

# Analysis of Vector Alignment With the Zitelli Bilobed Flap for Nasal Defect Repair

## *A Comparison of Flap Dynamics in Human Cadavers*

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**Objective:** To determine whether differences of angles between the alar rim and the long axis of the secondary defect in a Zitelli bilobed flap affect alar displacement in a fresh cadaver model.

**Methods:** In fresh cadaver heads, identical, unilateral 1-cm circular defects were created at the superior alar margin. Three different laterally based bilobed flap templates for reconstruction were used. One template, used on 3 cadavers, had an angle of 60° between the alar rim and the long axis of the secondary defect. Another template, used on 3 cadavers, had an angle of 90°. The last template had an angle of 135° and was used on 2 cadavers. Photographs were taken before the repair and after with the camera and cadaver heads in the same spatial relationship to each other.

**Results:** In the 3 cadavers that had repair using an angle of 60°, all cadavers experienced alar retraction, with a

mean displacement of 1.3 mm. This was not a statistically significant change ( $P=.07$ ). In the defects that had repair using an angle of 90°, there was also no significant alar displacement ( $P=.72$ ). In the 2 cadavers that underwent repair using an angle of 135°, both alae underwent depression by 1.0 mm. When the differences achieved between the different angles were compared, there was a significant difference in measured distortion between the cadavers that had 90° and 60° vector placement ( $P=.02$ ). There were no measurable changes to the contralateral maximal nostril distance.

**Conclusions:** Vector alignment can have an impact on nostril displacement. In bilobed flaps, the axis of the secondary defect may play an important role. This study suggests that secondary defects aligned perpendicular to the nostril have the least amount of alar distortion.

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**F**IRST DESCRIBED BY ESSER<sup>1</sup> IN 1918, the bilobed flap is a transposition flap used to reconstruct defects of the lower third of the nose. It is a random-pattern, single-stage flap that lacks a large-caliber vessel at its base. A bilobed flap uses 2 adjacent lobes or flaps that are rotated around a pivot point. The primary lobe, usually the same size as the defect, is used to restore the defect. The secondary lobe is used to repair the donor site of the primary lobe. The donor site of the secondary lobe is closed primarily.<sup>2</sup>

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The bilobed flap is the reconstruction of choice for most small- to medium-sized defects of the lower third of the nose, especially the lateral nasal tip, supratip, or ala near the nasal tip. In this area, it is more versatile than any other flap. Because it takes skin from adjacent areas, it pro-

vides excellent color match and is relatively free from distortion. Contour deformities are rare.<sup>3</sup>

The bilobed flap recruits lax tissue to allow for closure with less tension. This lax tissue comes from the loose skin of the upper dorsum and nasal sidewall.<sup>2</sup> However, the potential for tension-related complications exists. A major disadvantage of the bilobed flap is the potential for alar retraction. This complication rate has been reported to be around 5%.<sup>4</sup>

To ensure a safe blood supply, the width of the second flap should approach the width of the first. Although Esser<sup>1</sup> described the second flap as having the same size as the first, this is not necessary. The first flap is usually larger than the second.<sup>1</sup> Undersizing the primary or secondary lobe will result in increased tension, which leads to alar distortion. Cho and Kim<sup>5</sup> attributed this to excessive tension on closure of the primary lobe and distal defect due to a tethering at the base of the pedicle. By increasing the length of the pri-



**Figure 1.** The angle between the alar and the long axis of the secondary defect is demonstrated using red lines. The outline of the repair design is drawn in black.



**Figure 2.** This is an example of the prerepair measurement. At the nostril, a line is drawn from the anterior aspect of the nostril to the posterior aspect. The short black line is the point of maximal retraction, placed and measured perpendicular to this line.

mary flap by 10% compared with the standard design, Cho and Kim<sup>5</sup> demonstrated in fresh cadaveric specimens that a markedly decreased amount of distortion can be attained. Zitelli<sup>6</sup> responded to this study with a recommendation that a longer flap is necessary only when there is skin that is too tight for rotation of the flaps and closure of the secondary flap donor site. This type of situation exists at the immobile skin of the inner canthus, where there is little loose skin. Oversizing of the flaps may lead to trapdoor deformity and uneven contours. In cases of thick skin, the primary lobe should be the same size as the defect owing to limited ability to stretch the primary lobe.

The individual characteristics of each nose play an important role in the potential of alar distortion. The strength of cartilage and thickness of skin are the 2 important aspects of the alar architecture that have potential sequelae. Lower lateral cartilages with more thickness, and thus less compliance, are less likely to be distorted by soft-tissue tension vectors. Given its ability to stretch, thin skin will be more compliant with tension forces than thick skin. Ideal patients have thin and mobile skin. Sebaceous skin has less mobility for transfer and an increased risk of complications such as necrosis, trapdoor



**Figure 3.** This is an example of the postrepair measurement.

deformity, and depressed scars. Because of limitations of the lax donor skin or the upper nose, the flap should not be used for areas larger than 1.5 cm.<sup>2</sup>

The bilobed flap has a high flexibility of flap design variation and tissue movement. Esser<sup>1</sup> stated that the angle of tissue transfer had to be 90°. However, subsequent authors<sup>7</sup> have found that the angle can be decreased significantly to suit the situation. The chosen angle has effects on tension vectors. The direction of vector alignment plays a central role in alar retraction.

The secondary lobe may play a larger role in alar displacement than previously thought.<sup>8</sup> Closure of the secondary donor site involves tension. The vector of this tension can vary depending on the angle between the axis of the secondary lobe and the alar rim. Different variations of the angle exist, with most falling between 60° and 135°. If the sum of forces has a vector component that is perpendicular to the long axis of the ala, this will act to either retract the ala cephalically or displace it caudally. However, if the sum of vector forces is parallel to the alar rim, the tension should have no effect on alar position in a rostral or caudal direction. To our knowledge, no previous study has evaluated vector alignment's effect on nostril appearance. Our objective was to determine whether differences in this vector alignment affect the degree of alar distortion.

## METHODS

Eight fresh cadaver heads were obtained. Using a 1-cm circular template, standardized 1-cm circular defects were created in the same location in each cadaver head. The full-thickness skin defect was placed with its center at the superior alar margin (**Figure 1**). Each cadaver's nose was limited to 1 defect.

Three different templates for reconstruction were used. Three defects (on 3 separate cadavers) were repaired with a template that had an angle of 60° between the long axis of the secondary lobe defect and the alar rim. Figure 1 demonstrates the repair outline from this template. Three defects (on 3 separate cadavers) were repaired with an angle of 90° between the long axis of the secondary lobe defect and the alar rim. On 2 separate cadavers, 2 defects were repaired with an angle of 135° between the long axis of the secondary lobe defect and the alar rim. All defects were repaired by the same surgeon (C.H.) using similar techniques and similar amounts of undermining.

**Table. Measurements and Analysis**

Group, Cadaver No. <sup>a</sup>	Width on Profile View, mm <sup>b</sup>		Difference, mm <sup>c</sup>	Mean Difference, mm	P Value <sup>d</sup>	
	Preoperative	Postoperative			Within Group	Between Groups
60° Group						
1	4.4	5.0	0.6	1.3	.07	.02
2	2.8	4.3	1.5			
3	2.3	4.2	1.9			
90° Group						
4	1.9	1.4	-0.5	0.1	.72	NA
5	1.8	2.3	0.5			
6	3.2	3.6	0.4			
135° Group						
7	2.8	1.8	-1.0	-1.0		
8	2.3	1.3	-1.0			

Abbreviation: NA, not applicable (difference between the 90° and 135° groups).

<sup>a</sup>Angle between ala and axis of secondary defect.

<sup>b</sup>Midnostril to ala.

<sup>c</sup>Positive values indicate alar retraction; negative values indicate alar depression.

<sup>d</sup>Paired *t* test.

Using a camera held in a fixed position, standardized profile photographs were taken using a digital camera with a 100-mm ultrasonic lens (model EOS D30; Canon USA Inc, Lake Success, New York). Photographs were taken before and after repair with the camera and cadaver heads in the same spatial relationship to each other. Prerepair and postrepair photographs were also taken from the contralateral profile position.

Alar retraction was calculated using Adobe Photoshop CS (Santa Clara, California). Alar retraction was defined by drawing a line from the anterior aspect of the nostril to the posterior aspect. A point of maximal retraction was calculated. **Figure 2** presents an example of how the measurement was performed on a cadaver before repair. **Figure 3** demonstrates the measurement after repair. The 1-cm defect was used as a fixed measurable distance to calibrate the measured point of maximal retraction and give a distance in actual millimeters. This also increased the accuracy of standardization of the distance and position between prerepair and postrepair photographs.

## RESULTS

As shown in the **Table**, in the 3 cadavers that underwent repair using an angle of 60°, all had alar retraction, with a mean displacement of 1.3 mm. This was not a statistically significant change ( $P = .07$ ).

In the defects that underwent repair using an angle of 90°, 2 of 3 cadaver ala had measured retraction. The other cadaver had a depression of the ala. The mean direction of distortion was cephalad, by 0.1 mm. However, this did not demonstrate statistically significant retraction of the position of the ala ( $P = .72$ ). In the 2 defects that underwent repair using an angle of 135°, both ala underwent depression by 1.0 mm.

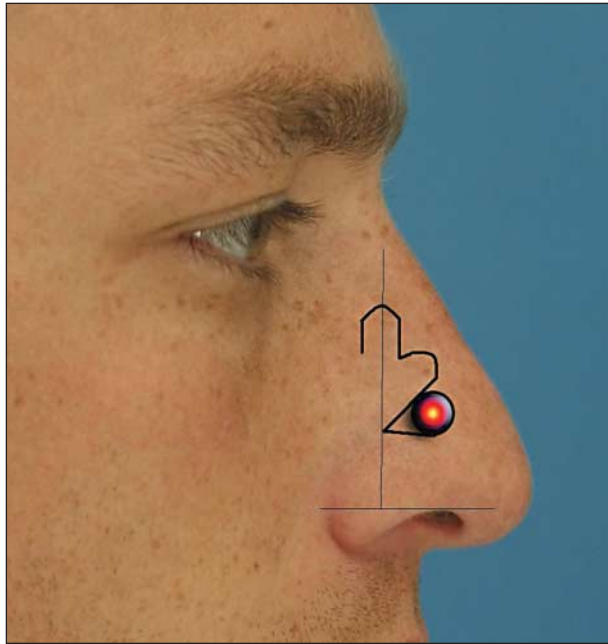
When the differences achieved between the different angles were compared, there was a significant difference in measured distortion between the cadavers that had 90° and 60° vector placement ( $P = .02$ ). There were no measurable changes to the contralateral maximal nostril distance.

## COMMENT

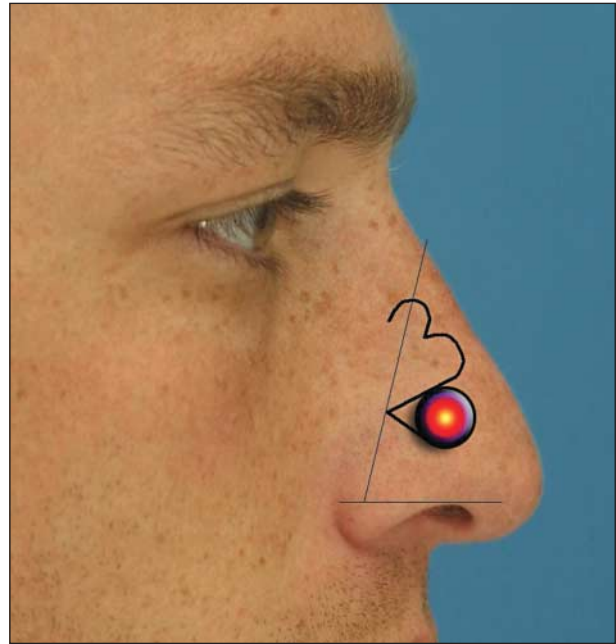
No standard approach exists for the repair of a nasal defect. Each defect is unique and must be assessed based on its location, size, skin type, and support. The bilobed flap has been a workhorse for small- to medium-sized defects (<1.5 cm). Many techniques have been developed to decrease the probability of alar distortion.

This study demonstrates that the angle between the alar rim and long axis of the secondary defect can affect alar distortion. The least amount of alar retraction is achieved with an angle of 90° between the long axis of the alar rim and the long axis of the secondary defect. When analyzing the tension vectors produced by closing the secondary defect, the axis of the tension vector is parallel to the alar rim. Therefore, one would expect that this tension would not cause the ala to be pulled cephalically. **Figure 4** demonstrates a design in which the angle between the alar rim and axis of the secondary defect is close to 90°. **Figure 5** demonstrates the direction of pull when the secondary defect is closed. The direction of pull (indicated by the arrows) is parallel to the alar rim. Thus, no retraction takes place owing to the tension at the site of the secondary defect.

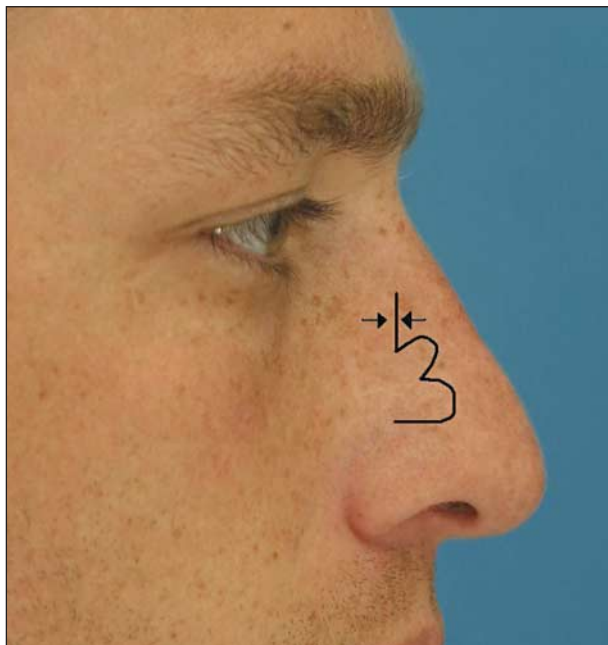
However, a more acute angle is more likely to result in alar retraction. When a more acute angle is used, a tension vector angle is produced that lies in a direction that can potentially pull the alar rim in a cephalad direction. **Figure 6** demonstrates a design in which the angle between the alar rim and axis of the secondary defect is close to 60°. **Figure 7** demonstrates the direction of pull when the secondary defect is closed. The arrows along the side of the secondary defect demonstrate the direction of pull from the closure of the secondary defect. The arrow near the nostril shows the vector component perpendicular to the alar rim that may cause alar retraction. Using an angle larger than 90° between the alar rim and axis of



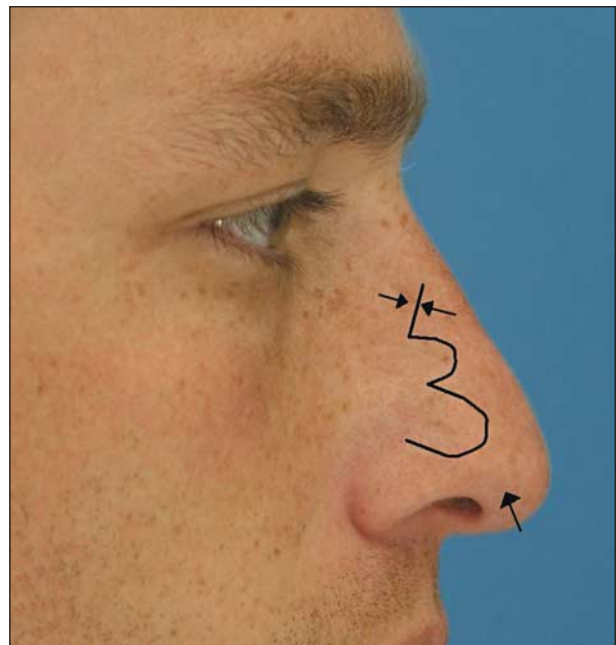
**Figure 4.** A prerepair schematic of a template with an angle of 90° between the alar rim and long axis of the secondary defect.



**Figure 6.** A prerepair schematic of a repair using a more acute angle.



**Figure 5.** A postrepair schematic of a repair using an angle of 90°. The tension vectors due to closure at the secondary defect are parallel to the alar rim. Therefore, no component of the tension from the secondary site should affect the position of the alar rim. The pair of arrows indicates the direction of pull.



**Figure 7.** The postrepair schematic of using a more acute angle demonstrates that tension forces have a component that is perpendicular to the alar rim (inferior single arrow). This may act to cause or contribute to alar retraction. The pair of arrows indicates the direction of pull.

the secondary defect demonstrated alar depression in both cadavers. When the angle becomes more obtuse, there is potential for vectors of the secondary defect to affect the position of the ala.

Individual differences between each cadaver head may have led to different amounts of retraction or depression. Although all defects and repairs had the same dimensions, the cadaver noses were different sizes. There were also noticeable differences in skin thickness and cartilage within the ala. Despite this, the technique was not altered.

This study does not account for long-term wound healing dynamics. Scar contracture may lead to delayed alar retraction. Scar and flap contracture is an expected process in the healing of any flap. Minimizing the risk of delayed alar contraction due to scar and flap contraction must be prioritized. The vector analysis conducted in this study supports the observation that larger bilobed flaps with more acute angles have more alar retraction. Less initial retraction due to less tension in the cephalad direction may lead to less ultimate alar retraction.

It is important to note that there were no measurable changes to the contralateral side in any of the cadavers. We did not use the contralateral side as a control owing to the potential of "interference" from secondary lobe tension factors.

In conclusion, vector alignment can have an impact on nostril displacement. In bilobed flaps, the axis of the secondary defect may play an important role. This study suggests that secondary defects aligned perpendicular to the nostril have the least amount of movement on the cadaver model.

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