Cadaveric analysis of nasal valve suspension

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ABSTRACT

This study was designed to measure the efficacy of a nasal valve suspension technique and determine the adequate traction length without creation of nasofacial fullness in a cadaveric model. Seven fresh frozen cadaveric heads were evaluated. Minimal cross-sectional (MCA) areas were measured with a transient-signal acoustic rhinometer (Ecco Vision; Hood Instruments, Pembroke, MA) before and after suspension. The adequate traction length, which did not cause obvious changes, was determined. Five millimeters of lateral nasal valve traction was determined to be the maximal traction achievable without creating facial fullness. After lateral nasal suspension, average MCA increased by 13.7%. Average distance to the MCA from the nostril changed from 1.57 to 1.76 cm. Postsuspension values were significantly higher than the presuspension values (p < 0.05). Nasal valve suspension with 5 mm of lateral traction has a significant impact on nasal valve area without obvious nasofacial changes.

The anterior part of the nose contains its narrowest segment, the nasal valve region, which is acknowledged for its importance for sufficient nasal airflow.[1] Nasal valve stenosis can cause significant nasal obstruction. Over the years, various techniques have been used to correct nasal valve stenosis. The spreader graft, alar batten graft, composite graft, and flaring suture are frequently used techniques that have been described, with mixed results.[2–5]

The nasal valve suspension was first described by Paniello and is a theoretically simple technique to correct nasal valve stenosis.[6] Nasal valve suspension involves placement of a permanent suture from the lateral alar cartilage to the bone of the infraorbital rim. It provides a direct upper lateral vector on the nasal valve area. Up to now, several authors have reported the effects of the nasal valve suspension technique, but there are still some drawbacks including unclear objective efficacy and postoperative nasofacial fullness.[6–11]

The purposes of this study were to (1) measure the efficacy of a nasal valve suspension technique and (2) determine the adequate efficacious traction length without causing severe nasofacial fullness in a cadaveric model.

MATERIALS AND METHODS

Cadavers with severe septal deviation or external nose deformities were excluded. Seven fresh frozen cadaveric heads (two male and five female heads) were defrosted before evaluation. To clear and hydrate, the nasal cavity was prepared by warm saline irrigation and suction three times. A transient-signal acoustic rhinometer (Ecco Vision; Hood Instruments, Pembroke, MA) was used to obtain the acoustic measurements according the manufacturer's specifications. For each subject, an external nasal adapter was selected for proper fit and a small amount of ointment was applied to prevent acoustic leakage. Special care was taken not to distort the nasal valve area.

The surgical technique was adopted from Friedman.[8,9] The incision was made to just below the infraorbital rim within a natural skin crease. A 3-0 polypropylene suture was passed from the nasal valve area into the infraorbital incision. After 3-, 5-, 10-, and 15-mm traction, we determined the proper amount of traction length to avoid obvious widening and fullness in the nasofacial groove. Incremental increases in traction were measured along with observation of nasofacial fullness. Up to the 5-mm length of traction, there were no significant changes in the nasofacial groove. Above this, nasofacial fullness was observed. Thus, 5 mm was used for standard traction length for acoustic rhinometry measurements. In each nose, the minimal cross-sectional area (MCA) and distance from nostril to MCA were measured before and after 5-mm traction was placed. All acoustic rhinometry measurements were repeated three times. Statistical calculations were performed using SPSS (SPSS, Inc., Chicago, IL). A paired samples *t*-test was used to compare the values.

RESULTS

A total of 14 nostrils were analyzed. We obtained the acoustic rhinometry data for MCA of the nasal valve area and the distance to the nasal valve from the nostril. Average MCA before surgery was 0.86 cm. After

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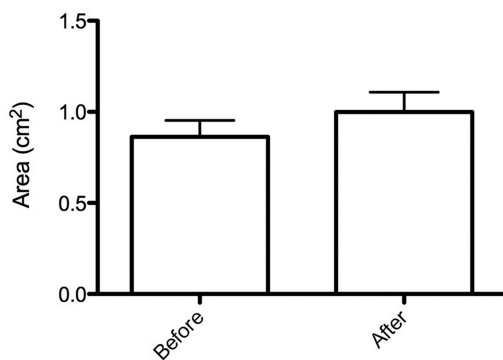
MCA area before and after suspension(n=14)

Figure 1. *Changes in the minimal cross-sectional area (MCA) induced by lateral nasal suspension (mean ± SD; p < 0.05).*
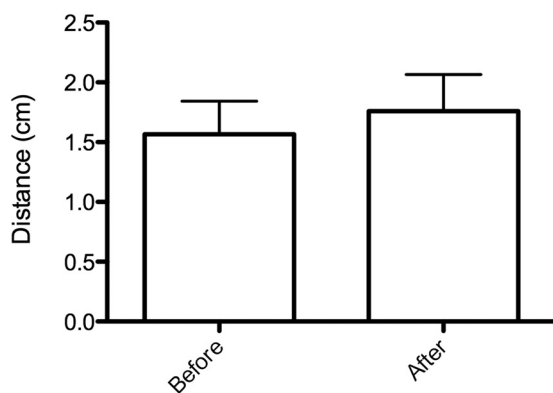
Distance from MCA to nostril (n=14)

Figure 2. *Changes in the distance from minimal cross-sectional area (MCA) to nostril induced by lateral nasal suspension (mean ± SD; p < 0.05).*

Figure 3. *Photograph showing nasofacial grooves after suspension. After 5-mm-length traction, there was no obvious fullness in right nasofacial groove (∗). Ten-millimeter-length traction caused definite changes in the left side (★).*

the nasal suspension, MCA increased by 13.7%. Postoperative MCA values were significantly higher than the preoperative values ($p < 0.0$; Fig. 1). The average distance to the MCA from the nostril changed from 1.57 to 1.76 cm ($p < 0.05$; Fig. 2). Compared with 10-mm-length suspension, 5-mm lateral nasal suspension did not cause definite nasofacial fullness (Fig. 3).

DISCUSSION

In many texts, the internal nasal valve is described as an area bordered by the caudal margin of the upper lateral cartilage and the nasal septum, with normal angles 10–15°.[1,2] At this point more than one-half of total nasal resistance occurs and it can be the main site of nasal resistance. The technique classically described to correct a narrow nasal valve is the placement of a cartilaginous spreader graft between the upper lateral cartilage and the septum.[3–5,12] The concept of the technique is to increase the cross-sectional area of the nose by increasing the distance from the starting point of the upper lateral cartilage and the septum in the midvault. Although many

authors reported effects of the spreader graft to the nasal valve stenosis, the objective results are still conflicting. In other options, such as the flaring suture, butterfly graft, and alar batten graft, the results are also unclear.[2,4,5]

In the mid-1990s, the idea of suture suspension of the lateral nasal wall was introduced by Paniello.[6] After that, Friedman reported the modified technique that used an infraorbital incision and soft tissue anchor system.[8,9] This technique can be a simple and effective method to widen a narrow nasal valve. Some incorporate the technique with an external rhinoplasty approach, which was purported to be more effective.[11,13] However, there are some problems with suture suspension by any method, such as widening and fullness in the nasofacial groove.[6,8] If the suture suspension is too tight, the fullness gets worse. Because of this, the adequate tension to widen the valve while not making excessive nasofacial fullness is important. In our work, after several lengths of suspension, we determined that the 5-mm length of suspension is the best. More than 5-mm suspension caused obvious fullness in most cases. This result may be different when applied to real patients rather than cadavers.

There have been a few reports concerning the objective effects of lateral nasal suspension.[6–8,10] In this study we used acoustic rhinometry to analyze the objective results of this technique. Acoustic rhinometry has been used as a valuable method for measuring nasal valve area.[14,15] Our study has shown that a 5-mm length of suspension significantly increased the MCA by 13.7%. By comparison, spreader grafts increased the MCA by 5.4% in a previous cadaver study.[12] Cottle's

maneuver or external nasal dilator showed similar effects.[16,17] In our results, the lateral nasal suspension elongated the distance from the nostril to the MCA by 12.1%. In separate studies, Cottle's maneuver, external nasal dilation, and spreader grafts did not change the distance.[16,17] These results may be caused by the more superior directional vector of the method presented here. Unlike the other methods, lateral nasal suspension pulls the upper lateral cartilage in a superior as well as lateral direction. It is unclear what the effect is on the subjective nasal feeling, which may be the topic of future clinical studies.

There are some limitations in this study. First, it was performed on normal cadaveric noses, not patients with valve stenosis. Second, the cadaveric lateral nasal wall tissues may not behave the same as living tissues. Thus, correlation of these findings to live patients is not necessarily tenable. Third, the results established here do not accurately represent the dynamic nature of the valve (*e.g.*, during inhalation). Despite these limitations, this study has shown that the lateral nasal suspension can be an effective method in increasing the cross-sectional area around the nasal valve area without definite nasofacial fullness.

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