

## Supplemental Digital Content

### ***Consensus recommendations on the use of hyaluronic acid-based fillers for nonsurgical nasal augmentation in Asian patients***

**Table 1. Summary of anthropometric studies of the Asian nose**

- In general, Caucasians have a narrow nose (leptorrhine), whereas African-Americans have a flat nose (platyrrhine). Asians have intermediate features between these two races (mesorrhine).<sup>1</sup>
- Asians have a higher prevalence of short nose, characterized by short nasal tip, short alar rim (alar retraction), and short columellar base (columellar retraction).<sup>2</sup>
- Asians have a shorter superior tarsus height, with an average of 6.5–8 mm compared with the Caucasian tarsus of 8–10 mm in height.<sup>3</sup>
- The radix in Asians tends to be flat and depressed.<sup>4</sup> It is slightly narrower than the black & Hispanic radix and much deeper than the Caucasian radix.<sup>5</sup>
- The bridge is usually low, wide and flat. There is often a deficiency in osteocartilaginous support. The average bridge width is 2.3 cm. The average nasion-to-tip length is 4.5 cm. Depending on one's racial descent or genealogy, the Asian bridge may be fuller and more prominent than usual.<sup>5,6</sup>
- The nose tip is low, wide and rounded (bulbous tip).<sup>1, 7</sup> It is often ptotic, with a slight-to-moderate projection deficit.<sup>4</sup> It is usually more defined than the black tip. The average tip height is 2.2 cm. The average tip width is 2.6 cm.<sup>5</sup>
- The skin of the nose tip and supratip area has a thick dermis and a subcutaneous layer, and an abundance of fibrofatty tissues. Sebaceous glands are highly developed.<sup>1</sup>
- The base is usually wide and flaring, but narrower than that of the black nose. The nostrils are oblique. The average base width is 3.4 cm.<sup>5</sup>
- The columella is relatively short and is recessed 2 to 3 mm cephalically.<sup>1, 5</sup>
- The nasolabial junction is characterized by a nasolabial angle of 90 degrees or more.<sup>5</sup>

- The nostril is splayed out horizontally when viewed from caudal side. Hence, the distance between alar base on both sides is wider.<sup>1</sup>
- In a study of 21 Korean adult cadavers, the lengths of the upper and lower lateral cartilage of Korean cadaveric noses were similar to those of Caucasian noses. However, the widths of the upper and lower lateral cartilage were substantially smaller in Korean cadaveric noses than in Caucasians.<sup>8</sup>
- Among 126 female students of the University of Indonesia of Deutero Malay sub race (including ethnic groups of Aceh, Jawa, Sunda, Minangkabau, Riau and Bugis), the intercanthal width was  $3.56 \text{ cm} \pm 0.27$ , alar width  $4.14 \text{ cm} \pm 0.28$ , nose length  $4.0 \text{ cm} \pm 0.21$ , pronasion projection  $2.29 \text{ cm} \pm 0.26$  and tip angle  $111.50 \pm 4.4$ , nasofrontal angle  $134.60 \pm 7.3$ , nasofacial angle  $36.30 \pm 4.3$ , nasolabial angle  $90.40 \pm 8.3$ , and nasion projection  $0.43 \text{ cm} \pm 0.22$ .<sup>9</sup>
- Among 2,065 Korean volunteers, anthropometric measurements from males were mostly 5% to 10% greater than for the females, except the nasofrontal, nasolabial and nasal tip angles. Many Koreans exhibited a columella protrusion of 4 to 5 mm, which is approximately 2 to 3 mm in Caucasians. The intercanthal distance was also relatively large compared with the facial width. In females, the intercanthal distance was similar to the length of the nasal dorsum and the nose width.<sup>10</sup>

**Table 2. Key studies investigating the vascular anatomy of the nose among Asian patients**

- Variations in the facial artery have been reported. In a cadaveric study, some terminal branches of the facial artery took a detoured course. The angular artery is a terminal branch of the facial artery that irrigates the lateral area of the dorsum of the nose, near the radix.<sup>11</sup> The angular artery was connected to the ophthalmic artery branches and occasionally did not originate from the facial artery. Vascular complications of the facial artery tributaries are frequently seen in the angular, dorsum of the nose, tip of the nose, and glabellar region.<sup>12</sup>

- A study of 54 embalmed Korean cadavers revealed that the facial artery may be categorized according to the patterns of its final arterial branches: type I, nasolabial pattern (51.8% of cadavers); type II, nasolabial pattern with an infraorbital trunk (29.6%); and type III, forehead pattern (18.6%). Each type was further subdivided according to the facial artery depth and relationship with the facial musculature layer.<sup>13</sup>
- Another Korean cadaveric study revealed that the final branch of the facial artery was the lateral nasal branch in 44.0% and the angular branch in 36.3% of cases. The facial artery ended symmetrically only in 54.5% of the cases.<sup>14</sup>
- The ophthalmic artery is a branch of the internal carotid artery where the anterior and posterior ethmoidal arteries that descend into the nasal cavity through the cribriform plate originates.<sup>11</sup> Ophthalmic artery embolism may lead to blindness.<sup>15</sup>
- A cadaveric study in China reported that four arteries were located in common filler injection regions that connected to the ophthalmic artery: supratrochlear artery, supraorbital artery, dorsal nasal artery, and angular artery.<sup>15</sup>
- The dorsal nasal artery also anastomoses with branches of the facial artery and could therefore manifest as skin necrosis in a geographic pattern.<sup>6</sup>
- The lateral nasal artery runs along the alar groove and is a branch of the facial artery. The lateral nasal artery may communicate with the ophthalmic artery and filler embolus can propagate to the eye and forehead area.<sup>6</sup>
- Among Caucasian cadavers, the lateral nasal artery serves as the main blood supply of the nasal tip.<sup>7</sup> A cadaveric study in Korea reported that the lateral nasal artery is the main blood supply to the nasal tip in only 78% of cases, whereas the dorsal nasal artery is the main blood supply to the nasal tip in 22% of cases.<sup>16</sup> The distance between the alar groove and the lateral nasal artery has been reported to be 3 mm in Caucasians and 4 mm in Asians.<sup>7</sup>
- In a histological analysis of midline longitudinal sections of the Asian nose (N=135 histological cross sections examined from 45 longitudinal strips of soft tissue), all nasal arteries were identified to be subcutaneous arteries. These coursed mainly in the superficial layer of the

subcutaneous tissues with smaller branches forming subdermal plexuses. Substantial arterial anastomosis occurred at the supratip region with arterial diameter between 0.4 and 0.9 mm.

This was at the level midway between the rhinion, above the supratip and the infratip.<sup>17</sup>

- A cadaveric study in China showed that in the glabellar region, deep injection on the periosteum poses a risk of injuring the supratrochlear artery and supraorbital artery. In the nasal dorsum and nasolabial fold, the sub-superficial musculo-aponeurotic system layer injection may injure the dorsal nasal artery, angular artery or facial artery. The authors concluded that injections in the periosteum layer at the glabellar region or sub-superficial musculo-aponeurotic system layer of nasal dorsum and nasolabial fold are not advised.<sup>15</sup>
- The dorsal nasal artery is also susceptible to injury. Injection into the deep fatty layer may reduce the risk of arterial injury and consequent complications. However, a cadaveric study in Asians revealed that in a hooked nose, the tip of the needle traveling along the deep layer approaches the superficial layer due to the convexity of the hump as it passes over it, which can increase the probability of damaging the dorsal nasal artery.<sup>18</sup>
- Venous complications may occur during filler injections, especially in the nasoglabellar area. In a study of 41 Korean and Thai cadavers, when the anastomosing vein between the bilateral angular veins was located in the nasoglabellar area, it was designated the intercanthal vein. The bilateral angular veins continued as the facial vein without any communicating branches in 29.3%. At the radix of the nose, the angular veins communicated and connected bilaterally through the intercanthal vein. The intercanthal vein was found above (type IIA) and below (type IIB) the intercanthal line in 63.4% and 7.3% of cases, respectively. The intercanthal vein may be a candidate causative site to explain the relatively frequent complications encountered when performing injection procedures in the nasoglabellar area.<sup>19</sup>
- A study of Korean and Thai cadavers revealed that the course of the angular artery may vary. The angular artery may be classified into: Type I (persistent), traverses the lateral side of the nose (11%); Type II (detouring pattern), traverses the cheek and tear trough area (18%); Type III (alternative pattern), traverses the medial canthal area through a branch of the ophthalmic artery (22.8%); and Type IV (latent pattern), in which the angular artery is absent (26.3%).<sup>20</sup>

- In a cadaveric study in Korea, the arterial vasculature of the columellar artery was supplied by the superior labial artery and entered the columella via the columello-labial junction.  
Knowledge of the vasculature of the columella is important to ensure safety during procedures directed to this area. A comprehensive analysis of the vascular anatomy of the columella has been reviewed by *Lee et al.*<sup>21</sup>
- Doppler and pulse detection of the emerging point of the ophthalmic artery was performed in volunteers in Thailand, which revealed that the inferior margin of the superior orbital rim was  $5.3 \pm 1.4\text{mm}$  from the emerging point of the ophthalmic artery. Moreover, the depth from the skin surface to the emerging point of the ophthalmic artery was  $4.5 \pm 1.1\text{ mm}$ .<sup>22</sup>

**Table 3. Complications associated with various dermal fillers in nonsurgical nasal augmentation**

*Hyaluronic acid*

- A retrospective review of 242 Korean patients who received HA injection for nasal augmentation reported mostly mild and transient adverse events, such as bruising, headache, swelling, and erythema. Only 3 patients (1.2%) had vascular complications.<sup>23</sup>
- A systematic review of cases in which blindness was a direct consequence of a cosmetic injection procedure on various areas of the face (glabella, nasolabial fold, nose, etc.) was published in 2012. Of 32 patients, the majority of blindness occurred after injections of adipose tissue (15 patients, 47%). Two patients (6.2%) experienced blindness with HA injection (one patient had HA injection of the glabellar area and cheeks; the other patient had nasal tip and bridge HA injection). For the other patients, blindness occurred after injection of corticosteroids, paraffin, silicone oil, bovine collagen, polymethylmethacrylate, and calcium hydroxyapatite.<sup>24</sup>
- A retrospective review of patients who received non-animal stabilized HA gel for soft tissue augmentation from Europe, Canada, Australia, South America and Asia from 1999 and 2000 revealed that HA was well tolerated. In 1999, data from approximately 144,000 patients treated

with HA revealed that the major reaction to injectable HA was localized hypersensitivity reactions, occurring in approximately 1 of every 1400 patients treated (0.7%). Adverse event was reported in 0.15% of patients. These were temporary events, such as redness, swelling, localized granulomatous reactions, bacterial infection, acneiform and cystic lesions. For the year 2000, there was an estimated 262,000 patients treated with HA gel, with adverse events reported in only 0.06%. The major adverse event was again hypersensitivity, occurring in 1 of every 5000 patients treated.<sup>25</sup> It is worthy to note that this data is on the use of HA in general and not specifically on HA nasal augmentation.

- Migration of HA fillers are rare but have been reported. Migration is thought to occur through several mechanisms, including poor injection technique (high-volume, high-pressure injection), massage, muscle activity, pressure-induced displacement, lymphatic spread and intravascular injection.<sup>26</sup>
- The most serious complications after nonsurgical nasal augmentation using HA fillers are dermal necrosis and blindness. Vascular compromise can be largely divided into intravascular or extravascular. Intravascular factors include direct obstruction of arteries by large-molecular-weight HA fillers and chemical damage of the endothelial lining by HA or impurities in the fillers.<sup>6, 27</sup>
- Blindness may occur immediately after HA injection and may present as partial or complete loss of vision. Symptoms may include severe pain and a sudden blackout of the involved eye.<sup>24</sup>
- Ocular ischemia with hypotonia following injection of a dermal filler for nonsurgical nasal augmentation are rare but have also been reported. In a case report, the patient demonstrated visual loss immediately after HA injection, with typical fundus features of central retinal artery occlusion. Multiple crusted ulcerative patches around the nose and left periorbit developed, and the left eye became severely inflamed, ophthalmoplegic, and hypotonic.<sup>28</sup>
- Neurologic complications caused by cerebral vessel embolus may also occur.<sup>24</sup>

*Other dermal fillers*

- Human collagen is derived from fibroblasts and do not require allergy testing. Unfortunately, the longevity of human collagen is limited, rarely persisting beyond three months. Collagen is therefore considered inferior and not recommended for nonsurgical nasal augmentation.<sup>29</sup>
- Autologous fat injection has been used for nonsurgical nasal augmentation. However, autologous fat has been associated with higher incidence of adverse vascular events, blindness with poor visual prognosis and cerebral infarction.<sup>30</sup>
- Silicone, although effective, may cause severe granulomatous reactions in some patients and is not recommended.<sup>30</sup>
- Controversy exists regarding calcium hydroxyapatite in nasal reconstruction and nonsurgical nasal augmentation.<sup>31</sup> Calcium hydroxyapatite is a mineral constituent of bone that has been used in various medical applications for more than a decade. The persistence of nasal correction from calcium hydroxyapatite is approximately 10 to 12 months.<sup>29</sup> Although calcium hydroxyapatite demonstrates good longevity, relatively high rates of adverse events have made it less favourable.<sup>32</sup>

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