Modifications to the Butterfly Graft Used to Treat Nasal Obstruction and Assessment of Visibility

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IMPORTANCE Graft visibility in the supratip region has been the main criticism of the butterfly graft. Because of the graft location, slightly unfavorable supratip fullness can occur, resulting in patient dissatisfaction with the cosmetic result.

OBJECTIVE To describe the clinical outcomes and visibility of the butterfly graft after technique modifications.

DESIGN, SETTING, AND PARTICIPANTS In this retrospective review of adults who had undergone primary or secondary rhinoplasty with butterfly grafting from July 1, 2013, through July 31, 2014, at a tertiary care center at an academic institution, an operative log and photographs were reviewed in an effort to analyze outcomes of butterfly graft use in rhinoplasty.

MAIN OUTCOMES AND MEASURES Nasal obstruction and visibility of the butterfly graft.

RESULTS Thirty-four patients were included in the case series (mean [SD] age, 46 [19.4] years; 23 women and 11 men). The mean (SD) length of the graft was 3.4 (0.5) cm, and the mean (SD) width was 0.9 (0.2) cm. A significant decrease was found in the Nasal Obstruction Symptoms Evaluation score after surgery (mean [SD] preoperative score, 69 [17]; mean [SD] postoperative score, 23 [24]; P < .001). In regard to appearance, 25 patients (74%) rated their appearance as improved or no changes, 6 (18%) as minimally worse, and 1 (3%) as much worse. Fifty-nine observers participated in the masked survey for the study. When the graft was present, observers detected it 59.7% (282 of 472 answers) of the time. When the graft was not present, its presence was suspected 36.5% (237 of 649 answers) of the time.

CONCLUSIONS AND RELEVANCE The modified butterfly graft is a longer and thinner graft than the originally described butterfly graft. It is still an effective tool in the treatment of nasal obstruction with acceptable visibility. In most cases, it is difficult for health care professionals to identify the presence of the graft.

LEVEL OF EVIDENCE 4.
The butterfly graft is a surgical technique to treat nasal obstruction that uses auricular conchal cartilage in reconstructing the internal nasal valve. The technique was originally described by Claus Walter in Germany in 1977 and later popularized by Clark and Cook in 2002. The internal nasal valve accounts for approximately 50% of nasal air resistance, making it a critical location in nasal anatomy. Nasal obstruction at the internal nasal valve occurs when the angle of the upper lateral cartilages (ULCs), the septum, and the turbinate is reduced. As originally described, the butterfly graft is a triangular cartilage that is placed over the caudal portion of the ULCs and slightly under the cephalic margin of the lower lateral cartilages (LLCs) (Figure 1). The graft treats nasal obstruction by stenting open the ULCs and LLCs, thus increasing the angle of the internal nasal valve and improving nasal airflow. In the original report of the butterfly graft, all patients experienced improvement in nasal breathing, and 97% had complete resolution of symptoms. Similarly high success rates have been replicated by several other surgeons. Graft visibility in the supratip region has been the main criticism of the butterfly graft. Because of the graft location, slightly unfavorable supratip fullness can result. Recently, Chaiet and Marcus quantified a mean change of 6.4% in tip volume with the butterfly graft technique. Despite careful surgical technique, experienced surgeons report that up to 19% of patients are dissatisfied with the cosmetic result.

The senior author (T.D.W.) has made efforts to improve the butterfly graft technique with modifications that maintained the benefits to the internal nasal valve patency and reduced graft visibility. The major modification to the butterfly graft has been an alteration in shape to decrease the width and increase the length of the graft. The longer graft now reaches the pyriform aperture. The width was decreased to help camouflage the graft and prevent visibility. The modifications were developed after 10 years of using the original technique for the treatment of nasal obstruction.

In this study, we describe the shape of and camouflage modification to the butterfly graft in an effort to expand the usefulness of this graft to rhinoplasty surgeons. The changes are described in detail, with diagrams and intraoperative photographs provided. The study includes a retrospective case series of patients treated for nasal obstruction using the modified butterfly graft with patient-reported outcomes. An

Figure 1. Modifications to the Butterfly Graft

<table>
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<th>A</th>
<th>Original butterfly graft</th>
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<tr>
<td>B</td>
<td>Modified butterfly graft</td>
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<tr>
<td>C</td>
<td>Intraoperative photograph of modified butterfly graft</td>
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<td>D</td>
<td>Modified butterfly graft sutured in place</td>
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Diagrams of the frontal view of the internal structure of the nose showing the original description of the butterfly graft (A) and the new modifications of the technique (B). Note the approximate proportions to the rest of the nose, the decrease in width (cephalic to caudal), and the increase in length (left to right) to reach the pyriform aperture in the modified technique. Intraoperative photographs of the modified butterfly graft technique over the soft tissue envelope and of the graft sutured in place (C and D).
A Modified Butterfly Graft Technique for Treating Nasal Obstruction

The electronic survey of masked observers in the medical field, which included residents, fellows, and attending physicians in otolaryngology, was conducted. Observers were asked to identify the presence or absence of the butterfly graft in patient photographs to determine graft visibility.

Methods

The senior author’s (T.D.W.) operative log and photographs were retrospectively reviewed in an effort to analyze outcomes of butterfly graft use in rhinoplasty. The primary outcomes for the study were nasal obstruction and visibility of the butterfly graft. This study includes a case series and an electronic survey. The electronic survey was designed for masked observers to examine postrhinoplasty photographs and determine the visibility of the graft. This study was approved by the institutional review board of Oregon Health and Science University for waiver of consent. All data were deidentified after data collection.

Case Series

The patients included in the case series were adults (at least 18 years old) who had undergone primary or secondary rhinoplasty with butterfly grafting from July 1, 2013, through July 31, 2014. All the patients were operated on by the senior author (T.D.W.) or under the direct supervision of the senior author. Nasal Obstruction Symptoms Evaluation (NOSE) scores were collected preoperatively and at 1-month, 4- to 6-month, 1-year, and subsequent follow-up appointments after surgery. Higher scores indicate worse nasal obstruction. NOSE scores are validated scores for self-reported symptoms of nasal obstruction. Patients were asked to self-rate their final appearance at their last follow-up. The Likert scale responses for self-rated appearance were as follows: 1, much improved; 2, minimally improved; 3, no change compared with preoperative appearance; 4, minimally worse; or 5, much worse. The medical records were reviewed to obtain clinico-demographic data, graft sizes, and concomitant surgical procedures performed during rhinoplasty. Patient-reported nasal allergies, chronic rhinosinusitis, and obstructive sleep apnea were collected as possible confounding variables, leading to nasal obstruction not treatable by rhinoplasty. A minimum follow-up of 1 year was necessary for inclusion in the study.

Electronic Survey

The electronic survey contained 1-year postrhinoplasty photographs of patients with or without butterfly grafts. Masked observers within the medical school class at OHSU were asked to evaluate the photographs to determine whether the graft was used. A frontal, profile, and three-quarter view of every patient was provided. Photographs were randomly selected from the postoperative collection for patients in this case series and matched controls who underwent rhinoplasty without butterfly graft from the same operative period. Figure 2 shows examples of 2 sets of photographs used in the survey: 1 patient had a butterfly graft and 1 patient did not. A total of 20 patients were included—12 without butterfly grafts and 8 with butterfly grafts. Photographs were standardized to the best of our abilities. The survey was administered to medical students only. The survey was administered via SurveyMonkey. We evaluated the accuracy in detecting when the butterfly graft was used. The full electronic survey with all photographs is available in the eMaterial in the Supplement.

Statistical Analysis

Spearman rank correlation was used to describe associations among clinico-demographic characteristics, surgery and graft characteristics, and outcomes on the NOSE and Likert scales. Preoperative and postoperative NOSE scores were compared using the Wilcoxon rank sum test. The Friedman test was used to compare the NOSE scores over time (preoperative and postoperative at 1 month, 4-6 months, and 1 year after surgery). Data from the case series were analyzed using STATA statistical software, version 10 (StataCorp).

A χ² analysis was used to evaluate the frequency of responses to the electronic survey by clinico-demographic characteristics and level of training. Data from the electronic survey were analyzed using SPSS statistical software, version 22.0 (SPSS Inc).

Results

Case Series

During the study, 65 patients underwent butterfly grafting during their rhinoplasty for nasal obstruction. Of these, 34 patients (52%) had longer than 1 year of follow-up.

Clinicodemographic characteristics of the patients in the case series are given in the Table. A considerable number of
revision rhinoplasties are included in the study (14 patients). The mean (SD) length (left to right) of the butterfly graft was 3.4 (0.5) cm (range, 2.5–5.0 cm), and the mean (SD) width (cephalic to caudal) was 0.9 (0.2) cm (range, 0.6-1.5 cm). No difference in size by sex was found. At the time of rhinoplasty, other procedures were also performed in all patients. Inferior turbinate reduction was performed in 32 patients (94%), extracorporeal septoplasty in 29 patients (85%), tip refinement in 30 patients (88%), spreader grafts in 29 patients (85%), osteotomies in 14 patients (41%), lower lateral cura strut or cephalic turn-in in 7 patients (20%), dorsal onlay graft in 5 patients (15%), hump re-duction in 3 patients (9%), endoscopic sinus surgery in 3 patients (8%), and alar base reduction in 2 patients (6%).

The mean (SD) follow-up was 16 (2) months. The mean postoperative NOSE scores were significantly lower than the preoperative scores, indicating significant improvement in nasal obstruction. Of the 34 patients in the study, 19 (56%) had the NOSE scores at all time points in the study. For the 34 patients, the mean (SD) preoperative NOSE score was 69 (17), and the mean (SD) postoperative NOSE score was 23 (24) (P < .001). Figure 3 shows the NOSE scores for these patients over time. The improvement in postoperative NOSE scores is evident at the first month after surgery and remains stable over time (Friedman χ² = 34.2, P < .001). No difference was found in final postoperative NOSE score by clinodemographic characteristics or additional surgery or graft characteristics. Patient-reported postoperative appearance 1 year after surgery was as follows: 11 patients (32%) reported appearance as much improved, 8 (24%) as minimally improved, 6 (18%) as no change, 6 (18%) as minimally worse, 1 (3%) as much worse, and 2 (6%) did not respond to this question. No associations among nasal obstruction, other procedures, or additionalsurgery or graftcharacteristics.Patient-reportedpostoperativeappearance1yearaftersurgerywasasfollows:11patients(32%)reportedappearanceasmuchimproved,8(24%)asminimallyimproved,6(18%)asnochange,6(18%)asminimallyworse,1(3%)asmuchworse,and2(6%)didnotrespondtothisquestion.Noassociationsamong nasal obstruction, other procedures, or additional surgery or graft characteristics. Patient-reported postoperative appearance 1 year after surgery was as follows: 11 patients (32%) reported appearance as much improved, 8 (24%) as minimally improved, 6 (18%) as no change, 6 (18%) as minimally worse, 1 (3%) as much worse, and 2 (6%) did not respond to this question. No associations among nasal obstruction, other procedures, or additional surgery or graft characteristics. Patient-reported postoperative appearance 1 year after surgery was as follows: 11 patients (32%) reported appearance as much improved, 8 (24%) as minimally improved, 6 (18%) as no change, 6 (18%) as minimally worse, 1 (3%) as much worse, and 2 (6%) did not respond to this question. No associations among nasal obstruction, other procedures, or additional surgery or graft characteristics.

Electronic Survey
The electronic survey containing 1-year postrhinoplasty photographs of patients with or without butterfly grafts was completed by a total of 59 medical students at OHSU. Survey respondents were masked to which patients underwent butterfly grafting. All the respondents were between 20 and 40 years of age. Thirty respondents (51%) were female.

A total of 20 patients were included—12 without butterfly grafts and 8 with butterfly grafts. Figure 2 shows photographs included in the electronic survey of patients with and without the butterfly graft. The patients were randomly selected, and the last postoperative photograph was used for the survey. Of the 1121 responses, 643 (57.4%) correctly determined whether the patients in the photograph had a butterfly graft, 410 (35.8%) were incorrect, and 77 (6.9%) did not determine whether a butterfly graft was used.

For the photographs with butterfly grafts, 282 of the 472 answers (59.7%) were correct in stating that the patient had a butterfly graft and 160 of 472 (33.9%) were incorrect. For photographs without the butterfly graft, 361 of 649 answers (55.6%) correctly stated that no butterfly graft was present and 237 of 649 (36.5%) incorrectly stated that a graft was present. Unable to determine responses occurred in 30 of the 472 photographs (6.4%) with butterfly grafts and 51 of 649 photographs (7.9%) without butterfly grafts. One photograph stood out because 91% of people correctly stated that a butterfly graft was present (eFigure in the Supplement).

Discussion
The butterfly graft treats nasal obstruction by stenting the internal nasal valve open and supporting the LLCs. The major modifications to the graft described in this article consisted of increasing the length of the graft to reach the pyriform aperture and decreasing the width to prevent visibility over the dorsum. In the original report of the butterfly graft by Clark and Cook, the graft lengths measured approximately 2.5 cm in men and 2.2 cm in women. In our study, the mean length was 3.5 cm for men and women. We believe the benefits of reaching the pyriform aperture are to increase the radius of the area functionally improved by the graft and to support the graft.
on a stable osseous structure. The width of the graft in the original report was 1.2 cm in men and 0.9 cm in women. In our study, the mean width was 0.9 cm. In our experience, the grafts are less noticeable the more caudally placed and more noticeable the more cephalically placed. Decreasing the width prevents the graft from extending into the rhinion area. Enough width should be preserved to support the internal nasal valve. The differences in changes are shown in Figure 1. However, we did not compare the old and new techniques but slowly over time adopted the currently used technique.

In addition to the size and shape modifications, other technique modifications are recommended. The graft is obtained from the antihelical crus as previously described. When carving the graft, the perichondrium over the anterior portion of the graft is maintained in an effort to preserve elastic recoil of the graft. The perichondrium over the posterior portion is removed to reduce bulkiness along the dorsum because this side will become the most superficial portion of the graft. The thickness of the graft differs from cephalic to caudal. The cephalic portion is thinner than the caudal portion because it is progressively shaved to smooth the transition to the dorsum. Before the graft is secured, the midline is marked (Video and Figure 1) to ensure proper alignment. Often the dorsum is shaved to accommodate blend with the thickness of the graft. The graft is placed partially under the most cephalic portion of the LLCs. If necessary, the scroll is divided and the vestibular skin is separated from the undersurface of the LLCs to accommodate the graft. Our method for securing the graft is a horizontal mattress suture over the center of the graft, as opposed to the originally described 2 sutures at the lateral edge of the LLCs. The suture prevents migration of the graft. Once the graft is in place, the dorsum is examined for any possible visibility. If necessary, the graft can be carved in situ to reduce the cephalic edge. The graft can also be removed and further dorsum carving performed to optimize contouring. Dorsal onlay grafts can also be used to camouflage the graft. Often the onlay grafts are placed over the butterfly graft and span the anterior septal angle to the radix. Rarely do the onlay grafts begin cephalic to the butterfly graft because it is difficult to prevent visibility at the transition point between the 2 grafts. In our study, dorsal onlay grafts were rarely used for camouflaging (only 3%).

Because placement of the butterfly graft was not the only procedure in any of the rhinoplasties in this series, the outcomes are confounded by other procedures. However, all patients experienced improvement in their nasal breathing as rated by the NOSE survey. This finding confirms the previously described benefit in treating nasal obstruction with the butterfly graft, even with the modifications. In addition to nasal obstruction, self-reported postoperative appearance appears to be favorable. Only 1 patient described the appearance as significantly worse, and 6 patients described it as minimally worse. We did not ask whether the concerns regarding appearance were about the graft or supratip area.

In an effort to better study the visibility of the nasal graft, the electronic survey was designed to determine visibility of the graft specifically. In most cases, it was difficult for the respondents of the survey to determine whether a patient had undergone butterfly grafting. Survey respondents were only correct in 57.4% of the cases even after they had been prompted in the survey to look for the butterfly graft. Even in cases without a butterfly graft, the respondents had difficulty noticing the absence of the graft. In 36.5% of the photographs without grafts, the respondents stated the butterfly graft was present. This is a high false-positive identification of the graft with very low specific identification of the graft suggestive of random guessing by the participants in the survey. Respondents easily identified the butterfly graft in 1 patient (eFigure in the Supplement). Although we view this outcome as unsatisfactory and readily observe supratip fullness, this patient is satisfied with her postoperative results and has declined revision surgery. On the basis of our results, it appears that casual observers have difficulty identifying the presence of the graft in most cases, and the butterfly graft can be adequately camouflaged.

Conclusions

Butterfly grafts are rhinoplasty reconstructive techniques used to treat internal nasal valve collapse. We describe graft modifications, including increased length and decreased width, to improve the butterfly graft technique. Modified butterfly grafts achieve predictable improvement in nasal breathing with acceptable cosmetic results.

Conflict of Interest Disclosures: None reported.

REFERENCES