# COSMETIC

# Deep Pyriform Space: Anatomical Clarifications and Clinical Implications

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**Background:** The purpose of this study was to define the anatomical boundaries, transformation in the aging face, and clinical implications of the Ristow space. The authors propose a title of deep pyriform space for anatomical continuity.

**Methods:** The deep pyriform space was dissected in 12 hemifacial fresh cadaver dissections. Specimens were divided into three separate groups. For group 1, dimensions were measured and plaster molds were fashioned to evaluate shape and contour. For group 2, the space was injected percutaneously with dyed hyaluronic acid to examine proximity relationships to adjacent structures. For group 3, the space was pneumatized to evaluate its cephalic extension.

**Results:** The average dimensions of the deep pyriform space are  $1.1 \times 0.9$  cm. It is bounded medially by the depressor septi nasi and cradled laterally and superficially in a "half-moon" shape by the deep medial cheek fat and lip elevators. The angular artery courses on the roof of the space within a septum between the space and deep medial cheek fat. Pneumatization of the space traverses cephalic to the level of the tear trough ligament in a plane deep to the premaxillary space.

**Conclusions:** The deep pyriform space is a midface cavity cradled by the pyriform aperture and deep medial cheek compartment. Bony recession of the maxilla with age predisposes this space for use as a potential area of deep volumization to support overlying cheek fat and draping lip elevators. The position of the angular artery in the roof of the space allows safe injection on the bone without concern for vascular injury. (*Plast. Reconstr. Surg.* 138: 59, 2016.)

n the landmark 2007 article describing the deep medial cheek fat compartment, Rohrich et al. alluded to a space medial and deep to the deep medial cheek fat compartment abutting the pyriform aperture. The authors titled this space "Ristow's space," referencing a personal communication with Bruno Ristow.<sup>1</sup> Gierloff et al. described the Ristow space to be a triangular paranasal structure and postulated that volumization of this area in conjunction with the deep medial cheek fat compartment elevates and effaces the nasolabial fold.<sup>2</sup> With the exception of these two citations, very little information has been published on the anatomical construct of the space and potential clinical implications for volumizing procedures.

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With our current understanding of bony resorption that occurs with aging in the midface, coupled with selective atrophy of the deep facial fat compartments, we believe this space enlarges with age and becomes a relevant target area for volumization.<sup>3-12</sup> It is well documented that the pyriform aperture recesses and the maxilla rotates with age, thereby diminishing anterior cheek projection and widening the orbital aperture. Therefore, as the pyriform recedes and the maxilla

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**Fig. 1.** Medical illustration of the deep pyriform space and important adjacent structures. *OO*, orbicularis oculi muscle. (Reproduced with permission from James Vargo, M.D. © James Vargo, M.D.)

rotates, it causes the deep medial cheek fat to fall laterally, resulting in increased dimension of the described Ristow space. The purpose of this study was to further define the anatomical boundaries, transformation in the aging face, and clinical implications of the Ristow space. In addition, we propose a title change to the deep pyriform space for anatomical continuity with other named potential spaces in the face, including the prezygomatic and premaxillary spaces.<sup>9,13</sup>

# MATERIALS AND METHODS

The deep pyriform space was dissected in 12 hemifacial fresh cadaver dissections. All dissections were performed under loupe magnification. Before injection, certain facial fat compartments were dyed with methylene blue for reference. Specimens were divided into three separate groups. In the first four specimens, no material was injected into the deep pyriform space before dissection. Layered dissection proceeded to the level of the space, and dimension measurements were performed. After measurements, a plaster mold of the deep pyriform space was made in each specimen to evaluate the shape and contour of the space. In the second four specimens, the deep pyriform space was injected percutaneously with dyed hyaluronic acid. A separate color of dye was homogenized with hyaluronic acid and injected into the premaxillary space. Layered dissection was performed to isolate both the deep pyriform space and the premaxillary space. In addition, the



**Fig. 2.** Demonstration of post–orbicularis oris fat (*POOF*). Cephalic to this fat compartment lies the entrance into the deep pyriform space.

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**Fig. 3.** Red-dyed hyaluronic acid injected percutaneously into the deep pyriform space. The depressor septi nasi muscle is demonstrated as the inferomedial border of the space. The angular artery and adjacent deep medial cheek fat are noted laterally.

angular artery and deep medial cheek fat were identified and examined for positional relationship relative to the deep pyriform space. In the last four specimens, the deep pyriform space was accessed percutaneously with a blunt cannula attached to a 10-cc syringe filled with air. The space was then pneumatized to evaluate the cephalic extension of the space relative to the orbitomalar and tear trough ligaments. Video footage of the pneumatization was obtained.

#### RESULTS

The average dimensions of the deep pyriform space are  $1.1 \times 0.9$  cm, with a range of 0.5 to 1.6 cm  $\times$  0.8 to 1.8 cm. In situ, the deep pyriform space possesses an inverted triangular shape bounded inferomedially by the depressor septi nasi, the softtissue insertions on the pyriform aperture, and post-orbicularis oris fat (Figs. 1 through 3). It is cradled laterally and superficially in a half-moon shape by the deep medial cheek fat (Fig. 4). The angular artery courses in the roof of the Ristow space within a septum between the space and deep medial cheek fat (Figs. 3 through 5). The premaxillary space and levator labii superioris reside superficial to this space. Based on pneumatization, the deep pyriform space traverses cephalic to the level of the tear trough ligament and exists in a distinctly deeper plane than the premaxillary space (Fig. 6). (See Video, Supplemental Digital Content 1, which demonstrates pneumatization of the deep pyriform space, *http://links.lww.com/PRS/B766*.)

## **DISCUSSION**

Recent studies suggest that selective atrophy of deep fat compartments and relative hypertrophy



**Fig. 4.** The deep pyriform space is cradled medially by the pyriform aperture and depressor septi nasi. The angular artery courses between the space and the deep medial cheek fat compartment. Note that the artery is not directly on the periosteum, but superficial and lateral within the roof of the space. Post–orbicularis oris fat (*POOF*) is stained green.



**Fig. 5.** Side-by-side comparison of a 27-gauge cannula and the angular artery on the boundary of the deep pyriform space. Post-orbicularis oris fat is stained green. *DPS*, deep pryiform space.

of superficial fat compartments occurs in the aging face. This corresponds to larger adipocyte size in superficial fat compared to deep fat. The proposed concept of pseudoptosis, or selective deflation of deep fat compartments leading to loss of support and sagging of the superficial cheek fat, leads authors to advocate for deep volumization techniques.<sup>3–12</sup> We and others have attempted volumization of the deep medial cheek fat and premaxillary spaces to obtain improved anterior cheek projection. This study demonstrates that these two structures along with the deep pyriform

space reside in distinctly different planes (Figs. 1 and 6). Intuitively, the combination of pyriform aperture recession and deep medial fat deflation with aging leads to diminished structural support of the anterior cheek. The rotation of the maxilla with age leads to lateral movement of the deep medial cheek fat. These factors likely translate into expansion of the deep pyriform space with age; however, the small sample size and limited age distribution of this study cannot statistically support this postulation. Given the described anatomy, volumization in the deep pyriform space may provide a fulcrum lifting of the deep medial cheek compartment and draping lip elevators that reside superficial to this space (Fig. 7).

Pneumatization of this space demonstrates its cephalic extension to the level of the tear trough ligament and lateral extension along the maxilla deep to the medial cheek soft-tissue layers (See Video, Supplemental Digital Content 1, http:// links.lww.com/PRS/B766). Although not proven, we believe this space may play a role in lymphatic drainage of the periorbita. Further cadaveric study will be needed to explore this concept.

In this study, the angular artery coursed superficial and lateral to the deep pyriform space within a septum separating the space from the deep medial cheek compartment (Figs. 3 and 4). Given the position of the artery, it is conceivable that filler or autologous fat placed deep in the space on periosteum is a safe approach and void of unwanted vascular injury. For clinical purposes, we performed a



**Fig. 6.** Instruments are placed in the premaxillary space and the deep pyriform. The instruments were advanced through the tear trough ligament, demonstrating that these structures reside in distinctly different planes.



Video. Supplemental Digital Content 1 demonstrates pneumatization of the deep pyriform space, *http://links.lww.com/PRS/B766*.



**Fig. 7.** Demonstration of the mimetic muscle insertions into the nasolabial fold. Note that the pre–orbicularis oris fat is fibrofatty, in contrast to superficial nasolabial compartment fat, which is more lobular in appearance.

side-by-side comparison of a 27-gauge cannula and angular artery diameters (Fig. 5).

Unlike the well-defined prezygomatic space and premaxillary spaces, there is no discernible encapsulation of the deep pyriform space,<sup>9,12</sup> which raises the question of material confinement and possible migration outside of the space following volumization. The borders of the space are well defined. The fanning insertion of the depressor septi nasi and septation of the postorbicularis oris fat provides a robust inferior hammock for the space (Figs. 1 through 3). Clinically, we access both the premaxillary space and the deep pyriform space with blunt cannulas. Once the cannula is subcutaneous, the angle of vector helps the injector determine which space the cannula is in. Effectively, once the cannula is deep to the nasolabial fold, the injector has arrived in a sub-superficial musculoaponeurotic system plane. A steeper, 60- to 90-degree vector down to bone will safely place the cannula within the deep pyriform space. In contrast, a shallower 30-degree vector will place the cannula in the premaxillary space. The clinical confirmation that the cannula has arrived in either of the targeted spaces is a perceptible free passage and movement of the cannula. If the injector feels resistance, the cannula is likely in the deep medial cheek fat. Anecdotally, we recommend highly cohesive filler, hydroxyapatite, or autologous fat for the deep pyriform space volumization. We do not recommend aqueous-based filler.

# CONCLUSIONS

The deep pyriform space is a midface cavity cradled by the pyriform aperture and deep medial cheek compartment. Bony recession of the maxilla with age predisposes this space to use as a potential area of deep volumization to support overlying cheek fat and draping lip elevators. The position of the angular artery in the roof of the space allows safe injection on the bone without concern for vascular injury. With time, this may prove to be a vital target area for restructuring the aging anterior midface.

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