Septal Cartilage Defined: Implications for Nasal Dynamics and Rhinoplasty

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Background: Although the septal cartilage is integral to structural nasal stability, it is routinely violated during septorhinoplasty. This occurs during dorsal hump reduction, caudal septal reduction, submucoperichondrial resection of a deviated septum, or harvesting of cartilage graft material. Despite such routine alteration and/or use, the characteristics of septal cartilage have not been adequately defined.

Methods: By measuring septal length, height, and cartilage thickness mapped out at 5-mm intervals over the entire nasal septum in 11 fresh cadaver specimens, the characteristics of septal cartilage were determined.

Results: Septal thickness measurements demonstrated significant differences along the nasal septum, with the greatest thickness along the septal base (2.7 ± 0.1 mm), followed by intermediate thickness along the septal dorsum (2.0 ± 0.2 mm) and the least thickness along the central portion (1.3 ± 0.2 mm) and at the anterior septal angle (1.2 ± 0.1 mm) ($p < 0.001$).

Conclusions: These observations clarify several nuances regarding septal structural stability, septal deformities, and the effects of septal alteration during rhinoplasty. The findings of this study reinforce several principles, including recognition of factors contributing to the high propensity of acquired central septal perforations; preservation of a generous L-strut width, especially at the anterior septal angle, or if planning dorsal hump reduction, prudent allocation of harvested septal cartilage; and clarifying the proclivity for supratip deformity following rhinoplasty. (*Plast. Reconstr. Surg.* 117: 2171, 2006.)

The septum is considered the most important anatomical structure in providing nasal support.[1] Septal manipulation is often associated with compromise of the caudal vault, whether open or closed rhinoplasty is performed.[2] This is portrayed by the profound effects on the postoperative position of the nasal tip after lowering the cartilaginous dorsum and shortening the caudal septum.[3] The degree of nasal support provided by the septum decrees the obligated preservation of a dorsocaudal L strut.[4] In addition, the nasal septum provides an integral pillar infrastructure to the middle vault that is supported by the upper lateral cartilages. Overresection of the septal dorsum can result in the development of an "inverted V" dorsal contour deformity secondary to middle vault collapse. This results from compromised support of the upper lateral cartilages, especially following disruption of the fused upper lateral cartilage and nasal dorsum regions.[5] Finally, the magnitude of structural stability offered by the septum is appreciated by observing collapse of the middle vault and lower vault in cocaine users presenting with septal perforations.[6] Despite being essential to structural nasal stability and its routine use and alteration, specific septal cartilage features have not been adequately defined. In this report, the quadrangular septal cartilage parameters will be outlined and their clinical implications expanded on.

From Cosmetic Surgery Clinics, Inc.
Received for publication November 16, 2004; revised March 17, 2005.

DOI: 10.1097/01.prs.0000218182.73780.d2

MATERIALS AND METHODS

Eleven fresh cadaver nasal septa were dissected to characterize nasal septal length (caudal to cephalic span), height (anterior to posterior span), and thickness. Cartilage thickness was measured at 5-mm intervals over the entire nasal septum using 40× magnification and a microtome for each of the cartilaginous specimens. The reference point or origin (0,0) for each of the measured intervals was defined by the posterior and caudal-most extent of the septal base adjacent to the anterior nasal spine (Fig. 1). All values were

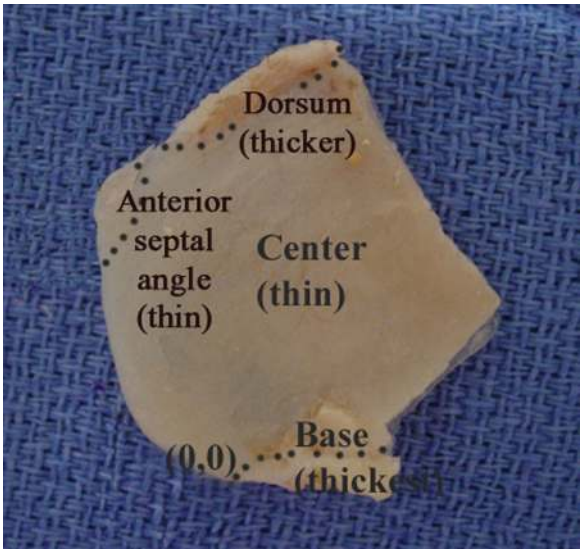

Fig. 1. The nasal septum was characterized based on its length, height, and thickness. The reference point (*0,0*) was set at the posterior, caudal septal base overlying the anterior nasal spine to create a 5-mm grid interval to measure cartilage thickness. Analysis of cartilage thickness was performed among several regions, including the septal base (thickest), dorsum (thicker), central regions (thin), and anterior septal angle (thin).

expressed as mean ± SEM. For purposes of analysis, the measured thicknesses were grouped into four regions, including the septal base, dorsum, central (central septum and caudal septum excluding the anterior septal angle), and anterior septal angle regions (Fig. 1). One-way analysis of variance was used to assess any differences in cartilage thickness among these groups (Sigma Stat; Jandel Scientific Software, San Rafael, Calif.).

RESULTS

Quadrangular septal cartilages were harvested from 11 fresh cadavers in seven female and four male cadavers with ages raging between 57 and 72 years. Although knowledge of medical history was not available on the donors, any physical signs of nasal abnormality, trauma, or prior surgery were excluded. Septal heights measured 2.6 ± 0.3 cm and septal lengths measured 3.1 ± 0.4 cm. Dorsal nasal septum and upper lateral cartilaginous fusion was associated with more cephalad septal areas; fusion was observed in seven of 11 septa at 1.0 cm cephalad and 2.5 cm anterior, in four of 11 at 0.5 cm cephalad and 2.5 cm anterior, and in one of 11 at 0 cm cephalad and 2.5 cm anterior to the anterior nasal spine at the reference point (Table 1). Septal thickness measurements demonstrated significant differences along the nasal septum, with the greatest thickness along the septal base (2.7 ± 0.1 mm), followed by intermediate thickness along the septal dorsum (2.0 ± 0.2 mm), and was thinnest along the central portion (1.3 ± 0.2 mm) and at the anterior septal angle (1.2 ± 0.1 mm) ($p < 0.001$) (Table 1).

DISCUSSION

The septum is a bony and cartilaginous midline structure that provides structural integrity to the nose. The quadrangular cartilage is unique to the nose in that it maintains articulations to cartilage, the upper lateral cartilages, bone, the vomer, and perpendicular plate of the ethmoid.[7] This study has further characterized nasal septal length, height, and thickness. Differences identified in cartilage thickness within the septum have clarified many of the clinical observations regarding nasal septal dynamics. For example, identifying the central region as the thinnest gives credence to the propensity of central perforations observed in cocaine users. When compromised, the cartilaginous septum affects proper function and aesthetics of the nose.

Table 1. Nasal Septum Thickness Measured at 5-mm Intervals at 40× Magnification with the Reference Point (0.0) Set at the Posterior, Caudal Septal Base Overlying the Anterior Nasal Spine

2.5			2.0 ± 0.4[b,f]	2.1 ± 0.3[b,g]	2.0 ± 0.1[b,h]		
2.0	1.1 ± 0.2[c,d]	1.3 ± 0.1[c,e]	1.5 ± 0.2[c]	1.5 ± 0.3[c]	1.7 ± 0.2[c]	1.7 ± 0.2[c]	
1.5	0.8 ± 0.1[c]	1.2 ± 0.2[c]	1.3 ± 0.1[c]	± 0.1[c]	1.5 ± 0.3[c]	1.6 ± 0.3[c]	
1.0	0.9 ± 0.1[c]	1.1 ± 0.2[c]	1.2 ± 0.1[c]	1.4 ± 0.1[c]	1.3 ± 0.3[c]	1.4 ± 0.1[c]	1.3 ± 0.3[c]
0.5	1.2 ± 0.2[c]	1.4 ± 0.2[c]	1.3 ± 0.2[c]	1.2 ± 0.1[c]	1.5 ± 0.1[c]	1.4 ± 0.1[c]	1.5 ± 0.4[c]
0.0			2.7 ± 0.1[a]	2.7 ± 0.2[a]	2.7 ± 0.1[a]	2.5 ± 0.2[a]	1.7 ± 0.1[c]
(cm)	–1.0	–0.5	0.0	0.5	1.0	1.5	2.0

One-way analysis of variance for set significant with $p < 0.001$
Post Tukey test: a > b > c with $p < 0.05$.
[d]Anterior septal angle in four of 11 nasal septa.
[e]Anterior septal angle in seven of 11 nasal septa.
[f]Fused to the upper lateral cartilages in one of 11 nasal septa.
[g]Fused to the upper lateral cartilages in four of 11 nasal septa.
[h]Fused to the upper lateral cartilages in seven of 11 nasal septa.

The supratip deformity is a common sequela of primary rhinoplasty. Review of secondary rhinoplasties has demonstrated supratip deformity in 25 to 36 percent of patients.[8,9] In 1979, Sheen explained the elusive cause of this deformity by delineating the interaction of the dorsal nasal soft tissue and underlying, cartilaginous structural support.[10] He hypothesized that the primary cause of the supratip deformity was in fact overresection of the cephalad nasal septum, resulting in excess skin and soft tissue that could no longer be accommodated by the remaining residual caudal dorsal nasal septum. Furthermore, the supratip cause was clarified by demonstration of significant fibrosis in 87.5 percent of secondary rhinoplasty patients based on histologic specimens obtained from the supratip deep tissue.[9] This has influenced various clinicians to recommend direct excision and/or steroid injection to reduce soft-tissue fullness as the treatment of choice for this deformity.[8,11] Our findings provide a basis for these observations. First, it is not surprising that the supratip deformity involves increased fibrosis focally over the thinner anterior septal angle region and not along the entire dorsum. We feel that increased fibrosis in this area results from potential increased surface contact between a dissected nasal mucosa and external supratip skin. Increased contact between these surfaces in the supratip area results because of a limited barrier provided by a thinner anterior septal angle. A thin anterocaudal septum, unlike the more cephalad dorsal septum, lacks adequate surface span to accommodate excess skin and soft tissue following redraping of the nasal skin envelope (Fig. 2). This is further compounded by an aggressive dorsal hump reduction, which eliminates the canopy effect that the dorsal septum provides by virtue of its thickness. Overresection results in exposure of a thinner underlying septal cartilage which, if not reinforced by extended spreader grafts, may leave even a larger area prone to fibrosis.

One can concede that compromised nasal support is further compounded by the loss of the septal continuity with the adjacent upper lateral cartilages. This was demonstrated by a cadaveric study observing the anterior septal angle positioned inferior to the caudal edge of the upper lateral cartilage in 68 percent of patients.[12] Our findings of variable continuity between the nasal septum and upper lateral cartilages is in accord with previous histologic reports. Natvig et al. reported fusion between the upper lateral cartilages and the cephalic one-third of the nasal septum after a histologic study of cadaver specimens.[13]

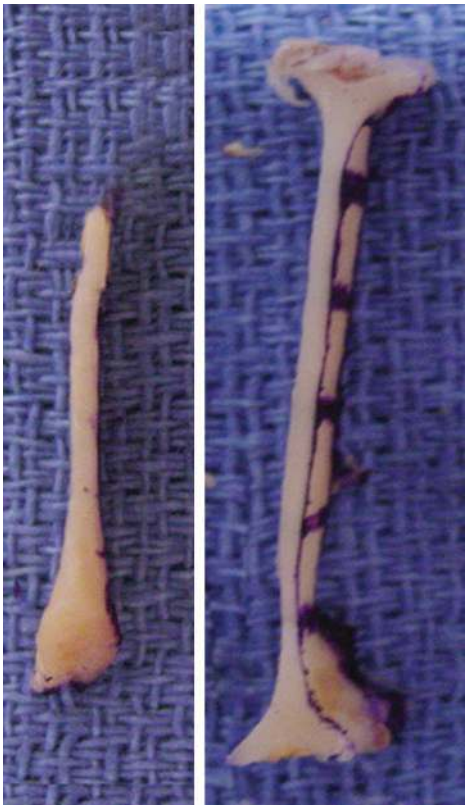

Fig. 2. The anterior septal angle allows for increased contact between the nasal mucosa and external supratip skin and provides a poor platform for redraping of the nasal skin and soft-tissue envelope when compared with the more cephalad dorsal septum. (*Left*) Cross-section taken at 0.5 cm anterior to the anterior nasal spine. (*Right*) Cross-section taken at 0.5 cm posterior to the anterior nasal spine.

Daniel and Letourneau reported continuity of the upper lateral cartilage in the cephalic two-thirds of the nasal septum, in contrast to fibrous attachment in the caudal one-third.[14]

Dorsal hump resection frequently risks elimination of a spreader effect of the removed vault roof on the upper lateral cartilages, which can result in collapse of the middle vault.[15] Sheen explains that overresection of the cartilaginous dorsum results in the upper lateral cartilages shifting toward the septum because they are no longer supported medially.[16] The main risk factor associated with this complication is a short nasal bone, which is defined by the nasal bone length equal to or less than one-third to one-half the nasal length.[15] To prevent this, Sheen has made the universally used spreader grafts popular. These are placed in the submucoperichondrial layer between the dorsal border of the remaining septum and dorsal border of the upper lateral cartilage.[16]

Submucoperichondrial resection is routinely performed during rhinoplasty either to remove septal deviation or to harvest graft material.[17] This maneuver requires preservation of an L strut that is often reduced to a 1-cm-wide construct.[18] Our observations may question the validity of such a standard. Because the caudal septum along with the anterior septal angle is significantly narrower than the dorsum, it may be wise to condone preservation of a wider, 1.5-cm cartilage construct in these areas. In addition, preservation of a wider cartilage may be advocated over the dorsum (the cephalocaudal portion of the L strut) after aggressive dorsal hump reduction, wherein the thicker dorsal cartilage has been eliminated. Moreover, graft material that is harvested is used for a myriad of constructs in rhinoplasty. Our findings may facilitate preoperative planning; for example, the resected posterior septal base may be used as a thicker spreader graft for more severe middle vault collapse as compared with the spreader graft harvested from the central septum.[19]

CONCLUSIONS

The most important factor regarding effective rhinoplasty is thorough knowledge of the underlying anatomy. Although we could not rule out confounders such as history of decongestant or cocaine use that would tend to thin out the cartilage material, we feel that the general septal cartilage thickness differences presented in this study were in agreement with our clinical observations. In addition, we observed intraoperatively an extension of the septal base posteriorly, termed the septal tail, with characteristics similar to those of the presented septal base parameters. This portion of the septum is wedged between the bony septal components and thus not amenable to en bloc resection as performed in this study yet available for graft harvest during rhinoplasty. These differences provide clarification of various nuances regarding nasal structural stability, septal deformities, and the effects of septal alteration during rhinoplasty. The findings of this study reinforce several principles, including the reasons for the high frequency of acquired central septal perforations; preservation of a generous L strut width, especially over the caudal septum, including the anterior septal angle or over the dorsal septum if planning dorsal hump reduction; thrifty allocation of harvested septal cartilage; and clarification for the potential development of the supratip deformity following rhinoplasty.

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