The C-Ring Complex: Defining the Parameters of Nasal Tip Anatomy

The human nose arises from the frontonasal prominence during the 4th to 10th weeks of gestation. Migration of neural crest cells into these soft tissues gives rise to the olfactory placodes. Invagination of the central placode epithelium within the proliferating mesenchymal tissue allows for the development of the nasal pits and the medial and lateral nasal prominences. In time, these prominences fuse to form the associated soft, muscular, and cartilaginous tissues of the paired external nares. The lateral prominence gives rise to the lateral nasal wall and ala while the medial prominence develops into the nasal septum, columella, and nasal tip. Each of the lower nasal cartilages is formed within paired external nares. The lateral prominence gives rise to the lateral nasal wall and ala while the medial prominence develops into the nasal septum, columella, and nasal tip.

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Methods. Twelve cadaveric nasal dissections were performed in specimens without traumatic, surgical, or positional distortion of the nose. Dissections were performed in a layered fashion with removal of external tissues, in sequential fashion, analogous to that of an archeological excavation. Isolation of 24 lower lateral cartilages was performed in 10 male and 2 female specimens. Eleven of 12 specimens appeared to be of Caucasian descent while the 12th specimen was of African descent.

Results. In all 12 specimens there was notable extension of cartilage lateral to the lateral crus of the lower lateral nasal cartilage. In all specimens the lateral cartilage(s) extended toward the piriform aperture, diverged inferiorly, and extended anteromedially toward the columella and anterior nasal spine to form a near-complete circle. The appearance of these findings directly resembled a C-ring configuration (Figure 1). Soft-tissue attachments extending from the distal tip of the ring complex toward the base of the medial crura were found to be of a continuous ribbon, a series of multiple hinged units, or segmented units aligned in a fashion similar to a string of pearls. The cartilage(s) varied in size, curvature, and number. Variations in lateral crural dimensions and configuration were appreciated as well.

Comment. The shape of the lower nose is determined by the lower nasal cartilages, ligamentous attachments, and surrounding soft tissues. Various discussions have highlighted the inherent framework of the nasal tip. The tripod concept by Anderson describes the medial crus as a single, anterior leg of a tripod with the remaining two legs represented by the lateral crura. Adamson et al refined this concept with the development of the M-arch model. Instead of representing forces in a linear arrangement, the M-arch model defines the surgical and anatomic considerations of the medial, intermediate, and lateral crura in an arch configuration. Both concepts define the nasal tip as an interrelated system in which alterations to any one specific region has a notable effect on all others.
In our anatomic and clinical investigations we have observed, with considerable variability, the cartilages that extend beyond what Anderson described as the hinge region, or the posterolateral point of the lower lateral cartilage. The configurations observed include a solid strip of cartilage, multiple hinged cartilage units, and a series of cartilages aligned similarly to a string of pearls (Figure 3). In the circumstance of multiple cartilage units, the cartilages were commonly aligned in tandem and connected by overlying perichondrium. Classically described as the accessory cartilages, these cartilages appear along the planes of their embryonic origin and create a shape analogous to that of a C-ring. The cartilaginous ring, which also includes the medial, intermediate, and lateral crura, is enveloped by perichondrium and invested with multiple soft-tissue and muscular attachments. These attachments impart various forces along the ring and ultimately influence the static and dynamic shape of the nasal base. There is considerable biological variation in the quantity of cartilage, its inherent resilience, and the overall general configuration. Each of these parameters ultimately defines nasal tip projection, length, width, and rotation.

Knowledge of the various nasal cartilage configurations, the underlying forces, and their clinical appearance can allow the rhinoplasty surgeon to identify the anatomic considerations of surgical significance. Extremes in the orientation of a single C-ring can range from a nearly horizontal orientation, as observed in a cleft lip nasal deformity, to a sagittal position, in which the cartilages are aligned parallel to the nasal septum as seen in a parentheses deformity. Orientation of the lower nasal cartilages should be evaluated bilaterally and can be envisioned as two rings with the medial crura representing a relatively stable, central hinge. From this central hinge one can appreciate the various degrees of divergence between the rings.

The extent to which the cartilages beyond the hinge region contributes to the functional shape and appearance of the nose is speculative but not without merit. The destabilization of the lateral crura or hinge region is well described in its potential to compromise the nasal airway with resultant in-flaring of the soft tissues. Furthermore, when performing a lateral crural steal or repositioning of cephalically oriented lower lateral cartilages one is confronted with the considerations of dividing, strengthening, and repositioning the cartilages of the lower nose. We submit that the interrelated nature of these individual surgical maneuvers is associated with the common embryologic origins of the cartilages and soft tissues comprising the cartilaginous ring complex. The current discussion builds on the conceptual principles of the tripod theory and the M-arch model while integrating embryologic relations of known anatomy as well as their biologic variability.

Of course, there are limitations in our ongoing investigation. Owing to the limited number of specimens, specific characteristics could not be identified for various ethnic groups. A larger sample population would probably reveal greater variations of the C-ring complex than those currently presented. What interrelations between nasal width and protrusion are present? Are there implications with regard to nasal flare? These questions and many others are beyond the scope of this pilot study, but we feel the C-ring concept may prove as a useful tool in the conceptualization of interconnected forces as well as the surgical maneuvers necessary in nasal base surgery.

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