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The Relationship Between Inter-canthal Distance and Implant Height in Asian Rhinoplasty

Chih-Jung Huang[1] · Cheng-I Yen[1] · Chun-Shin Chang[1] · Hung-Chang Chen[1] · Yen-Chang Hsiao[1]

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Abstract Augmentation rhinoplasty is one of the top three anesthetic surgeries in Asia. I-shaped silicone-polytetrafluoroethylene composite implants are feasible for both primary and secondary augmentation rhinoplasty in Asians. This series was to analyze and evaluated the effect of the rhinoplasty to the intercanthal distance and to compare the height of the implantation with those differences in ICD before and after rhinoplasty. We retrospectively reviewed data from a single medical center via a single surgeon (Hsiao YC), at Chang Gung Memorial Hospital, between 2011 and 2017 with follow-up through 2018. There were 223 patients who received augmentation rhinoplasty with an I-shaped composite silicone-polytetrafluoroethylene ePTFE-lined silicone dorsal composite implant (Implantech, Ventura, CA) with a glabellar component (chimeric technique) or without a glabellar component. There were 169 patients with the height of the I-shaped composite implant over 3 mm, and 15 patients were less than 3 mm. There was no distribution significance between two groups even in gender, age, type of surgery, or indication. The paired difference of ICD/IPD ratio was statistically significant in the group with the height of composite implant over 3 mm ($1.04\% \pm 0.11$, $p < 0.005$, 95%). The normalized ratio of the ICD to IPD is estimated to decrease by 1–2%. Appropriate candidates including those with a wide ICD should be informed about these data during preoperative decision-making.

✉ Yen-Chang Hsiao
nosehsiao@gmail.com

[1] Department of Plastic and Reconstruction Surgery, Linkou Chang Gung Memorial Hospital, Chang Gung University, 5, Fu-Hsing Street, Kweishan, Taoyuan City 333, Taiwan, R.O.C.

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Background

Aesthetic surgery is increasingly more popular in Asian societies but emphasizes natural appearance rather than a Caucasian look. Although the majority of rhinoplasty in western society are reductive rhinoplasty, but augmentation rhinoplasty is now one of the top three anesthetic surgeries in Asia [1]. Compared to the allograft (e.g., cartilage, bone, dermis/fat grafts), I-shaped silicone-polytetrafluoroethylene (ePTFE) composite implants are feasible for both primary and secondary augmentation rhinoplasty in Asians, which can avoiding donor-site morbidity and decreasing operative time [2]. Furthermore, the height of I-shape ePTFE implant mainly determines the postoperative nasal profile, especially the dorsum augmentation.

Besides, Eyelid profiles including intercanthal distance (ICD), interpupillary distance, and eye show play significant roles in the recognition of craniofacial feature and lead to a difference in morphology and structure according to age and race. However, it is widely known that augmentation rhinoplasty will impact the eye profile, but few reports have discussed the relationship between the intercanthal distance and the height of the implant in augmentation rhinoplasty in an Asian population. The purpose of this series was to analyze and evaluate the effect of the rhinoplasty to the intercanthal distance and to compare the height of the implantation with those differences in ICD before and after rhinoplasty.

Materials and Methods

Data Collection and Study Population

We retrospectively reviewed data from a single medical center via a single surgeon (Hsiao YC), between 2011 and 2017 with follow-up through 2018. There were 223 patients who received augmentation rhinoplasty with an I-shaped composite silicone-polytetrafluoroethylene ePTFE-lined silicone dorsal composite implant (Implantech, Ventura, CA) [3–6] with a glabellar component (chimeric technique) or without a glabellar component [4]. The patient demographics data included gender, age, surgical indication, and follow-up time. The surgical procedure was obtained by surgical records and special charting.

All cases were categorized according to gender, age, primary or secondary of rhinoplasty, indication of rhinoplasty, and the most importantly, the height of the composite implant. Preoperative and postoperative photographs were obtained with photographic consent confirming that their photographs could be used in the medical literature for instructive purposes. All patients provided informed consent before receiving surgery and this study. Patients who elected for concomitant procedures like glabellar augmentation were excluded. Patients with incomplete surgical records and those lost to follow-up were also excluded leaving 184 patients were included in our study.

Rhinoplasty Technique

An open approach was used in every case under general anesthesia. In primary rhinoplasty cases, the desired site of augmentation was marked before injection of a local anesthesia. A mid-columellar invested-V incision was made, and the alar cartilages was exposed through a marginal approach. Suprapericondrial dissection proceeded along with the lower lateral cartilage (LLC) and the upper lateral cartilage and the dissection then transitioned to subperiosteal dissection at the nasal bone. The LLCs were released from the upper lateral cartilages at the scroll area and the medial crura were teased apart to expose the septum via submucoperichondrial dissection when the septal cartilage was harvested.

To augment the dorsum, a subperiosteal pocket was dissected for a "hand-in-glove" fit with an appropriately sized I-shape composite implant. The base of the implant was conservatively shaped to meet the difference in nasal dorsal slope. The implant height was measured at the point where the thickest site from lateral view with a Caliber. The size of the implant was chosen by sizers (Fig. 2), skin characteristics, and the patient's desires. The implant was inserted into the packet after the recipient site, and the implant was rinsed with antibiotics.

Generally, the implant was positioned so that the lower pole abutted the cephalic margin of the lateral crura. The cephalic implant margin was between the interpupillary line. After hemostasis and applicable positioning, quilting transfixion sutures were used to obliterate dead space between the mucoperichondrial flaps to prevent hematoma. The wounds closed layer by layer. Tape and nasal spline were applied to every case and removed one week after discharge.

ICD to IPD Ratio

We used the IPD to normalize the ICD and minimize the personal error in measurements, photography, and/or calculation. The IPD would not change before or after rhinoplasty regardless the height of the implant. Thus, we used the ICD-to-IPD ration as the proportion to evaluate the difference to ICD before and after different heights of composite implants. Figure 1 shows the preoperative evaluation of a 30-year-old female patient, ICD, Intercanthal distance, IPD, Inter-pupil distance.

Photogrammetric Evaluation

Preoperative and postoperative photographs were analyzed with previously described photogrammetric methodology via the newest edition of Adobe Photoshop CC measure tool (Adobe Systems, Inc., San Jose, CA).

Efforts were made to ensure true profile views were obtained via paper tape at 0-, 45-, 90-, 135-, and 180°, with the camera lens at 90° from a rotating stool. Patients were asked to look straight ahead with their eyes in a neutral position. The landmarks used in the lateral view were the pronasale (prn), subnasale (sn), and sellion (se). All measurements were performed by a single blinded investigator, and each measurement was repeated three times, using the average for analysis.

Outcome and Comparisons

Demographic data and outcomes were summarized by descriptive statistics and a chi-squared test. Preoperative and postoperative ratios were compared using the paired-t test. All data were evaluated using SPSS software (SPSS, Inc., Chicago, Ill. Version 22.0). Statistical significance was established with a value of $P < 0.05$.

Result

We included 184 patients, 26 males and 159 females. The mean age was 33.9 years old. The common indication for augmentation rhinoplasty is cosmetic. Nearly two-thirds (122 of 184, 66.3%) patients received primary rhinoplasty (Table 1).

Both primary and secondary cases were grouped into six categories according to the height of implant. The height of the implant was less than 3 mm in 15 patients (Table 2). The post-operation ICD-to-IPD ratio decreased relate to the preoperative value (paired difference: 0.88 ± 0.62), and but the difference was not statistically significant (p = 0.179, 95%) (Table 3). In another 169 patients, the height of the implants was over 3mm. Those from 3.0 to

Fig. 1 The 30-year-old female patient received primary augmentation rhinoplasty with a 4 mm implantation. The top right is the preoperative anteroposterior view, and top left picture is the postoperative anteroposterior view. The bottom right picture is the preoperative lateral view, and the bottom left picture is the postoperative lateral view. Red line: ICD, intercanthal distance; Blue line: IPD, interpupillary distance

Table 1 Patient information

	All patient	Composite implant < 3.0	Composite implant >= 3.0	*P*
n	184	15	169	
M/F, *n*	26/158	0/15	26/143	0.101
Age, y	33.96 ± 12.15	27.87 ± 5.71	34.50 ± 12.42	0.042
<= 20	17	0	17	0.208
21–30	71	10	61	
31–40	54	4	50	
41–50	18	1	17	
51–60	19	0	19	
>60	5	0	5	
Type				
Primary	122 (66.3%)	9 (60.0 %)	113 (66.9%)	0.590
Secondary	62 (33.7%)	6 (40.0 %)	56(33.1%)	
Indication				
Cosmetic, *n*	170 (92.4%)	15 (100.0%)	155 (91.7%)	0.510
OGS	7	0	7	
Trauma	7	0	7	

Table 2 ICD-to-IPD ratio before and after rhinoplasty

Implant	*n*	Pre-OP ratio	Post-OP ratio	Paired differences	*P*
Composite implant < 3.0	15	58.95 ± 0.67	58.08 ± 0.68	0.88 ± 0.62	0.179
Composite implant >= 3.0	169	58.09 ± 0.27	57.04 ± 0.26	1.04 ± 0.11	< 0.005*

**P* value < 0.005, with significant difference

Table 3 ICD-to-IPD ratio before and after rhinoplasty, including primary and secondary

Implant	*n*	Pre-OP ratio	Post-OP ratio	Paired differences	*P*
Composite implant < 3.0	15	58.95 ± 0.67	58.08 ± 0.68	0.88 ± 0.62	0.179
Composite implant 3.0	27	57.81 ± 0.79	56.63 ± 0.70	1.18 ± 0.22	< 0.005*
Composite implant 3.5	35	58.64 ± 0.54	57.68 ± 0.53	0.96 ± 0.22	< 0.005*
Composite implant 4.0	23	57.53 ± 0.71	56.41 ± 0.58	1.11 ± 0.40	0.011*
Composite implant 4.5	42	58.60 ± 0.54	57.52 ± 0.60	1.08 ± 0.25	< 0.005*
Composite implant 5.0	42	57.59 ± 0.55	56.64 ± 0.51	0.95 ± 1.15	< 0.005*

**P* values < 0.005, with significant difference

5.0 mm had a decreased ICD to IPD ratio before and after augmentation, and the paired differences were statistically significant. There was a nearly 1% shortening of the ICD/IPD ratio. We summarized the primary cases to exclude the effect of previous surgical intervention. Among the primary cases, all categories of implant were higher than 3mm and revealed a decreased ICD/IPD ratio before and after augmentation from 0.65 to 1.91%; the paired differences were all statistically significant (Table 4).

There were 169 patients with the height of the I-shaped composite implant over 3 mm, and 15 patients were less than 3 mm. There was no distribution significance between two groups even in gender, age, type of surgery, or indication. The paired difference of ICD/IPD ratio was statistically significant in the group with the height of composite implant over 3 mm (1.04% ± 0.11, $p < 0.005$, 95%). In contrast, there was no significant difference in the group with the height of composite implant less than 3 mm (0.88 ± 0.62, $p = 0.172$, 95%).

Discussion

Although the most rhinoplasties are reductive rhinoplasty (e.g., removal of a dorsal hump) in western society, augmentation rhinoplasty is now one of the top three aesthetic surgeries in Asia and emphasizes natural appearance rather than producing a Caucasian appearance [7, 8]. However,

Table 4 ICD-to-IPD ratio before and after rhinoplasty, only primary cases

Implant	*n*	Pre-OP ratio	Post-OP ratio	Paired Differences	*P*
Composite implant < 3.0	8	59.42 ± 1.11	58.01 ± 0.98	1.41 ± 1.02	0.210
Composite implant 3.0	17	58.93 ± 1.05	57.35 ± 0.99	1.57 ± 0.24	< 0.005*
Composite implant 3.5	27	59.07 ± 0.58	57.79 ± 0.62	1.29 ± 0.22	< 0.005*
Composite implant 4.0	15	58.15 ± 0.66	57.14 ± 0.55	1.01 ± 0.35	0.012*
Composite implant 4.5	30	59.18 ± 0.67	58.10 ± 0.72	1.08 ± 0.24	< 0.005*
Composite implant 5.0	24	58.54 ± 0.76	57.21 ± 0.74	1.33 ± 0.26	< 0.005*

*P values < 0.005, with significant difference

Asian faces have a wide intercanthal distance, smaller eye fissures, less anterior projection, and more retruded frontal bones than Caucasian faces. Autogenous tissue (e.g., cartilage, bone, dermis/fat grafts) is conventionally preferred to alloplastic augmentation rhinoplasty for Asian patients [9]. In recent decades, I-shaped silicone-polytetrafluoroethylene (ePTFE) [5, 6] composite implants have become feasible for both primary and secondary augmentation rhinoplasty in Asians to avoid donor-site morbidity and decreasing operative time [2].

The composite nasal implant (Implantech, Ventura, CA) is the only available prosthetic consisting of flexible silicone bound to a 0.3-mm PTFE shell. It is available as a straight (dorsal nasal) or L-shaped (dorsal columella) implant in various sizes [3]. Fewer complication rates, including post-op infection and tissue reaction have been reported in several prior studies in both primary and secondary cases. Hong et al. reported an infection rate of 3.2–3.7% in a large western series 3–5. Other series reported infection rates of 5.3% when silicone prostheses were used in Asian patients [10, 11]. Tissue in-growth to the micro-hole of the ePTFE-coating surface makes the secondary revision more difficult. Augmentation rhinoplasty using I-shaped ePTFE better conforms to the bony nasion and promotes forward translation of the radix to otherwise preserve the dorsal profile. This is equally relevant in primary and revision rhinoplasty in patients who seek either a higher or lower radix [12].

The preorbital profile should always be considered and evaluated before and after cosmetic surgery, especially in augmentation rhinoplasty. The 3D construction of the implant affects the periorbital area after the procedure. The intercanthal distance (ICD) is the length between the bilateral medial canthi—it usually ranges from 30 to 36 mm. The interpupil distance (IPD) is the length between the bilateral pupil (Fig. 1). Park et al. [13] reported in 2008 that the interpupillary distance (IPD) does not change after age 18 year of age in an Asian population: 64.4 ± 2.9 mm in males and 63.6 ± 2.9 mm in females. However, the effect on the changing of periorbital profile after augmentation rhinoplasty is controversial. Nevertheless, we found that both primary and secondary augmentation rhinoplasty have a significant difference in shortening of the intercanthal distance when the height is greater than 3 mm (Fig. 2).

In this study, two-thirds of patients were primary cases: Most were female for cosmetic reasons. Patients receiving the composite implant rhinoplasty with an implant height over 3 mm have a significantly shorter inner intercanthal distance (about 1.5% of the ICD to IPD ratio). Based on the mean interpupillary distance in Asian populations, there may be a 1 mm difference before and after surgery. However, there is no significant correlation between the height of implant and ICD. Our cohort was all Asian patients, 86% were female (26:158), and mean age was 33.96 ± 12.15 years (Table 1). However, there is no distribution difference between the group of implants higher than 3 mm, and the group of implants lower the 3 mm. This implies that "3 mm" is a cut-point with a significant decrease in the ratio of ICD/IPD regardless of the gender and age in Asian patients.

Periorbital swelling and ecchymosis are rare complications after rhinoplasty and can persist for one week [7, 14]. The location where the implant is anchored is planned before surgery. Normally, the upper border of the composite implant is anchored at the region between the intercanthal line to the double eyelids line. Malposition in chimera rhinoplasty is 4.5% versus 9.4% in silicon rhinoplasty. This craniofacial feature is stable in for 6–12 months without any complications after augmentation rhinoplasty with uncontrolled follow-up timing. The interval between preoperative and post-operative photographic analysis was at least more than 6 months (Mean 6.23 ± 3.27). The most common purpose for rhinoplasty is cosmetic; patients are less willing to return to the clinic after six months unless there are complications. A long-term follow-up could reveal more precise result and more detail in facial profiles after augmentation rhinoplasty.

There is another limitation to this method of measuring the intercanthal distance: The photographic evaluation can lead to calculation errors. Our study highlights the relationship between the height of the implant and the decrease in ICD-to-IPD ratio in Asian patients regardless of the gender, filler injection history, or facial skin texture. As

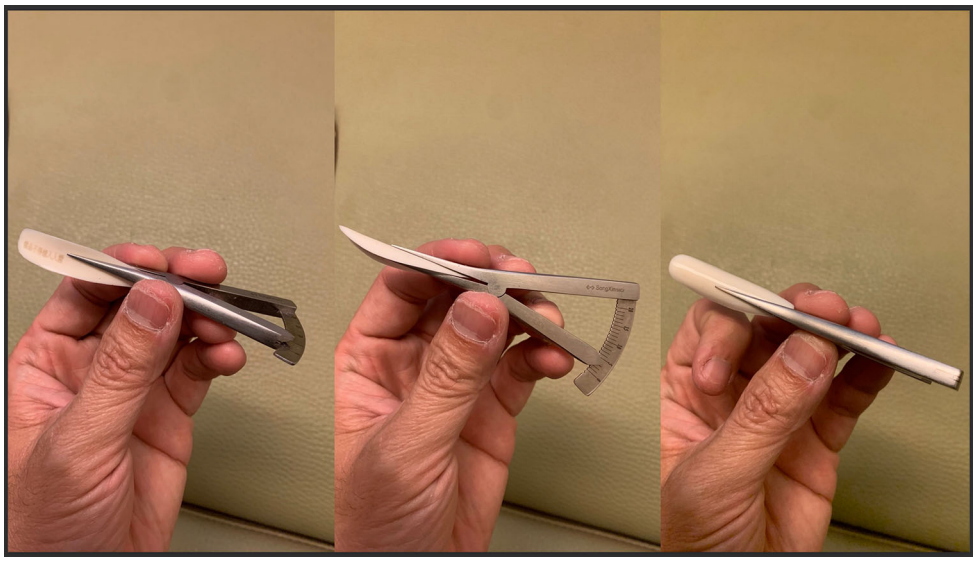

Fig. 2 The measurement of the thickness of the implant from posterior, lateral and anterior view

with any dorsal augmentation, sufficient soft-tissue coverage and skin quality are critical to prevent the graft extrusion seen when implants are in direct contact with the dermis [15]. The variables that affect the soft-tissue envelope for augmentation rhinoplasty should be considered. In future, craniofacial 3D scans and related valuable of parameters can provide precise prediction and measurements and then determine the correlation between the difference of periorbital profile after rhinoplasty and these parameters.

Conclusion

Composite implants are a feasible alternative for use in Asian rhinoplasty. Implants over 3 mm in height lead to a decreased ICD in Asian patients in both primary and secondary procedures. The normalized ratio of the ICD to IPD is estimated to decrease by 1–2%. Appropriate candidates including those with a wide ICD should be informed about these data during preoperative decision-making.

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Declarations

Conflict of interest The authors declare that there is no conflict of interest.

Ethical Approval Not required.

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