin thickness, the amount of tenting or projection, the firmness of the implant, the degree of tip and peritip tissue release, and longer-term motion of the surrounding area, disasters such as nasal implant protrusion derived from nasal tip skin necrosis can occur.⁶

Using artificial prostheses on the tip of a nose or in front of the columella alone should be avoided. An implant prosthesis should be used on the area that stretches from the nasal dorsum to the slightly upper part of the nasal tip. Silicone rubber nasal implants are classified into three types based on

Fig. 2 L-shaped implant.

the degree of hardness: soft, medium, and hard. Due to the risk of extrusion on the nasal tip, prostheses implanted in the nasal tip should be soft enough. This is why plastic surgeons prefer a nasal implant product with double hardness: soft on the tip of a nose and intermediate on the bridge of a nose.^{9,10}

Advantages of Silicone

No Height Change Once Placed

Unlike Gore-Tex, silicone has the advantage of not showing any change in height or shape even after a prolonged period of insertion in the body. It is a visual variable used for stable and predictable shape.⁹

Fig. 1 Carving blocks.

Fig. 3 Various L-shaped implants.

Capsule Formation

Once the silicone is implanted, the body recognizes it as a foreign substance and the macrophage's foreign body reaction causes fibrous tissues to develop and enclose the implant. These capsules separate silicons from neighboring tissues. The capsule can be useful in that it acts to prevent adhesion of neighboring tissues, making any subsequent explantation easier. Additionally, the capsules can act as a barrier tissue that is placed between the skin and the implant, which improves the transparency of the implant through the skin.

Disadvantages of Silicone

Capsule Formation

The presence of a capsule means its mobility is greater when compared with Gore-Tex implants. As silicones cannot adhere to neighboring tissues, they are vulnerable to postoperative infections. The capsules can cause an upturned nose or visible marks at the edges of the implant.⁹

Calcification of the Silicone Surface

When the silicone implants remain in the body for a prolonged period, the surface of the silicone can accumulate calcium, which starts the calcification process. Calcification forms at the dorsal surface, but can also appear at the surface of the capsule. The external appearance can resemble a small hump or nodule. Gore-Tex can also show calcification, but such incidents are rare compared with those of silicone.⁹

Gore-Tex

Gore-Tex is constructed of micropores of 0.5 to 30 μm in size created with nodules of expanded fibrillated polytetrafluoroethylene (ePTFE) interconnected with one another, through which peri-implant tissues grow into the implant and anchor it firmly, minimizing contracture due to higher stability and lower film forming (→ Fig. 4).

Within the human body, the ingrowth starts to appear within pores of connective tissue from the tissues with a time lapse of 2 months or more and continues its integration over time. New blood vessels have been found in tissues that are 1 year or older. There are several reports on the morphological change of the nose upon insertion of the nasal dorsum where a nasal dorsal height can decrease by as much as 40%, but the average change is approximately 20%. Fortunately, few changes have been seen in terms of the length and width.

Advantages of Gore-Tex

Tissues can grow within the pores. Because of this ingrowth, there is less mobility, as integration will immobilize the implant to a higher degree, with less mobility. Higher resistance against infections can come from the increased, more integrated vascularity. The integration would also minimize distortion by capsular contracture by an absence of capsular formation. All this can lead to a decreased rate of visible calcification.^{6,8}

Disadvantages of Gore-Tex

The height or shape can change after inserting the implants, which means less height predictability. Ingrowth into the

a

For copyright reasons, Figure 4b has been removed.

b

Fig. 4 (a) Gore-Tex in package; (b) Gore-Tex in layers for dorsal augmentation.

pores by body tissues and interaction with neighboring tissues can complicate removal, fighting against increased integration. Lack of capsule formation means implants are more closely adhered to the skin, which in fact can make the implants' edges more visible, despite its softer profile.^{8,11}

Sili-Tex

Sili-Tex is made by wrapping an inner silicone with a surface, thin ePTFE sheet. The exposed floor surface of the implant consists of silicone (→ Fig. 5).

Advantages of Sili-Tex

The inner silicone core maintains a stable height, which means there will be no changes in implant height after the insertion of implants. The surface is wrapped with ePTFE, which causes ingrowth of neighboring tissues. Implant mobility is limited.

Disadvantages of Sili-Tex

Sculpting is only allowed on the floor surface of the implant, where the silicone portion resides, which prevents a more

Fig. 5 Sili-Tex implants.

detailed sculpting on the width or slope of the implant. Compared with silicone and Gore-Tex, Sili-Tex is more likely to reveal the shape of the implant around the margins after insertion due to its characteristic capsule formation location. Removal is somewhat difficult.

Indications for Each Implant

There are no ideal prostheses that are free of side effects. Each piece of implant prosthesis has its pros and cons so it is necessary for surgeons to carefully choose the most appropriate implant prosthesis for each person on a case-by-case basis instead of sticking to one type of implant prosthesis over others. Every individual has his or her own nose conditions and preferences so different types of prostheses must be used for those who seek to improve their nose aesthetically. Silicone has widely been used as it shows no intrinsic morphological changes, one of the most important requirements for prostheses, and excellent predictability.⁸

Indications for a Silicone Implant

1. Primary implant use for general dorsal augmentation
2. Thin-skinned dorsum: Autogenous tissue use is preferred, but if implants are used, a capsule-forming silicone implant is recommended.
3. Can combine with osteotomy
4. May alternatively consider an autologous fascial or dermal wrap around the implant

Indications for a Gore-Tex Implant

1. Secondary cases with a contracted nose
2. Weak periosteum: Implants are more mobile in cases of a weak periosteum, but Gore-Tex can offset this mobility by offering a higher degree of cohesion with the nasal bone and neighboring tissues.
3. Secondary surgery caused by calcification on the surface of a silicone implant
4. Patients showing foreign body reaction to silicone
5. Secondary surgery caused by a late spontaneous hematoma in a silicone implant

Indications for a Sili-Tex Implant

As a hybrid, the indication falls somewhere between that of a silicone implant and a Gore-Tex implant/sheet. Its use is more for a softer look than a true silicone implant, and an integrated dorsal component with the surrounding tissue through the porous interface when needed, with a firmer support base of silicone underneath.

Major Precautions in Nasal Implant Placement

1. Root of the nose: The cephalad portion of the implant to be placed lower on the forehead at the radix level in the midline should be carved to be gradually narrower and thinner.

2. Bridge of the nose: From the side view, the line from the cephalad portion of the implant should be a little concave for women and straight for men as it nears to the nasal tip. When trimming the underside the implant, a groove should be carved on the bridge of a patient's nose that fits perfectly into its rounded outline throughout the total length of the nasal bridge. Otherwise, a hematoma may develop in the area where the implant does not tightly fit with the bridge of the nose upon completion of operation, or the patient may suffer the "seesaw phenomenon" after recovery and pressure exerted on the skin near the lower forehead or nasal tip may distort the implant. If this pressure persists, the skin will get thinner and eventually the implant underneath may extrude. Also, the bottom of both sides of the implant should fit tightly the outline on both sides of the nasal bridge in a balanced manner. If the implant is asymmetrical, it slides into the thinner side and deviates away from the midline.
3. Top of the nasal tip: For a female patient, the supratip break should be a little lower to create an elegant line of the nasal bridge.
4. The nasal tip: It should be rounded similar to the curved surface of the nasal tip with no sharp edges, and be thick enough but not be too heavy on the nasal tip skin. In creating an implant for a patient with high nasal tip, make sure to have it end right on top of the nasal tip.
5. Bottom of the nasal tip: In trimming an L-shaped nasal implant, its thickness in the area between the medial crus of the alar cartilage should be appropriate, and the length should be properly adjusted so as not to have the implant come into touch with the maxilla. If the columella nasi area of the nasal implant is long enough to touch, the nasal tip and upper chin go in the opposite direction, creating an unpleasant look (→ Figs. 6 and 7).

Fig. 6 Positioning of L-implant.

Fig. 7 Positioning of L-implant.

Tip of Implant Prosthesis Pieces

What determines the shape of an implant prosthesis is not just its height and length, but its width and the curved angle and length of the nasofrontal area; the slope of a cross section should also be taken into consideration. It is important to put prostheses of various shapes in place so that you can select one that best fit the patient's nose and then custom carve it.

1. Nasion nasal root and nasofacial angle: Determine the length of nasal implant based on the nasion. For a patient with a prominent superior orbital rim and a protruding forehead, the area a little lower than the nasal root should be taken as the base to create a natural look.
2. Making an optimal nasofacial angle is critical in augmentation rhinoplasty. The most optimal nasofacial angle is 34 degrees for a Caucasian female, 36 degrees for a Caucasian male, and 33 degrees for a Korean female and 35 degrees for a Korean male.¹² It is important to take the extent of the midface into account.
3. The width of the implant prosthesis is normally between 8 and 12 mm and is dependent on the width of nasal bone. Excessive width of the implant at the nasal tip may cause extrusion through the alar rim incision scar.
4. The underside surface of the implant needs a concave curve groove so that the groove fits in with the nasal bone and restricts movement of the implant.
5. Additionally, it is not enough to carve just the bottom of the implant prosthesis to adjust the height of the nasal dorsum, but the adjustment of various areas, including the slope of an incline on the side and the width of implant prosthesis all should be made as well.
6. After the implant prosthesis insertion into a nose, the shapes and curves should be thoroughly checked to make final corrections and optimizations.

7. Use of soft silicone rubber: A nasal implant made of silicone rubber is likely to be displaced due to its failure to adapt to morphological changes of the soft tissue of the nasal implant, and a hard nasal implant continues to press the skin, making it thinner with an increasing risk of exposure. Therefore, it is desirable to use a nasal implant made of soft silicone rubber. Use a nasal implant with an intermediate hardness component for the bridge of a nose and a soft implant component for nasal tip and columella nasi.

8. Cuts on the edge of the implant prosthesis can be made to ensure adherence on the nasofrontal nasion (► **Fig. 8**); however, it is not recommended as it is not only difficult to perform what was originally intended, but also to make consistent the thickness of the capsule, with the increased surface area increasing the chance of developing an inflammation.
9. Sometimes, holes are made on the silicone implant to prevent it from moving (► **Fig. 9**), but it should be avoided as it may cause a sudden hematoma for no reason some time after a rhinoplasty operation.
10. It is good to have the size of the subperiosteal pocket into which an implant prosthesis is inserted precisely fit its width to prevent the occurrence of displacement. In reality, because a correct and precise pocket on both sides cannot be guaranteed, it is better to have the pocket slightly wider than the width of the implant prosthesis, leaving room to make corrections externally by hand massage in the event of implant displacement in the future. However, widening the pocket excessively may cause not only swelling, but also increase the risk of displacement.
11. Gore-Tex tends to reveal the small irregularities or humps of the nasal dorsum that are hardly visible, so delicate and meticulous carving is required; several rounds of inspection and correction should be done even after the implant insertion into the nasal dorsal pocket before finalizing the operation.

Fig. 8 L-implant with serrated edges.

Fig. 9 L-implant with perforated holes.

Preoperative Considerations

Patient Selection

Patient criteria for augmentation rhinoplasty include

1. Patients who have not had previous augmentation rhinoplasty using inappropriate materials such as liquid silicone and paraffin
2. Patients whose skin thickness is appropriate. Excessively thin skin is likely to reveal the outline of the implant and the signs of operation with a higher risk of extrusion, whereas too thick a skin reduces the effect of raising a nose. Therefore, patients with appropriate skin thickness are recommended.
3. Patients who do not want their nose to be raised dramatically
4. Realistic expectations for the results of the operation

Preoperative Examination

Analysis of the External Nose

1. Nasal length is two-thirds of the vertical length of the midface.
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3. The nasal height is one-third of the nasal length.
4. The width of the nasal bone area is 75 to 85% of the distance between the sides of the nose.
5. The distance of the nasal alar base is the same as the length of the palpebral fissure on one side.
6. The nasofrontal angle is between 30 and 35 degrees, and the columellar–labial angle is between 90 and 95 degrees for men, and 95 and 100 degrees for women.
7. The nostril is oval and runs an oblique course toward the nasal tip.
8. From the side view, the columella is located nearer to the tail than the alar rim by 2 to 3 mm.

Check if there are any restrictions and prohibitions with regards to the operation in terms of aesthetic aspect of external nose as well as anatomical and physiological aspects of the internal nose.

Nasal Length

If a long implant is inserted into a rather short nose in an effort to create a desired nasal length without extending the inner lining between the skin outside the nose and internal nose, the implant will continue to exert abnormal pressure on the nasal tip skin, eventually extruding the implant.

Nasofrontal Angle

It is harder to correct a nose with a wide nasofrontal angle than a nose with narrow one.

Hump

A close preoperative inspection should be conducted to detect and remove even minor nasal humps, if any are present. Otherwise, the implant will rock or deviate after placement.

The Consideration of Facial Proportion to the Nasal Surgery Change

Relationship between Nose and Chin

Most patients who seek augmentation rhinoplasty pay attention to the shape of their nose only. More often than not, they have never even considered the harmony and balance between the nose and the rest of their face. Therefore, plastic surgeons need to explain to their patients the importance of harmony between the nose and the chin from the perspectives of cosmetic surgery. The Asian chin can be recessive, and augmentation rhinoplasty without considering the overall facial balance is most likely to have the chin look weaker with anteroposterior deficiency. A useful guide in defining the correlation between the nose and the chin is the Ricketts' aesthetic line, which is between the nasal tip and soft tissue pogonion (→Fig. 10).¹³ The upper and lower lips are located 4 mm and 2 mm behind this line, respectively. If you raise a lower nasal bridge and tip through augmentation rhinoplasty, the lips and chin are further swept back, so a genioplasty or mentoplasty should be performed simultaneously or later to ensure the overall balance of the face if the patient has microgenia, micrognathia, or mandibular retrognathia prior to the operation. Asians have a smaller chin and prefer their chin slightly swept back. Therefore in relation to the Ricketts' aesthetic line, the upper and lower lips should be located 2 mm and 0 to 1 mm back from this line in Asians as opposed to what was indicated above.

In augmentation rhinoplasty, it is important to maintain the balance between the nose and the rest of the face and to avoid risks incurred by the use of an excessively large implant.

Fig. 10 Modified Rickett's line, correlating the nose-to-chin-with-jaw relationship in the Asian side profile. It is suggested that the line touches the nasal tip, upper lip, lower lip, and chin.

Operation Guidelines

1. Preparation of silicone implant prosthesis: Prepare the appropriate implant and pick the one to carve during the consultation.
2. Anesthesia: Give an anesthetic with epinephrine.
3. Operation procedure:
 - a. Skin incision: Incise the 1-mm inner part of the nostril's edge (~10–13 mm in length).
 - b. Dissection of the nasal tip: Strictly dissect the central long nasal axis with Metzenbaum scissors all the way to the radix in the subperiosteal plane.
 - i. Perform skin thinning near the nasal tip where the thickest possible subcutaneous tissue layer exists.
 - ii. Bony dissection should be performed below the periosteum.
 - iii. Dissection: Perform dissection carefully so that the implant prosthesis can be placed right on the midline.
 - c. Dissection of the nasal periosteum: Dissect the nasal periosteum using a periosteal elevator.
 - d. Irrigation of pocket implant prosthesis: Irrigate the pocket using saline solution mixed with a hemostatic agent and an antibiotic.
 - e. Insertion of implant prosthesis: Insert the prepared implant prosthesis. Make several attempts of insertion and check if there is no convex–concave portion.
 - f. Suture of incision site: Suture the incision site using 6–0 absorbable sutures.
 - g. Taping: Tape with cloth or paper tape to create multiple layers that serve as a splint.

Postoperative Complications

Side effects involving an implant prosthesis can be the result of the material properties of the implant prosthesis itself, but are mostly related to the height of implant prosthesis, the application methods used, and the thickness of the patient's nasal skin. The use of an excessively high implant prosthesis is the most common cause of side effects.¹⁴

Infection

The chance of infection increases with the use of a large implant prosthesis that has a large surface area and high degree of hardness because it is likely to damage delicate tissues. Accordingly, an excessively high implant prosthesis should be avoided, while its surface should be made or carved to be smooth and not rough (reduction of surface area): One with a lower degree of hardness should be adopted for use. When infection occurs, antibiotics should be taken for 1 week; if there are no signs of improvement, the implant should be removed. There are rare cases where a patient improves with a large dose of antibiotics while delaying the removal of the implant, but in most cases the implant has to be removed; otherwise, the patient may develop a fistula. Implant removal should be performed before fistula development or implant protrusion to prevent scar development. The implant may be reinserted in 1

to 6 months after removal, but at least 3 months is recommended before reinsertion.^{9,14}

Signs

When the skin component becomes thinner and reddish or there is show-through of the implant prosthesis or border visibility, these conditions are largely dependent on the nasal skin thickness, skin tension, and the degree of adhesion to surrounding tissues than by the type of implant prosthesis used for rhinoplasty. Because the silicone capsule plays the role of adhesion prevention between the skin and the implant, the use of silicone is deemed more appropriate than Gore-Tex for a patient with thin skin. Replacement of the implant prosthesis with autogenous tissue (dermal fat) is the best solution. Under circumstances where the use of an implant prosthesis is inevitable, the height of the implant prosthesis should be reduced or the location of insertion switched to the subperiosteal plane if inserted above the periosteum.⁹

Nasal Height Change

Plastic surgeons are well aware that Gore-Tex decreases in height over time in vivo, unlike silicone implants that resist any morphological changes. The extent of height reduction is around 42 to 45%, but the range of general vertical changes is 20% or so. However, the thicker the implant prosthesis, the deeper its height reduction, and a wider degree of changes are experienced among patients. It usually takes about 6 to 9 months until there are no longer any vertical height reductions, but the variabilities among individuals are so extreme that some complain about the height reduction phenomenon even at 1 year or longer: This lack of predictability is one of the biggest drawbacks. The change in length and width is too minor to be of any concern.

Movement of Implant Prosthesis

Movement of an implant prosthesis may occur if the implant prosthesis is incorrectly inserted above the periosteum, or if the periosteum itself is weak or thin even if it is inserted below the periosteum. To correct this, the implant prosthesis should be inserted below the periosteum in the case where it was previously inserted above the periosteum, but it is also often helpful to change the type of implant prosthesis used to a softer type (e.g., Gore-Tex) if the original insertion was done correctly in the subperiosteal plane but the periosteum itself was determined to be weak or thin.⁹

Abnormal Location of Implant Prosthesis

The bridge of a nose may look crooked unless the implant prosthesis is located right on the midline. This may be caused by a lack of precise manipulation while creating a pocket for insertion during the operation. Reoperation is the only way to correct this, but in the initial stage, the implant prosthesis may be moved slightly to the appropriate location to correct this problem.

Silicone Implant Protrusion

It is rare that a silicone implant protrudes through the nasal skin, but it is one of the most serious complications of

augmentation rhinoplasty. The tension on the nasal dorsum can be significant—caused by perinasal and perioral motion resulting in a perforation. A second cause may be infection and necrosis of the skin that was compressed by a tightly adhered nasal implant.^{9,10}

Conclusion

Using implant prostheses for augmentation rhinoplasty offsets the need to harvest autologous tissue. For a natural-looking nose in balance with the rest of the face, the use of an excessively large implant should be avoided. Because there are no implant prostheses without side effects, it is important to understand the pros and cons of different types of implant prostheses and to selectively apply them on a case-by-case basis. It is equally important to have patients with the appropriate surgical clearance and to properly carve and finish implants to minimize the occurrence of side effects. Finally, surgeons should have a sense of Asian beauty aesthetics.

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