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Cosmetic

Predictive Evaluation of Septal Cartilage-bone Complex for Rhinoplasty Using Cone Beam Computed Tomography

Min-Gi Seo, MD*
Dong-Woo Jung, MD, PhD†

Background: Septal extension grafting (SEG) is commonly used for correcting Asian short noses. When septal cartilage is limited, septal bone can be included. This study evaluates the outcomes of SEG using a septal cartilage-septal bone complex (SCBC) and assesses preoperative cone beam computed tomography (CBCT) for predicting septal bone suitability.

Methods: A retrospective review was conducted of Korean women planned for SEG with SCBC from July 2021 to June 2022. Preoperative CBCT scans measured Hounsfield Unit (HU) values for septal cartilage, perpendicular plate of the ethmoid (PPE), and vomer. Of 27 patients, 19 underwent SEG with SCBC, whereas 8 did not due to unsuitable septal bone. Clinical outcomes and satisfaction were assessed through surveys and photographs.

Results: For the 19 patients using SCBC, the average HU for PPE was 286.5 ± 126.6 (ratio 6.8 ± 2.1), and for vomer, HU was 230.3 ± 95.2 (ratio 5.7 ± 1.8). SEG significantly improved nasal length and tip projection, although tip softness was less favorable. Among the 8 patients not using SCBC, 5 had bones that were too thick and stiff (PPE: 667.8 ± 102.2, ratio 15.5 ± 2.7; vomer: 342.8 ± 55.1, ratio 8.1 ± 2.3), and 3 had fragile bones (PPE: 148.7 ± 45.4, ratio 3.1 ± 0.7; vomer: 199.0 ± 68.6, ratio 4.1 ± 0.9).

Conclusions: SEG using SCBC effectively corrects short noses in Asian patients. Preoperative HU ratios from CBCT can help predict septal bone quality and guide surgical planning. Further research with larger cohorts is needed to confirm these findings. *(Plast Reconstr Surg Glob Open 2025;13:e6473; doi: 10.1097/GOX.0000000000006473; Published online 14 February 2025.)*

INTRODUCTION

Asian noses typically have shorter lengths and lower nasal tip projection compared to White noses.[1] To correct these characteristics, augmentation procedures are commonly performed in Asian rhinoplasty, necessitating modifications to the internal cartilage structure. Among the various techniques available, septal extension grafting (SEG) using septal cartilage is favored because it avoids the need for additional incisions.[2,3] However, the available septal cartilage is limited in smaller Asian noses, which can pose challenges during surgery.[3] To increase the amount of harvestable tissue, techniques involving the inclusion of septal bone during harvesting have been discussed.[4,5] Although this method allows for sufficient tissue harvest, septal bone is more challenging to handle and often requires drilling for suturing. Additionally, placing overly rigid septal bone in the nasal tip can lead to a less flexible and excessively firm structure.[6] Another limitation is the difficulty in predicting the quality of the harvested septal bone.

In this study, the authors present the surgical techniques and outcomes of cases where both septal cartilage and septal bone were harvested for SEG. Furthermore, we will utilize cone beam computed tomography (CBCT), a tool commonly used in private plastic surgery clinics, to predict the preoperative quality of septal bone. Based on our experience, we aimed to provide valuable insights into determining the clinical viability of septal bone before surgery.

*From the *Department of Plastic and Reconstructive Surgery, College of Medicine, Yeungnam University, Daegu, Republic of Korea; and †Honesty Plastic Surgery Clinic, Seoul, Republic of Korea.*

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PATIENTS AND METHODS

Study Design, Participants, and Recruitment Methods

A retrospective chart review was conducted on Korean women who were planned for SEG using a harvested septal cartilage-septal bone complex (SCBC) during primary rhinoplasty for short nose correction between July 2021 and June 2022 at a single private clinic. If the SCBC was insufficient, patients were informed before surgery that additional cartilage, such as conchal cartilage or irradiated homologous costal cartilage (IHCC), might be needed. Patients with follow-up periods shorter than 3 months were excluded. Two plastic surgeons and two consulting directors analyzed preoperative and postoperative photographs. A survey was administered at 3 months postsurgery to assess patient satisfaction. Informed consent was obtained from all patients for the publication of postoperative photographs. This study adhered to the principles of the Declaration of Helsinki.

Measurement of CBCT Images

All patients underwent a preoperative CBCT scan (DENTRI; HDXWILL Corp., Seoul, South Korea), acquired at 85 kV and 9 mA with a scanning time of 15 seconds. The Hounsfield unit (HU) values were calculated from the grayscale values obtained from the CBCT scans using the WillMaster software (HDXWILL Corp.). The midsagittal or adjacent parasagittal image that best visualized the total nasal septum was selected for analysis. After excluding the L-strut, which measured 1 cm, the size and average HU of the remaining septal cartilage were measured.[7,8] Additionally, the mean HU values were calculated for the perpendicular plate of the ethmoid (PPE) and vomer where the harvest was planned (Fig. 1). The ratio of HU values for each region to the HU value of the septal cartilage was calculated.

Surgical Technique

Surgery was performed under sedative anesthesia using propofol. After administering a local anesthetic solution of 1% lidocaine with 1:100,000 epinephrine, an inverted-V transcolumellar incision and infracartilage incisions were made. The skin and soft tissue envelope was dissected and elevated in the supraperichondrial plane up to the radix of the nose. Dissection was then carried out between the medial crura to expose the caudal septum. The septal cartilage, PPE, and vomer were exposed using a Cottle elevator. Dissection continued until sufficient exposure was achieved to harvest the septal bones. The SCBC was harvested for the anterior portion of the graft using a size 15 blade, ensuring that dorsal and caudal L-struts measuring 10 mm in width were preserved. The vomer and PPE were cut with septal scissors along the dorsal septal strut, whereas the portion connected to the maxillary crest was fractured using a Freer elevator.[5]

During SEG, the harvested cartilage was divided into half to be used on both sides. The bony portion of the graft was typically positioned posteriorly, whereas the cartilage portion was placed anteriorly. A drill or 18-gauge needle was used to create holes in the bone where sutures would pass (Fig. 2). The graft was then fixed in place using PDS 5-0 sutures. The lower lateral cartilage was advanced caudally and anteriorly, then fixed to the SEG. Additional tip grafting was performed as needed. Augmentation of the radix was achieved using a silicone implant (Fig. 3).

Assessment of Clinical Outcomes and Subjective Evaluation

Perioperative clinical photographs were analyzed using Adobe Photoshop 2024 (Adobe Systems, Inc.) to measure nasal length and nasal tip projection. To assess

Takeaways

Question: How can we effectively utilize the septal cartilage-septal bone complex (SCBC) in septal extension graft (SEG) for Asian short noses? What role does preoperative Hounsfield unit (HU) measurement play in predicting challenges with SCBC?

Findings: Utilizing SCBC for SEG in Asian short noses has shown positive results both aesthetically and subjectively. Preoperative HU values obtained from cone beam computed tomography images are effective in predicting whether the SCBC will be too thick or fragile.

Meaning: HU ratios from cone beam computed tomography can guide surgical planning by predicting septal bone quality when using SCBC for SEG.

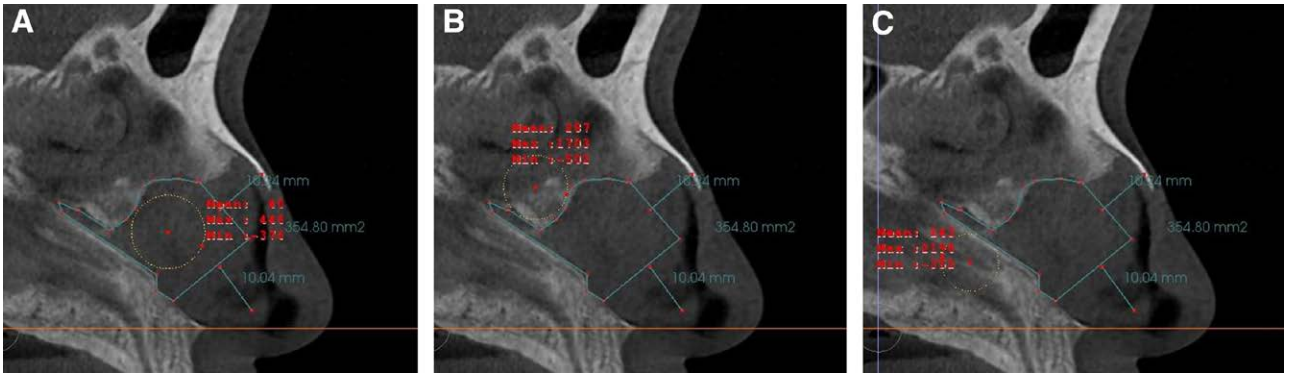

Fig. 1. Measurement of HUs of the SCBC using CBCT. A, HU of septal cartilage. B, HU of the perpendicular plate of the ethmoid. C, HU of the vomer.

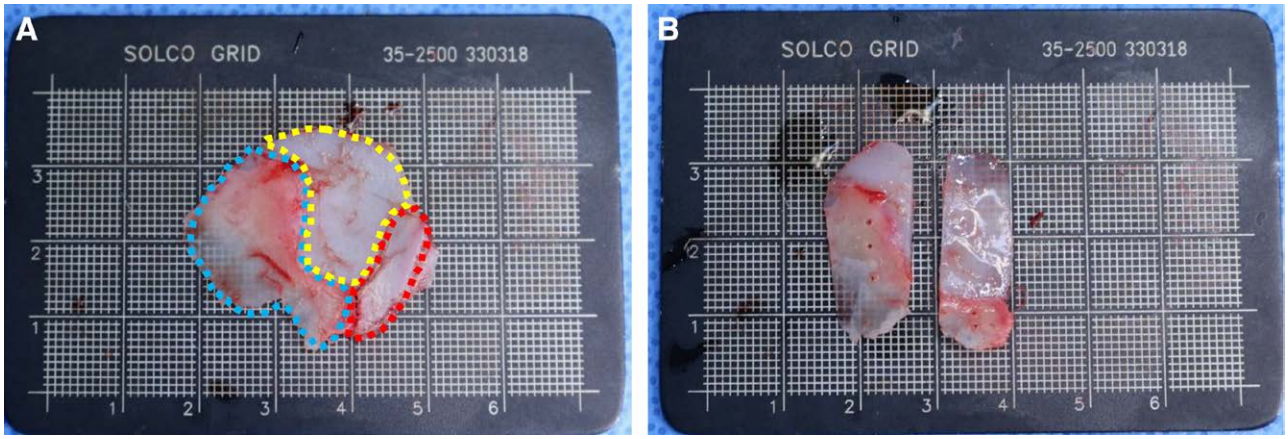

Fig. 2. Harvested SCBC during operation. A, Different portions of the SCBC (Yellow dashed line: septal cartilage; blue dashed line: perpendicular plate of the ethmoid; red dashed line: vomer). B, The harvested SCBC is carved into 2 segments. Several holes are made in the bony portion for sutures.

Fig. 3. Sequential steps of SEG using the SCBC. A, The bony portion of the graft is positioned posteriorly, whereas the cartilage portion is placed anteriorly. The SEG is fixed to the septal cartilage using 5-0 PDS sutures. B, The lower lateral cartilage is advanced caudally and anteriorly, then fixed to the SEG. C, Conchal cartilage is used for a tip graft on the nasal tip refinement, and a silicone implant is inserted for dorsal augmentation.

Table 1. Visual Analog Scales for Assessing Patient Subjective Satisfaction

Question	Rating Scale (0–10)
Q1. How satisfied are you with the appearance or shape of your nose after rhinoplasty?	(0 = very dissatisfied, 10 = very satisfied)
Q2. How satisfied are you with the tip projection of your nose after rhinoplasty?	(0 = very dissatisfied, 10 = very satisfied)
Q3. How soft does the tip of your nose feel to the touch?	(0 = very stiff, 10 = very soft)
Q4. How satisfied do you feel with your breathing after rhinoplasty?	(0 = very dissatisfied, 10 = very satisfied)

patient satisfaction with the rhinoplasty outcomes, visual analog scales were used to evaluate responses to specific questions (Table 1).

Statistical Analysis

The Wilcoxon signed-rank test was used to analyze perioperative changes. A *P* value of less than 0.05 was considered statistically significant. All analyses were performed using SPSS ver. 20.0 (SPSS, Inc., Chicago, IL, USA).

RESULTS

Demographic and Perioperative Details

Harvesting the SCBC was performed on 27 Korean women. The mean age was 31.6 years (range, 20–53 y), and the mean follow-up period was 4.9 months (range, 3–12 mo). Of the 27 patients, 19 patients were able to use the harvested septal bone for the SEG. Among the remaining 8 patients, the septal bone was too thick and stiff to be used in 5 patients. Three patients had fragile SCBC, with 1 case where the cartilage and bone separated during harvesting and 2 cases where the septal bone segmented during handling (Fig. 4). One patient underwent SEG using septal cartilage alone, whereas the remaining 7 required IHCC in addition due to insufficient septal cartilage. Patient demographics and clinical characteristics are summarized in Table 2. Septal perforation, deformity, or deviation did not occur. Graft-related complications, such as resorption of the septal cartilage or bone requiring revision, were also not observed. Furthermore, no silicone

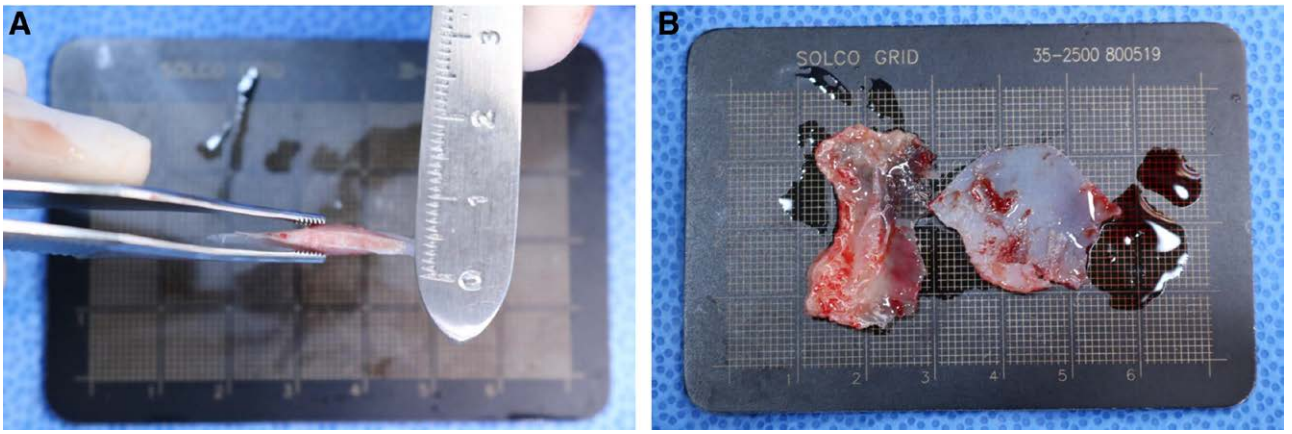

Fig. 4. Intraoperative evaluation of SCBC. A, The PPE from the harvested SCBC was too thick and stiff to be used, with a thickness exceeding 3 mm. The HU of the PPE was 512 with a ratio of 12.2, and the vomer had an HU of 369 with a ratio of 8.8. B, The harvested SCBC was too fragile, causing it to fracture and separate in the middle. The HU of the PPE was 164 with a ratio of 3.8, and the vomer had an HU of 121 with a ratio of 2.8.

Table 2. Demographic and Clinical Characteristics of Patients With Harvesting of SCBC

Characteristic	Value
Mean age (y)	31.6 (range, 20–53)
Mean follow-up period (mo)	4.9 (range, 3–13)
Septal extension graft type (patients)	
SCBC	19
Septal cartilage, only	1
IHCC	7
Complications (patients)	
Septal perforation, deformity, or deviation	0
Graft cartilage-related complications	0
Silicone implant-related complications	0

implant-related complications, such as infection, migration, extrusion, or delayed inflammatory reactions, were reported.

Analysis of Cartilage and HU

Among the 19 patients who used the SCBC for SEG, the average HU for the PPE was 286.5 ± 126.6, with an average HU ratio of 6.8 ± 2.1. The average HU for the vomer was 230.3 ± 95.2, with an HU ratio of 5.7 ± 1.8. Among the 8 patients who did not use SCBC for SEG, 5 patients had septal bones that were too thick and stiff for surgery. Their average HU values were 667.8 ± 102.2 for the PPE and 342.8 ± 55.1 for the vomer, with HU ratios of 15.5 ± 2.7 for the PPE and 8.1 ± 2.3 for the vomer. The average thickness of the septal bone was 3.6 ± 0.5 mm. For the 3 patients whose septal bones were too fragile for use, the average HU values were 148.7 ± 45.4 for the PPE and 199.0 ± 68.6 for the vomer, with HU ratios of 3.1 ± 0.7 for the PPE and 4.1 ± 0.9 for the vomer (Table 3).

Clinical Outcomes and Subjective Evaluation

A total of 19 patients underwent SEG using both the harvested septal cartilage and septal bone. Both nasal length and nasal tip projection significantly increased postoperatively (Table 4; Fig. 5). In the subjective evaluation of these 19 patients, appearance or shape scored an average of 8.1 points, tip projection averaged 7.9 points, tip softness averaged 5.9 points, and breathing scored an average of 7.7 points.

DISCUSSION

When correcting a short nose, providing sufficient structural support is crucial, as the amount of septal cartilage available in Asian patients is often insufficient for effective SEG using cartilage alone.[3] Although costal cartilage provides ample volume and robust strength, its use presents challenges such as difficulty in carving and potential donor site morbidity.[9,10] To address these issues, we prefer using the SCBC in primary rhinoplasty for short noses. When harvesting SCBC, it is essential to carefully harvest the septal bone and cartilage together to prevent separation. Even after successful harvesting, creating a hole in the bony portion for suturing may require a drill

Table 3. HU Values for Septal Cartilage and Septal Bone in Different Patient Groups

	Average HU for Septal Cartilage	Average HU for PPE	Average HU for Vomer	Average HU Ratio of PPE	Average HU Ratio of Vomer
Patients using SCBC for septal extension graft (19)	41.6 ± 11.3	286.5 ± 126.6	230.3 ± 95.2	6.8 ± 2.1	5.7 ± 1.8
Patients not using SCBC for septal extension graft (8)					
Thick/stiff (5)	42.8 ± 10.9	667.8 ± 102.2	342.8 ± 55.1	15.5 ± 2.7	8.1 ± 2.3
Fragile (3)	47.7 ± 9.6	148.7 ± 45.4	199.0 ± 68.6	3.1 ± 0.7	4.1 ± 0.9

Table 4. Perioperative Changes in the SCBC for the SEG

	Preoperative	Postoperative	*P**
Nasal length	3.90 ± 0.44	4.85 ± 0.46	<0.001†
Nasal tip projection	2.21 ± 0.39	2.71 ± 0.45	<0.001†

*Wilcoxon signed-rank test.
†Significant difference, $P < 0.05$.

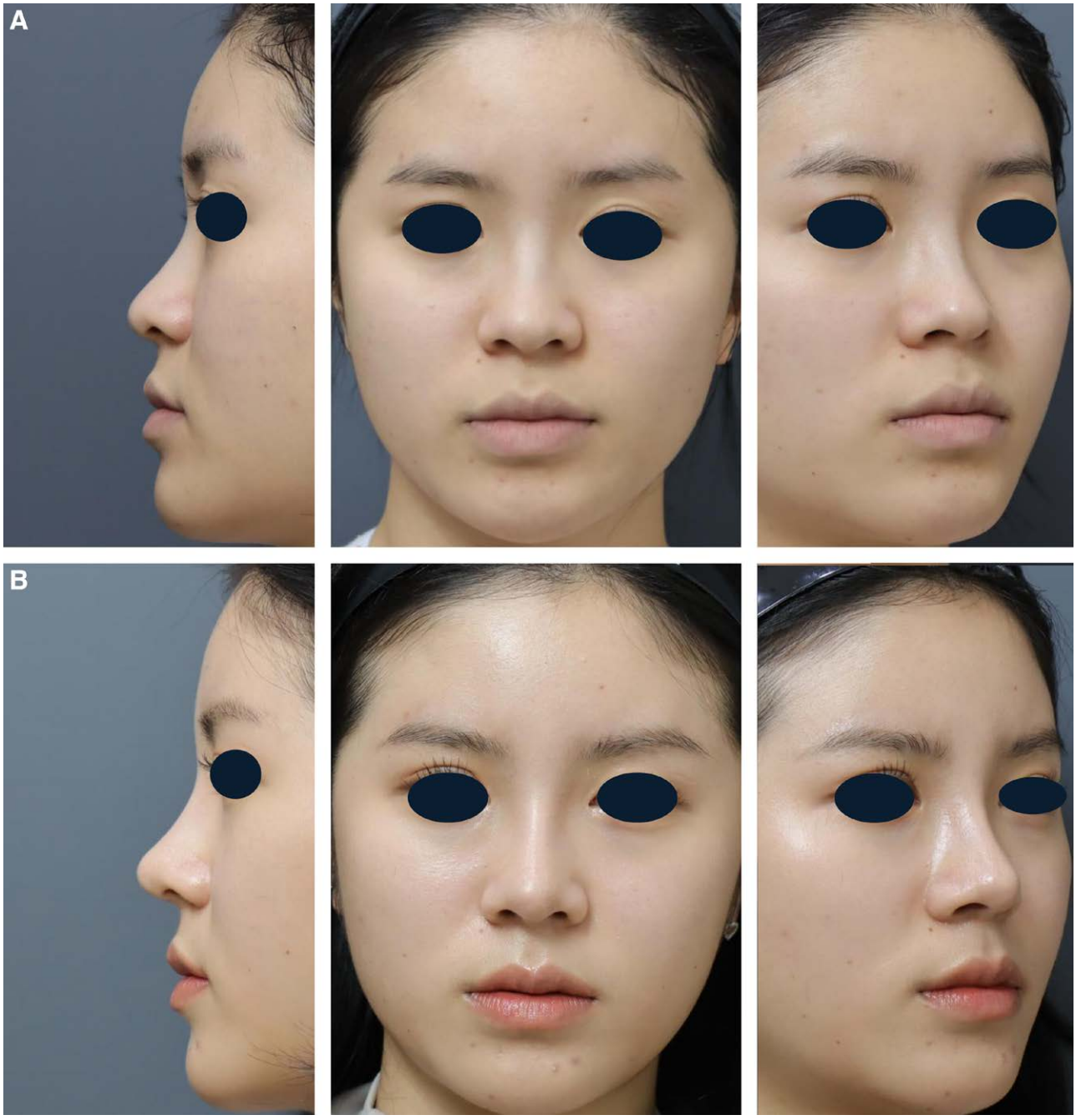

Fig. 5. A 23-year-old woman with a short nose, treated with a septal extension graft using the septal cartilage-septal bone complex, tip graft with conchal cartilage, and dorsal augmentation with a silicone implant. A, Preoperative photographs. B, photographs taken 8 months postoperatively.

or other instruments. The lack of elasticity in the bony portion increases the risk of cracks, particularly if the SCBC is fragile. Therefore, careful handling is crucial, and it is beneficial to anticipate these challenges preoperatively. In our private clinic, we routinely use CBCT to assess the quality of the SCBC before surgery.

CBCT is frequently used to assess nasal structures for rhinoplasty due to its advantages, including ease of use, satisfactory image resolution, minimal artifact incidence, and lower radiation dose. It is also used to estimate bone mineral density, with grayscale values obtained from CBCT being predictive of mineral density.[11] These grayscale values can be converted to HU, and several studies have demonstrated a linear relationship between them.[11–13] In our study, the average HU values for the SCBC used in SEG were as follows: the mean HU for the PPE was 286.5 ± 126.6, and the mean HU for the vomer was 230.3 ± 95.2 (Table 3). These values correspond to type IV according to Misch Classification (less than 350 HU), which is characterized by very thin trabecular bone with little cortical bone.[14] Type IV septal bone is typically considered pliable and suitable for use in surgical procedures like SEG. In contrast, the average HU values for the 5 patients whose septal bones were too dense for surgical use were higher: 667.8 ± 102.2 for the PPE and 342.8 ± 55.1 for the vomer. These values suggest that the bone is too stiff for effective use in SEG, corresponding to type III (350–850 HU).

However, grayscale values can vary due to factors such as noise, scattered radiation, the heel effect, and beam hardening artifacts.[13] Converted HU values from grayscale values may also be inaccurate depending on the clinical environment or software used.[13,15] Thus, the use of CBCT as a standardized reference for evaluating the density of nasal septum remains debatable.[12,13] To address this issue, we utilized the ratio of septal cartilage to septal bone based on converted HU values, as this approach may compensate for differences in clinical settings across different clinics. In our patient cohort, analyzed using consistent CBCT settings and software, we observed that SCBC with a high HU ratio in the septal bone, specifically above 10.0 for PPE and above 7.0 for vomer, was too stiff and thick for use. This made it difficult to carve the desired tip shape and often led to tip stiffness when used in SEG. Conversely, when the septal bone had a low HU ratio, below 4.0 for PPE and 5.0 for vomer, the bone and cartilage tended to separate during harvesting. Even when successfully harvested, these fragile, inelastic septal bones frequently fractured during manipulation. Anticipating these difficulties allows surgeons to plan alternative cartilage sources such as IHCC and inform patients of potential intraoperative changes. However, due to the small sample size, further studies with larger patient groups are needed to better understand the application of HU ratios in clinical practice. Additionally, when the SCBC is deviated, it may not be fully visible or may appear distorted on a single CT slice, making it challenging to obtain accurate measurements of its density. Therefore, a surgeon should recognize that there may be errors in the HU ratio in patients with severe septal deviation.

Following SEG using SCBC, both nasal length and tip projection significantly improved in short Asian noses, and subjective satisfaction was high. However, the score for tip softness was lower compared with other satisfaction parameters. Ideally, the bony portion of the SCBC should be placed posteriorly, with the cartilage portion in the anterior segment. In some patients, there was a greater proportion of septal bone in the anterior side, which might increase tip stiffness. Although the stiffness of the nasal tip typically decreases over time following SEG, longer follow-up is needed for patients who undergo SEG using SCBC. It is advisable to inform patients preoperatively about the potential for increased nasal tip stiffness.[6] In patients who receive SEG, a decrease in tip projection may occur over time.[6] The average follow-up duration in this study was 4.9 months. During this period, no severe decrease in tip projection was observed, and the subjective satisfaction were favorable. However, further studies with longer follow-up periods are necessary.

CONCLUSIONS

Using the SCBC for SEG provides both aesthetically and subjectively pleasing results for Asian short noses. By maintaining consistent CBCT settings and utilizing HU ratios, even private clinics may simplify the assessment of SCBC quality and suitability using CBCT alone. The preoperative HU ratio can help predict the difficulty of SCBC harvest and the quality of the harvested septal bone.

Dong-Woo Jung, MD, PhD
Honesty Plastic Surgery Clinic
8F, 589, Gangnam-daero, Seocho-gu
Seoul 06526, South Korea
E-mail: psdrjdw@gmail.com

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

PATIENT CONSENT

The informed consent was taken from the patient of clinical photographs and data in the figure.

DECLARATION OF HELSINKI

This study was conducted in accordance with the Declaration of Helsinki.

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