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Grafts and implants in rhinoplasty—Techniques and long-term results

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Rhinoplasty continues to behoove even the most experienced facial plastic surgeons in achieving long-term predictable success. To achieve the goals of a natural, refined, and esthetically flattering appearance of the nose while maintaining a functionally patent nasal airway, surgeons must adhere to certain guiding principles: preservation of favorable structural components, reorientation and augmentation of selected areas, and conservative resection. In keeping with this paradigm, the astute rhinoplastic surgeon must have thorough knowledge of grafts and implants commonly utilized in rhinoplasty today. After a systematic review of the literature, the authors present the pros and cons of commonly applied graft and implant materials utilized in rhinoplasty. The authors enlighten the reader about the indications of various grafting techniques endorsed by world experts in the field, especially as it pertains to the harvest, preparation, and insertion of these grafts into the nose. Finally, data supporting the long term results of these grafts and implants in rhinoplasty is presented.

Rhinoplasty proves to be among the most difficult of facial plastic surgical procedures to execute and achieve long-term predictable success. The ultimate goal of rhinoplasty is to achieve a natural and esthetically flattering appearance while maintaining a functional airway. This goal is accomplished through preservation of favorable structural components, reorientation and augmentation of selected areas, and conservative resection to promote favorable redrapage of the skin–soft tissue envelope (S-STE). In keeping with this paradigm, an essential component of the astute rhinoplastic surgeon's armamentarium is a thorough knowledge of grafts and implants commonly used in rhinoplasty.

The ideal graft

Despite significant advances in biomedical engineering, the perfect graft material has yet to be attained. Macroscopically, the ideal graft would not create any donor-site morbidity. It would be readily available, inexpensive, easily carved, fixed to the recipient site without difficulty, and not lose its volume or alter its shape over time. The physical properties of the graft should match those of the recipient site, with a proportional level of rigidity or flexibility. Finally, if the indication should arise, one should be able to effortlessly explant the graft without damage to the overlying S-STE.[1]

Microscopically, the ideal graft must be easily biointegrated by the host. This requires the graft to be inert, pure, and lacking any contamination that may promote excessive inflammatory reaction from host macrophages. The surface properties of the graft must encourage attachment from the surrounding connective tissue without excessive mesenchymal infiltration and capsule formation. Although graft pore sizes greater than 50 μm allow for greater host tissue infiltration, increased fixation, and commensurate decrease in infection rates, there is extensive tissue ingrowth that necessitates sacrifice of the S-STE in the event of removal.[2] The graft should not induce cancer, nor should it be a vector that can transmit infectious organisms like hepatitis or HIV. Resistance to infection is also a very desirable feature. The graft should be safe from degradation into hazardous byproducts. Finally, although hypothetical, the graft should not be a catalyst for autoimmune diseases.

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Graft classification

Essentially, grafts can be obtained from 3 major sources: organisms, synthetically manufactured products, and tissue biomedical engineering. Although in its infancy and beyond the scope of this article, biomedical engineering and stem cell research are rapidly advancing fields that may ultimately culminate in the production of genetically compatible living tissues and organs that can be transplanted without immunosuppression; this in essence is "the ideal graft."[3] Grafts that are synthetically manufactured are defined as alloplasts. Grafts procured from organisms are classified based on their genetic relationship to the recipient individual. Autografts are acquired from the same individual or a genetically identical person. Allografts or homografts are grafts derived from genetically different individuals but belonging to the same species, where as xenografts are obtained from organisms belonging to an entirely different species.[4]

Alloplasts

Alloplasts have enticed surgeons with their unlimited availability and concomitant lack of donor site morbidity, ease of contouring, maintenance of shape and volume over time, and relative simplicity of insertion. Although alloplasts have achieved widespread success, it would be remiss to ignore the serious potential, albeit infrequent, complications of infection and aggressive foreign body reaction leading to extrusion and damage to the overlying S-STE.[5]

Many experts believe that the nose is a less-than-forgiving environment for alloplastic implantation. For instance, the nose is the most commonly traumatized area of the face because of its prominent location, placing the alloplast at increased risk for trauma-associated displacement and extrusion. The thin S-STE in Caucasian patients provides little cushioning for the alloplast and, therefore, it cannot be buried deeply to prevent extrusion. Finally, the mobility of the lower third of the nose makes the foundation of the alloplast unstable. Implant instability is a major factor leading to extrusion.

Nevertheless, alloplasts are still widely implemented for dorsal augmentation. They are indicated when large volumes of grafting material are required and the donor site morbidity of harvesting autologous grafts is unacceptable to the patient. Even if the patient meets this criterion, the surgeon must be vigilant of certain relative contraindications to avert disaster. Caution must be exercised in the use of these implants in multiply-revised noses because there is a loss of vascularity and thinning of the S-STE, leading to increased extrusion rates. Alloplasts should be not be used to support the nose (eg, columellar strut), because this increased stress on the implant will inevitably lead to extrusion. Nasal alloplasts should also be avoided in young men who continue to engage in full-contact sports that subject their nose to constant and severe trauma. Except in Asian patients, who are endowed with a thicker S-STE, it is best to avoid alloplasts in young individuals who will have to face the life-long risk of extrusion, which can occur even decades after implantation.

Solid silicone

Dorsal augmentation with solid silicone has enjoyed widespread success in Asia for a multitude of reasons.[6,7] Because the S-STE of Asian patients is thicker, it allows for greater cushioning and protection of the implant. The softer elastopolymer variant of solid silicone places less stress on the overlying S-STE. Finally, the procedure is executed by extremely meticulous and experienced Asian surgeons who have performed thousands of Asian rhinoplasties.[6] The implant (Implantech, Ventura, CA) is available in a prefabricated L-shaped configuration that acts as an onlay graft for both the dorsum and tip. It enhances dorsal height, improves tip definition and projection, counter rotates the tip, and even corrects columellar retraction. In concert, a premaxillary silicone implant is also applied to address maxillary recession, a defining feature of the Asian nose. The authors of series that have up to 10 years of follow-up in Asia report a very low acceptable rate of implant infection, extrusion (0-7.9%), and malposition (5%).[8] As solid silicone is nonporous, extensive capsule formation occurs. At the host–implant interface, there exists some micro-motion between the implant and the capsule, increasing the risk of infection compared with porous implants. As a consequence, there is a lack of enthusiasm for this implant in the Western world.

Gore-Tex (expanded polytetrafluoroethylene, subcutaneous augmentation material)

Gore-Tex (W.L. Gore, Flagstaff, AZ) has become the alloplast of choice for dorsal augmentation for a number of reasons. Microscopically, it consists of multiple nodes connected through an array of fibrils oriented in a grid like pattern. Although Gore-Tex is a porous material, tissue infiltration is limited because of the small average pore size of 22 μm.[9] This creates a favorable condition whereby the implant is adequately stabilized with minimal tissue in-growth and no capsule formation.[10,11] As a result, the rate of infection and extrusion with the use of Gore-Tex is less than that experienced with silicone. Furthermore, it can be explanted without damage to the overlying S-STE compared with more porous materials like Mersilene (Ethicon, Somerville, NJ).

One can use vascular Gore-Tex sheets available in 1-, 2-, or 4-mm thickness or preformed dorsal Gore-Tex implants (subcutaneous augmentation material; Medtronic Xomed, Jacksonville, FL). The authors of a 10-year experience of dorsal augmentation with Gore-Tex revealed a 3.2% infection rate and less than 1% extrusion rate.[12] These complications were approximately four-and-a-half times more common in revision than primary rhinoplasties, reiterating the fact that caution should be exercised when using alloplasts in revision rhinoplasty.

High-density porous polyethylene (HDPPE; Medpor)

Although Gore-Tex is an excellent material for dorsal onlay grafting, it is too soft to provide nasal architectural support. Medpor (Porex Surgical, Newnan, GA) is a more rigid implant that can provide nasal structural support.[13] Although alloplasts carry a significantly increased risk of extrusion when used to support the nose, Medpor may be indicated if autogenous materials are not available or the donor site morbidities are unacceptable to the patient. It is easily carved and can be shaped into structures like a col-