



# Functional Surgery 2: Consideration of Internal Valve Problems in Asian Rhinoplasty, and Turbinate Reduction

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Asian rhinoplasty can be divided into two completely different categories: a primary operation and a secondary operation. In Asian rhinoplasty, these two surgeries have few shared concepts.

Among the Asian rhinoplasty techniques, secondary rhinoplasty has an entirely different concept of dissection from the primary operation. The reason for this is that most of the previous surgery uses alloplastic implants. Primary rhinoplasty is mainly confined to an anteroposterior or cephalocaudal enhancement of the nose. Most of the secondary rhinoplasty are surgeries fighting against the scars caused by alloplastic materials and thriving to manage the previously removed quadrangular cartilage and the previously applied grafts.

Apart from the distinction between primary and secondary operations, another criterion is divided into surgery that requires septal dissection and surgery that does not.

In Asian rhinoplasty, septoplasty is rarely done to improve the function of the nose. Most of the surgeries require cartilage graft, so the septal dissection is for collecting the septal cartilage. In most cases, tip projection is required even after the hump removal in reduction rhinoplasty, not to mention the deviated nose correction.

The purpose of harvesting the quadrangular cartilage from primary rhinoplasty of Asian rhinoplasty is not to correct the septal deviation but to obtain grafts for septal extension or tip plasty. Most grafts are applied to the tip to improve the profile rather than the spreader graft to correct the function after hump removal or deviation correction. Paradoxically, there are many clinical cases in which the nasal function worsens after Asian rhinoplasty because the nasal septum is resected for the projection rather than the functional improvement. Below comes from the reality of Asian rhinoplasty, 180 degrees different from western rhinoplasty, so it needs the wisdom to decide whether to perform subdivision projection between normal and abnormal cases.

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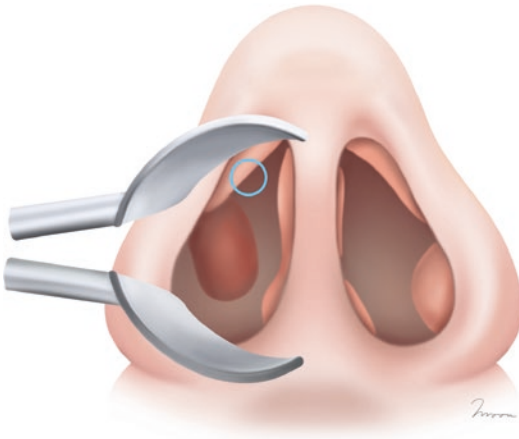
## Functional Aspects of Internal Valve

### Anatomy

An internal valve representing the most significant resistance to air intake from the nose is present at a distance of 1.3 cm from the external nares. Most of the causes of nasal congestion occur at a distance from the outer valve to the nasal valve and account for the highest nasal resistance to airflow. As for the anatomical structure, the roof consists of the junction of the caudal portion of the upper lateral cartilage (ULC) and the cephalic portion of the lower lateral

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**Fig. 1** Nasal obstruction is located in the area seen by the nasoscope. The internal nasal valve is easily found

cartilage (LLC), the medial wall of the inferior turbinate, the nasal septum, and choana. Nasal obstruction is present in the area seen by nasoscopy. In other words, even if there is no endoscopic instrument, nasal obstruction can be observed with the simplest nasoscopy. As such, nasal obstruction is located in the front part of the entrance (Fig. 1).

### Cottle Test

Cottle test is to measure the function of the navel valve. It determines the positivity of the test as the nasal obstruction is improved when the cheek outside the alar crease junction is pulled out. The modified Cottle test is a method to measure the improvement of the nasal obstruction by lifting the roof of the internal nasal valve more directly. The valve is lifted using a small freer elevator. Many studies have different views on the usefulness of this test result. Instead, studies are showing that the nasal strip test shows more valid results than the Cottle test. The sensitivity and specificity of the Cottle test differ according to the various reports. Although there are various cohort studies, the author has never seen a patient whose mild nasal obstruction is not resolved by this Cottle test. Mild nasal obstruction is resolved in all patients with the Cottle test. Therefore, the result of this test is not directly judged by the

extent of the patient's nasal obstruction. Even in the outpatient clinic, direct observation, CT findings, and more detailed medical history listening are prioritized rather than the Cottle test.

### Physiology

With olfaction, respiration is the most critical function of the nose. Warm, moist air should be inhaled through the nasal cavity without vortices to avoid stuffiness. The critical concept is the nasal cycle. The nasal cycle is an unconscious phenomenon: partial congestion and decongestion of the nose. Thus, there is a greater airflow through one of the nostrils, alternating between the left and right. It is a physiological blockage called a nasal cycle due to selective activation of half of the autonomic nervous system by the hypothalamus. It should not be confused with a pathological stuffy nose. The total nasal resistance is usually kept constant and is less than the resistance of each nose, so ordinary people are usually not aware of this phenomenon. The circulation of the nose subconsciously alternates between partial congestion and decongestion. It is essential to compare records before and after surgery using NOSE SCALE for objective measurement. There are also objective methods such as rhinomanometry and mask peak flow, but the author uses acoustic rhinometry and CT scan as the most direct modality. The most crucial method is taking medical history. In acoustic rhinometry, it is essential to observe the overall flow as the observation of the pattern. The quantitative measurement of the curve is not directly proportional to the nasal obstruction (Fig. 2). As shown in the figure, two minimal cross-sectional areas (MCA) are shown, and the front one is judged as the external nares and the second MCA as the internal nasal valve.

### The Shape of Internal Valve and Collapse of ULC

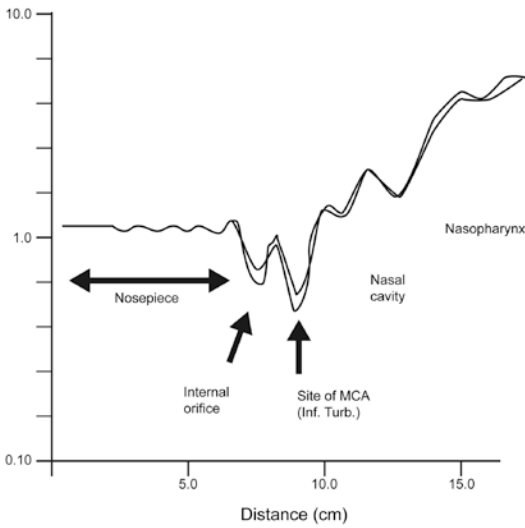
Many studies have reported whether the shape of the internal nasal valve (INV) is related to the actual intake function. However, the evidence is

still insufficient, but when convexity exists at the anterior edge of the septal cartilage, it is considered an acute angle, which can also be associated with poor airflow. Conversely, in the case of a round shape INV, the frequency of nasal obstruction was minor. These shreds of phenomenon need more evidence. According to the INV angle, when considering the size of the graft, the excessive width of the spreader graft may change the

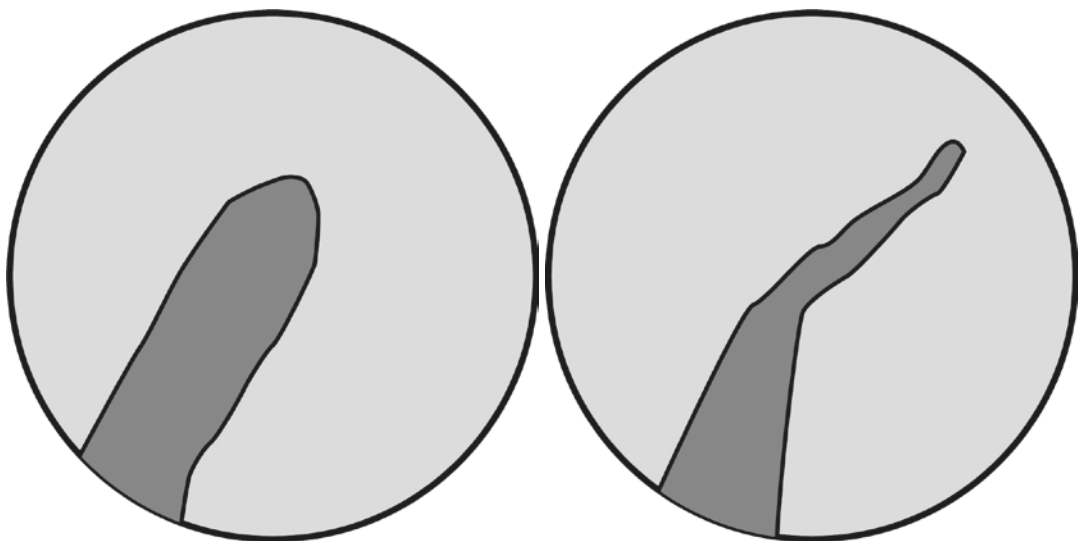
shape of INV. An extensive spreader graft can change INV to an acute angle. So far, there is no study on how the shape of the internal valve acts in the airflow of directly inhaled air. The narrower the angle of the internal nasal valve, the less airflow will be, but there is only a physical simulation of the total volume: many studies on whether the shape of the internal nasal valve is related to the actual intake function. However, the evidence is still insufficient, but when convexity exists at the anterior edge of the septal cartilage, it is considered an acute angle, which can be considered to be associated with nasal obstruction. Conversely, in the case of a round shape INV, the frequency of nasal obstruction was minor. . The smaller the internal nasal valve angle, the less airflow will be, but there is only a physical simulation of the total volume (Fig. 3).

Poiseuille’s law explains the resistance and physiologic flow related to the radius, tube length, viscosity, resistance, and pressure difference. Two different flows are laminar flow and turbulent flow. Irregular tubes, such as the nose cause turbulent flow. Moreover, nasal turbinate and septum regulate nasal airflow.

This law explains the relationship between resistance and flow velocity and the relationship between laminar flow and turbulent flow in a structure with possible obstruction. Surgery



**Fig. 2** Acoustic rhinometry: Internal nasal valve located at the minimal cross-sectional area (MCA)



**Fig. 3** Two different types of INV angle: (Lt) obtuse angle and (Rt) acute angle

related to the internal nasal valve (INV) is limited to constantly improving the collapsibility of the valve. Surgery on the nasal septum to secure the rest of the nasal cavity on the curved nasal septum. The angle between the ULC and Septum must be 10–15 degrees or more for expansion in this area. The purpose is to secure the roundness of the roof as it is opened by inserting a spreader graft having a length of 1–1.5 cm and a width of 4–5 mm. It is more purposeful to prevent collapse with ULC spreading rather than improving INV shape. Therefore, if a sufficient length spreader is not secured, there is a problem in the function of INV. In other words, the purpose of the spreader graft is to expand the gap between the ULC and septum, including INV. Also, a spreader graft can correct the shape of the cartilaginous dorsum to the left or right sides and the s-shaped deformity. In primary rhinoplasty, surgery can be considered as a primary choice, but there are two problems, especially for Asians:

1. There is a limit to express the dorsal profile with the spreader graft itself in Asians. In other words, the spreader graft is the invisible graft that can repel the ULC to be straightened. Spreader graft can correct the deformation of deviation; however, there is no scientific background on how the graft will

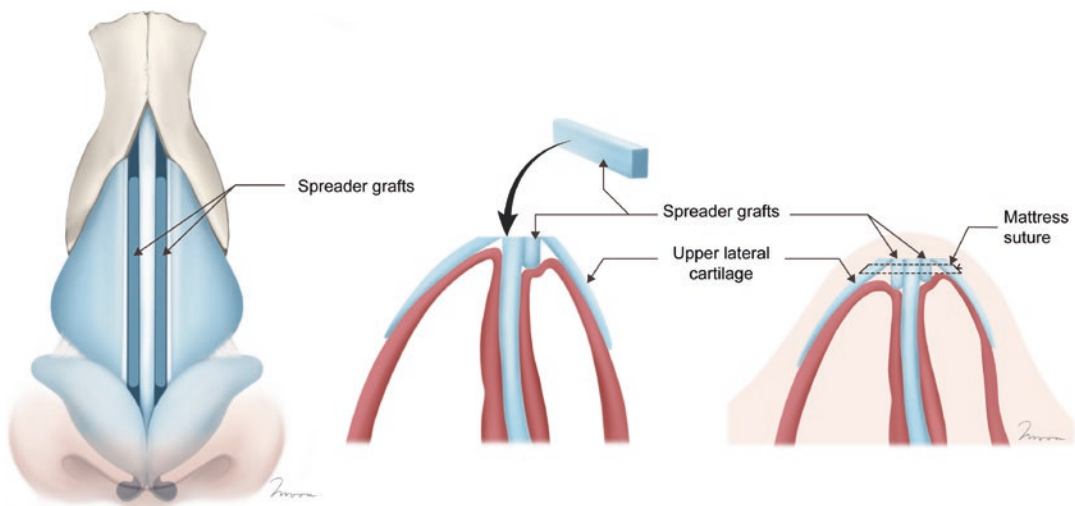
function when an alloplastic implant is inserted thereon. Spreader graft under the alloplastic implant is to be studied in the future for the current abusive applications.

2. The spreader graft can ruin the shape of the nose. In particular, there is concern that the dorsal esthetic line may deteriorate after the change of the width if it must be inserted in the second surgery. In other words, serious consideration needs to be given to how far the role of the invisible graft will be limited. Since many cartilage grafts are needed in Asians, using the vast amount of cartilage in the spreader graft on the invisible area makes tip surgery impossible.

## Spreader Graft

The spreader graft is defined as a graft that inserts a cartilage strip with a length of 2–3 cm, a width of 3–5 mm, and a thickness of 1.5 mm between the upper lateral cartilage to spread the gap between the anterior septum and the sidewall. This graft has the following functional aspects and the esthetic aspect of the dorsal profile at the same time (Fig. 4).

1. Prevent mid nasal collapse.
2. Improve inverted V deformity.



**Fig. 4** Spreader graft

3. Restore “T” appearance of the dorsal septum.
4. Restore the internal valve angle more than 15 degrees by obtuse the acute angle of the roof of the internal valve.
5. Correct left to right deviation of the anterior septum.
6. Make the dorsum wide and maintain the width of 7–12 mm or more.

Since, inevitably, the removal of the dorsal “T” shape cartilage that occurs after reduction rhinoplasty leaves the internal valve angle acute, it is necessary to perform a spreader graft at this time. When removing the generalized hump, the larger the removal, the wider the width of the spreader graft is required. The spreader graft is invisible. In other words, it is not a concept of applying spreader graft more anteriorly than ULC. However, in Asians, you should have a different perspective. Here, the anteriorly extended spreader graft determines the dorsal profile as a correct physiologic operation.

### Extended Spreader Graft

The length of 2–3 cm mentioned above corresponds to the length from the dorsal septum to at least the cephalic border of the lower lateral cartilage in Westerners. In Asians, it will be within 2–2.5 cm.

For correcting a contracted nose or short nose, a longer spreader is required, and an extension that allows the caudal end to reach the middle crus is required.

In addition to this, the author mainly uses an anteriorly extended spreader graft. It is a form of anterior extension of the spreader graft for projecting the dorsal profile. This method is a “visible spreader graft” and has the advantage of making the dorsal profile with the spreader graft itself. For dorsal augmentation, there is no need to put alloplastic material, and it has the advantage of expressing cartilaginous dorsum as the anterior septum (Fig. 5).

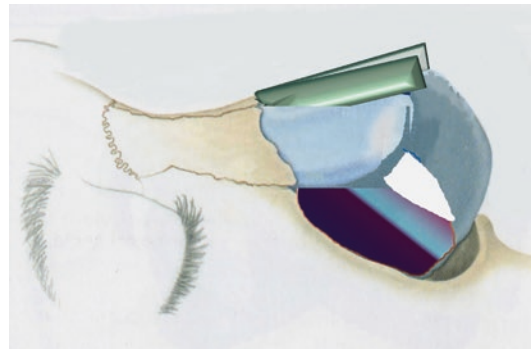
### Specific Perspectives in Asian Rhinoplasty

1. Lack of size of the septal quadrangular cartilage.

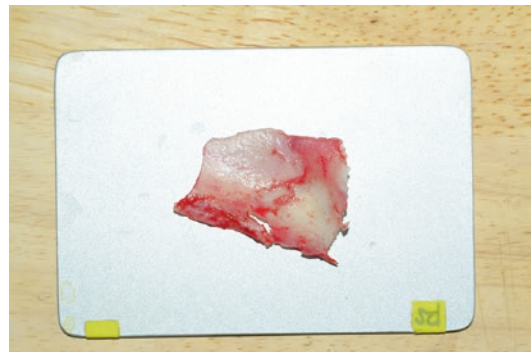
The biggest obstacle is that the size of the quadrangular cartilage is limited. In most patients, the abovementioned 2–3 cm length graft is not possible. If the rib cartilage or ear cartilage is not harvested, the ethmoid perpendicular plate is connected to the cartilage to use the small quadrangular cartilage properly (Fig. 6).

2. Invisible graft under alloplastic implants.

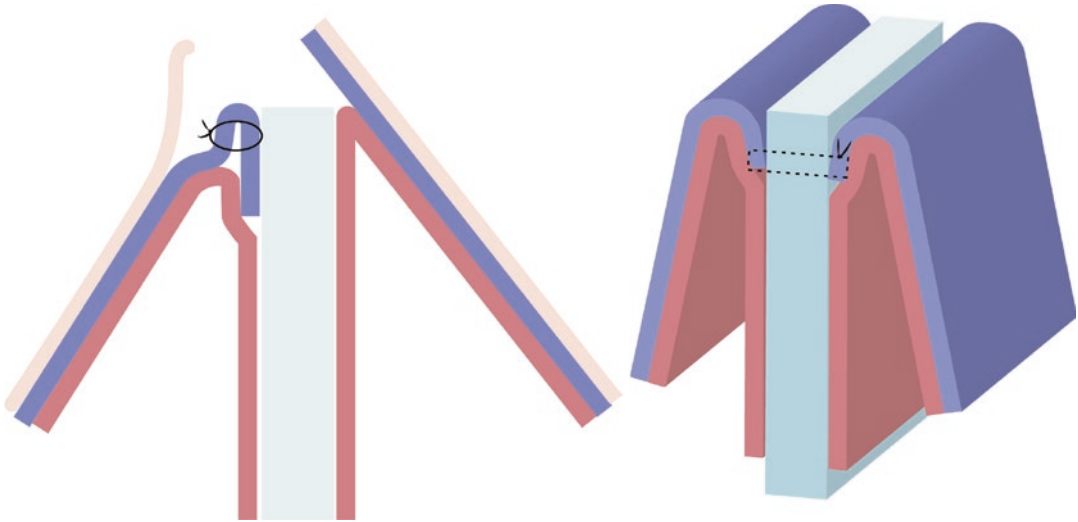
Another problem mentioned briefly above is onlaying the alloplastic implant on the dorsum



**Fig. 5** Anteriorly extended spreader graft: visible spreader graft



**Fig. 6** Quadrangular cartilage harvest connected with ethmoid perpendicular plate



**Fig. 7** Spreader flap

over the spreader graft. Is it physiologically correct? There are several risks. Even if there is no laceration perforating to the nasal cavity with the well-preserved mucoperichondrium, there will be risks about putting the alloplastic implant in the widely dissected dorsum, which is thought to be the cause of late-onset inflammation. Another problem is its functional aspect. It can be argued that rationale is made to create a flat platform for alloplastic implants to be inserted by spreader grafts on the dorsum. However, clinically, implants located straight in the middle of the nasal axis are rarely found in the author's experiences; a more significant problem may occur if the implant sinks to either side. The author believes applying the alloplastic implant to the dorsum after the spreader graft is physiologically lacking evidence.

### Spreader Flap

As a method possible in reduction rhinoplasty, the anterior septal cartilage is first removed during component dorsal reduction, and then the medial flap of the remaining upper lateral cartilage is rolled down to create a spreader graft. For Asian rhinoplasty, its application is minimal. This is possible for a large nose with a lot of

ULC, but in most Asians, it cannot be used as a flap on the cartilaginous dorsum, and then the ULC must be cut off (Fig. 7).

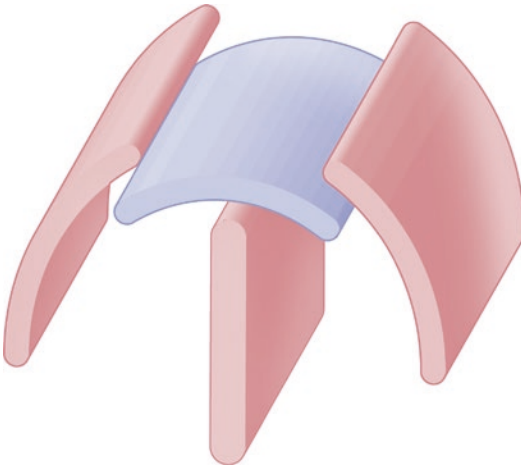
### Splay Graft (Spring Graft)

The splay graft is a method that can be applied when the collapse of the internal nasal valve is judged as the cause of nasal obstruction. The anterior edge of the septal cartilage is used as a tent pole, and flat cartilage is inserted into the undersurface of the ULC on both sides. However, it has the disadvantage of widening the width of the nose and should be used with care in patients with thin skin. In other words, it is called spring graft, and it is the same surgical method that has the same meaning. This is the best way to get an obtuse internal nasal valve angle (Fig. 8).

### Internal Valve: The Impact on Asian Septorhinoplasty

#### The More Reduction, the More Spreader Graft

As the size of the hump increases, the size of the spreader graft to be applied increases. This is



**Fig. 8** Splay graft (spring graft)

because the overall INV angle changes in the lateral inward fracture to improve the open roof deformity after hump removal. However, Asians' humpectomy should be operated with a slightly different view. The entire dorsal profile should be considered after the humpectomy in Asians. In other words, there are many cases in which humpectomy cannot be performed as much as desired, but rather the nasion area is augmented, and the reduction in the rhinion area is minimized. The amount of humpectomy can be reduced, and the projection of the nasion and cartilaginous dorsum can be considered in consideration of the entire dorsal profile. In many Asians, hypoplastic lower 2/3 is a typical characteristic with a bony hump or pseudo hump deformity.

However, it is a misconception that cases of nasal obstruction after humpectomy are less compared to those of Westerners. The reduction of cartilaginous dorsum should be well planned by distinguishing between generalized hump, isolated hump, and pseudo hump.

### **What Is the Cause of Nasal Obstruction after Septorhinoplasty?**

The most common cause is the residual septal deviation. Most of the surgery is submucous

resection rather than septoplasty in Asian septorhinoplasty. Conventional septoplasty preserving most of the quadrangular cartilage is impossible in many Asian septorhinoplasties unless the patients have huge noses. This is because the quadrangular cartilage is required as a graft donor. In Westerners, after hump resection, the acute angle of the internal valve is the most significant cause, but in Asians, some other causes are as follows.

### **Nasal Synechia**

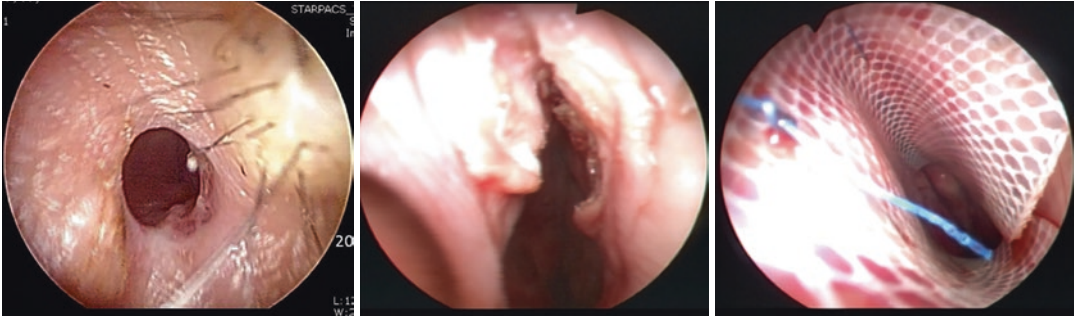
Mucosal wounds after packing removal cause intranasal adhesion, and most of the adhesion occurs in a high portion of the nasal cavity. Although the preference of nasal packing materials differs from author to author, damaging the mucosal barrier is frequently found when gauze use. Minor mucosal erosion may occur while removing the gauze. When such adhesions are found during secondary rhinoplasty, simple cutting with the freer elevator is performed first (Fig. 9). However, it is also essential to manage using appropriate smooth packing material even after adhesiolysis.

### **Ignorance of Internal Valve**

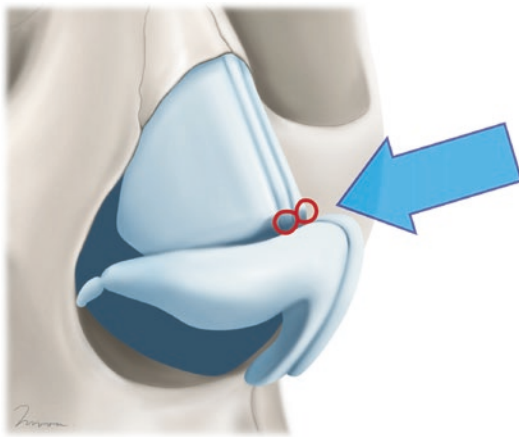
Since most patients visit the plastic surgery clinic to improve their appearance, functional problems are apt to be ignored. So the patient's history and careful internal nasal inspection should be focused.

If a patient whose nose is not obstructive preoperatively, obstructive symptoms after cosmetic surgery, in severe cases, maybe a legal problem. The safest device, NOSE SCALE, needs to be actively conducted to receive legal protection.

It is the safest policy and the path for patients to measure and record the clinical severity of existing nasal obstruction through a simple questionnaire that takes less than 5 minutes.



**Fig. 9** Nasal synechia: (Lt) preoperative view, (middle) release of synechia, and (Rt) silastic sheet dressing



**Fig. 10** Paradoxical INV depression after excessive tip projection anchoring

## Unique Internal Valve Problems in Asian Rhinoplasty

### Exaggerated Tip Sutures

For the tip projection, in specific techniques, the lateral crus is rotated excessively cephalically, and the middle of the lateral crus is anchored together with the high septum. This tip anchoring can obtain the projection. As mentioned earlier, tip tripod support with stiff LLC is hardly adopted in Asian rhinoplasty and Asian secondary rhinoplasty. No matter how strong the medial crus are held up, that is, in other words, even if the septal extension grafts or the columellar strut was applied, excessively anchored lateral crus may press the high septum paradoxically (Fig. 10). The minimal cross-sectional area (MCA) may abruptly be reduced in the cephalic portion of the

INV in the CT axial view, as shown in the case below.

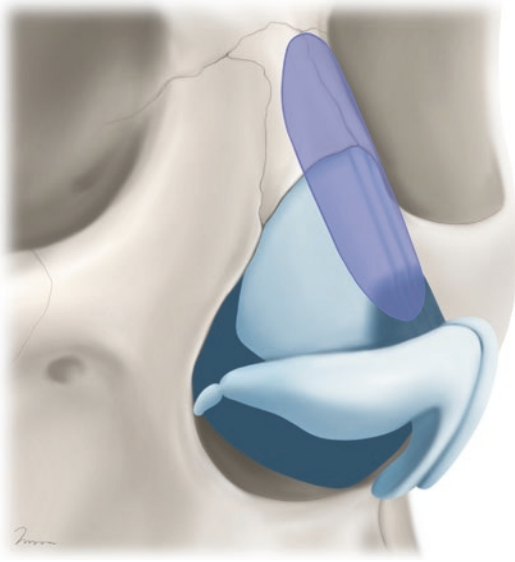
### Exaggerated Supratip Graft

In many patients, septal extension graft or columella strut is used for tip projection, but recently batten type graft in the supratip area, including derotation graft, has gained popularity. The biggest problem is that even with this batten graft, the dorsal profile usually cannot be obtained by itself. Therefore, another dorsal graft, including the alloplastic implant, is required. Almost all Asian rhinoplasty only pay attention to the power of the tip projection; the dorsum is, of course, taken as implanting or grafting. The abovementioned INV area's step ladder deformity, something like supratip depression, can be found (Fig. 11). INV depression at the supratip area results from the fragile septum. The tension caused by graft or alloplastic implant at the dorsum with tight soft tissue envelope and gravity may play a role.

### Possible Solutions

The surgery to open the nasal airway using the spring graft or spreader graft mentioned earlier is necessary. There are no data on the effectiveness or usefulness of placing an alloplastic implant on a spring graft or spreader graft in the literature yet. What is certain is that the stability of the high septum determines whether or not the strong anchoring suture can withstand and whether or not the heavy graft of the supratip area can be sustained. In other words, there is a possibility that derangement may occur in the function of





**Fig. 11** INV depression after supra tip graft and dorsal implanting

the nose, unless a physiologic INV lift is accompanied by an appropriate projection of the anterior septum. The dorsal profile created by the anterior septum will prevent the decrease in the INV angle even after the excessive tip projection. If LLC cannot be lifted because of its poor strength, it will not overcome the MCA difference between the LLC and ULC, thereby resulting in step ladder deformity. This problem will ultimately be solved only when the anterior septal is extended too like the septal L-strut extension graft (Fig. 12). In numerous Asian rhinoplasty, the concept of focusing on the tip only, then controlling the dorsum with alloplastic materials will result in an unanticipated derangement in function as the above patient.

## Turbinate

### Inferior Turbinate Surgery

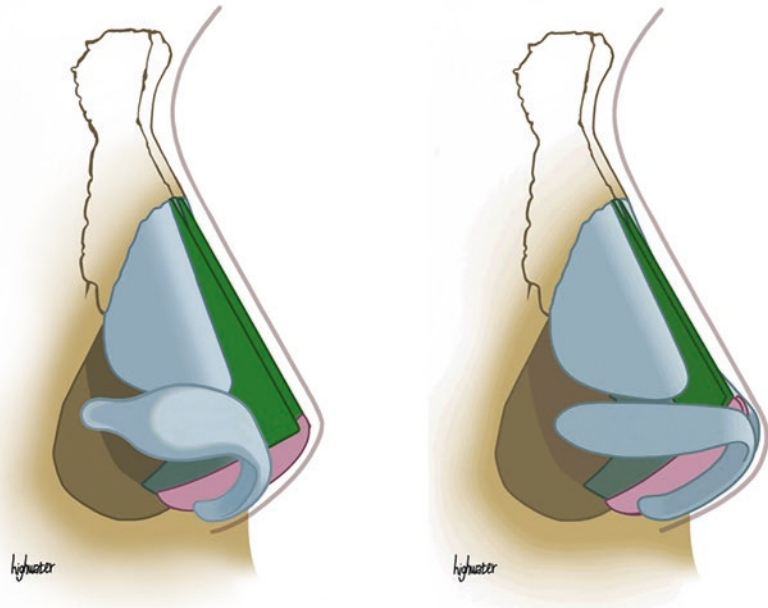
Septum and concha are one unit. Even if the septal surgery is successful, nasal obstruction is not resolved with conchal hypertrophy. The septum and concha should be considered simultaneously. If one side of the nasal septum concave, compen-

satory ipsilateral turbinate hypertrophy occurs. Therefore, it is necessary to reduce the inferior turbinate. There are several types of surgery related to inferior turbinates, but from a plastic surgery point of view, out fracture with a simple freer elevator and packing can expand the nasal cavity easily. A conventional method of reducing turbinate is inferior submucosal turbinectomy (SMT). This method has been used to preserve the function of the nose by minimizing the resection of the conchal mucosa by preserving it and removing mainly the bony part inside. In the review of the effects of out fracture and SMT, the short-term results are similar, but in the long term, it can be seen that the Sino-nasal outcome is excellent in SMT. The predominant layer of the inferior turbinate is an intrinsic lamina propria made of loose connective tissue and superficially harboring inflammatory cell infiltration. The cavernous medial bone layer is made of a woven trabeculae mass and houses the major arterial supply of the turbinate. From this point of view, SMT may not be effective because the focus of reduction should be lamina propria. Direct contraction of lamina propria using radiofrequency-assisted inferior turbinoplasty (RAIT) is frequently compared with microdebrider-assisted reduction surgery outcomes (MAIT). The direct mechanical treatment method, the MAIT, is considered more effective in two years postoperatively. As a plastic surgeon, the simple minimal invasive technique can avoid unwanted complications, and can be stably operated with local anesthesia. Out fracture with RAIT is a reliable method to prevent paradoxical nasal stuffiness caused by excessive resection.

### RAIT

Radiofrequency turbinate reduction (RFTR) is a minimally invasive technique that can reduce tissue volume. This technique uses high frequency to create lesions within the submucosal tissue of the turbinate to reduce tissue volume. The long-term evaluation revealed a reduction in resistance, and subjective benefits that are maintained for two years after the procedure.

**Fig. 12** INV lift using septal L-strut extension graft (SLEG): (Lt) SLEG, (Rt) INV lift based on high septal support



## MAIT

Microdebrider is a tool made up of mechanical components. The disposable blade is a hollow metal tube coupled with suction, which cuts the obstructive tissue and removes it from the airways. The handpiece drives the blades through an electric motor and is compatible with blades of various sizes. Microdebrider blades are 5–7 mm in diameter with a rigid endoscope so that tissue dissection can be performed with optimal visualization and control. Appropriately used microdebriders allow better preservation of the normal airway mucosa than conventional inferior turbinectomy.

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