

TITLE: Alloplastic Materials and Homografts in Nasal Reconstruction
SOURCE: Grand Rounds Presentation, UTMB, Dept. of Otolaryngology

DATE: April 20, 2005

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The goal of nasal reconstruction is to create an aesthetically inconspicuous nose while preserving nasal function. In order to accomplish this, the surgeon must apply the principles of aesthetic subunits of the nose and have an appreciation for the three distinct layers of the nose: internal lining, a firm structural foundation, and an outer covering. The reconstructed structural framework of the nose should resist deformity by counteracting retraction and collapse and serve as scaffolding for nasal covering. Autogenous cartilage remains the gold standard for structural reconstruction. However, when autogenous cartilage is in short supply (as in revision nasal surgery), when the amount of cartilage needed is high or the quality of donor cartilage is questionable, other materials have been used for structural reconstruction. Several alloplastic materials have been used for structural repair including expanded polytetrafluoroethylene, silicone, and high density porous polyethylene. Homograft materials include alloderm and irradiated costal cartilage. The use of these materials is reviewed and the growing field of tissue engineering of chondrocytes is discussed.

Alloplasts

Expanded Polytetrafluoroethylene. ePTFE is a polymer carbon and fluorine; this extremely strong bond makes ePTFE nondegradeable and biologically inert with nonstick properties provided by electronegative fluorine. This material has a pore size between 10 and 30 micrometers. Only the perimeter of the implant experiences ingrowth of surrounding tissue. This material can be used in a variety of ways: augmentation of dorsum or lateral nasal sidewall, premaxilla graft, and tip or supratip graft. Ham, in 2003, reviewed several large series of patients in whom ePTFE was implanted during nasal surgery. Rates of infection in all the reviewed series ranged from 0 to 10%. Rates of overaugmentation ranged from 0 to 6%. Rates of removal ranged from 0 to 11%.

Silicone. Silicone has been used as a nasal implant in Asian culture for many years. Pre-fabricated implants are available; as well, implants can easily be carved to the desired shape pre- and intra-operatively. Silicone is non-porous and does not allow tissue ingrowth; a capsule forms around the implant after placement. This is speculated to be the cause for implant migration and extrusion. These implants are commonly used to augment the dorsum and/or as a columellar

strut. Ahn, in 2004, reported a retrospective review of 100 patients for whom he performed nasal augmentation with a combination of cartilage and silicone. Silicone was used to augment the dorsum and cartilage was used at the nasal tip. Patient follow up ranged from 2 to 5 years. No implant extrusions occurred. Five patients required revision due to misalignment of the silicone dorsal implant; two patients required revision for tip graft shifting and one for recurrent dorsal edema. Lam et al reported results of 1097 rhinoplasties in which a “bird”-shaped silicone implant was used. The implant was used to augment the dorsum and tip. He reported infection in 3% of patients and displacement in 3%. No extrusions were encountered. Deva et al reported a series of 422 patients who had undergone nasal augmentation with silicone. 5.5% of those patients had complications requiring removal of the implant within 30 days of surgery. Early complications included: displacement, prominence, hemorrhage and supratip deformity. On late follow up, another 4.3% of patients had implant removal. Late complications requiring implant removal included: displacement, overprominence and extrusion (0.5%).

Porous High-Density Polyethylene. The pore size of this implant is 100 to 250 micrometers in size which allows fibrovascular ingrowth throughout the implant; this has been cited as a reason for resistance of the implant to infection and extrusion. This is also a firm material which can provide much structural support. Pre-formed implants are available (dorsal implant, columellar strut, and external nasal valve battens). This material is available to be individualized by carving as well. Yaremchuk reviewed the literature relating to the morbidity of PHDP implants and found low rates of infection and exposure. The largest series reported was 187 patients receiving PHDP implants at multiple nasal sites. There were 5 infections (3 early, 2 delayed). There were no exposures reported in this series.

Homografts

Irradiated Homograft Costal Cartilage. Homograft cartilage can be used to replace nasal cartilaginous structures. It is readily available, can be easily contoured, shortens operating time by eliminating graft harvest, avoids donor-site morbidity, and has excellent tissue tolerance. Complications associated with irradiated homograft costal cartilage include warping and resorption. Strauch et al reported a series of 55 reconstructive and cosmetic procedures (52 rhinoplasties) in 2002 with follow-up from 7 months to 12 years. He noted only one case of partial resorption and no warping. The author speculated that, if any cartilage is resorbed, the volume deficit may be replaced by fibrous tissue with no loss in functional or cosmetic outcome. Strauch also reviewed the literature on complications associated with irradiated homograft costal cartilage and found a rate of infections between 0 and 4.8%; a rate of resorption between 0.7 and 6.7%; a rate of immediate complications between 1 and 5.5%; and a rate of late complications between 2.1 and 3.3%.

Demirkan et al in 2003 reported a series of 65 patients undergoing rhinoplasty procedures with the use of irradiated costal cartilage. The mean follow up in this study was 33 months. The authors found no resorption and little warping (1.3%); there was a 1.3% extrusion rate.

In 2004, Burke reported results of follow up on 193 patients who had undergone nasal reconstruction with irradiated homograft rib cartilage. The mean follow up was 36 months with a range of 3.3 to 138 months. Grafts were used as caudal strut, dorsal onlay, butterfly valve, tip, and spreader. Graft resorption was the most frequent complication and resulted in a loss of nasal

form or function in 11%.

Alloderm. Alloderm is derived from cadaveric skin; the epidermis and dermal cells are removed via freeze-drying to create an acellular graft. Because alloderm lacks MHC antigens, it does not induce immunologic reactions. It has been used to cover the reconstructed osseocartilaginous framework of the nose in an attempt to achieve a smooth contour and natural feel. Gyskiewicz reported a series of 58 patients receiving alloderm implants as part of a rhinoplasty procedure in 2001. Few patients experienced partial absorption over the nasal dorsum, particularly if they were thin-skinned. Sclafani reported his results with alloderm in 2001. There was a decrease in implant volume over the first six months with stabilization after that time. The authors recommend overcorrection to compensate for the initial resorption.

Chondrocytes and Tissue Engineering

There is increasing interest in engineering autologous chondrocytes into implantable cartilage grafts. Chondrocytes can be harvested from the nasal septum and cultured in a two-dimensional monolayer. Koch et al describe the cultivation of chondrocytes on biodegradable polymer scaffolds. Chia et al describe the use of alginate gel to induce chondrocytes to produce substantial cell-associated matrix; this method was used to create neocartilage without the use of a biodegradable scaffold. Yanaga reported a method of harvesting chondral cartilage and culturing it into a gel-type mass which was later transplanted into patients via injection into a subperiosteal pocket on the nasal dorsum. The grafted chondrocytes develop into mature chondrocytes after approximately one month. The results of this study were stable with follow up between 6 and 24 months. Further work is ongoing in this field.

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