Secondary Rhinoplasty (1): Implant-Related Complications

Jaeyong Jeong

Introduction

The popularity of revisional rhinoplasty in Asians tends to be higher than other aesthetic surgeries. The reason for this, is because, in Asian rhinoplasty, there is a higher frequency of implant usage which may lead to a higher risk of cosmetic and physiologic problems over time. Due to these reasons, secondary rhinoplasty in Asians is generally difficult and complex and should be addressed with meticulous preoperative preparation and planning.

Types of dorsal implants frequently used in Asian rhinoplasty include silicone, Goretex, chimeric types (silicone + Goretex), and more recently, acellular dermal matrix (ADM). Although many surgeons prefer to use autologous materials for the nasal tip, there is persistent usage of Medpor, irradiated homologous costal cartilage (IHCC), PDS plate, and scaffolds with PCL. This chapter will explore the various complications that can arise from the array of implant materials used in Asian countries and suggest available treatments.

J. Jeong (✉)
THE PLUS Plastic Surgery Clinic, Seoul, South Korea

Dorsal Implant Movability and Migration

Causes of Movability (Unstable Moving) and Migration

The characteristics of movability and migration vary depending on the type of implant. However, implant movability and migration are generally more common with the use of silicone implants. Silicone implants form a capsule, which may cause movability of the implant within its capsule. On the other hand, Goretex implants are porous, and tightly adhere to the surrounding structure by tissue ingrowth. Silicone implants tend to move or migrate because of these capsules. The most common cause for silicone implant movability is subcutaneous implantation (Fig. 1). Implant demarcation or deviation is often accompanied by other symptoms. The rate of these complications may increase with multiple revisions. Although rare, movability can be observed in some cases where the Goretex implant has been placed inside the previous capsule of a silicone implant. Mild-to-minimal movability can be seen even when the implants are situated properly in the subperiosteal plane. These cases rarely lead to serious problems, but patients should be advised not to forcefully move or touch their implants to prevent displacement or migration.

M. K. SUH (ed.), *State of the Art Rhinoplasty Techniques*,
https://doi.org/10.1007/978-981-16-5241-7_10

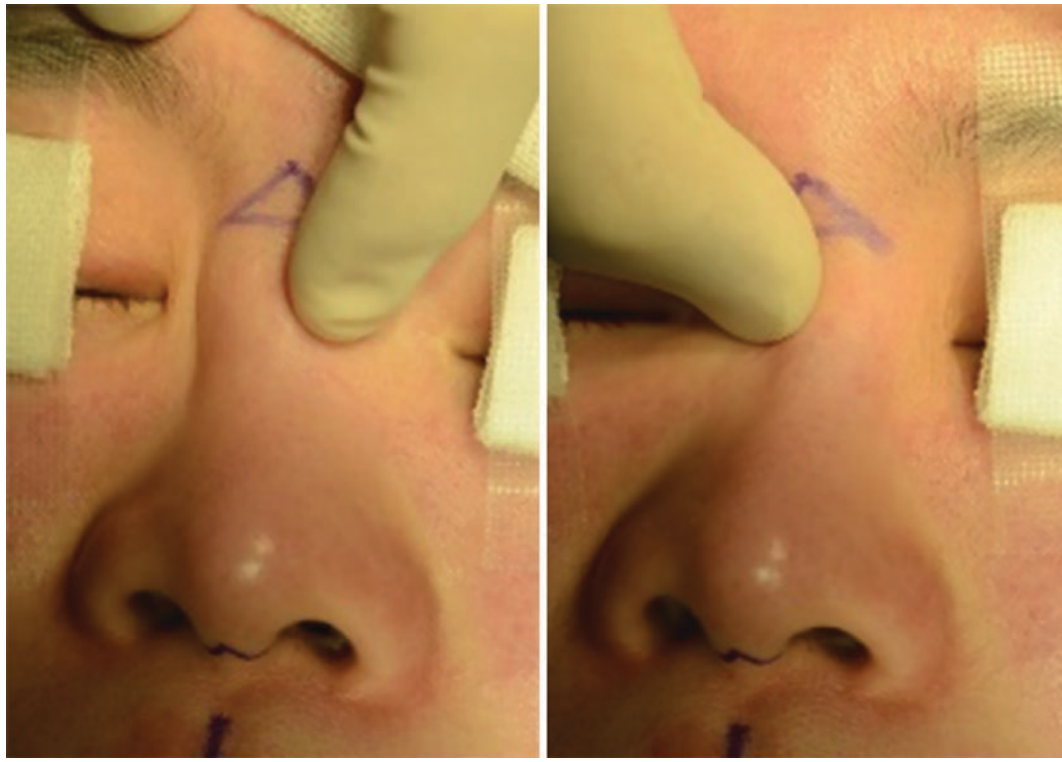

Fig. 1 Movable implant due to subcutaneous implantation

Common causes of implant movability are listed below:

1. Subcutaneous placement of the implant.
2. Chronic seroma or hematoma.
3. Habitual behavior of the patient including frequent touching, moving, or massaging of the nose.
4. Formation of a biofilm around the capsule due to subclinical infection.
5. Using the same pocket and capsule from prior surgery as revision.

Significant migration of the implant may be a phenomenon following severe complications. In other words, it is a common deformity seen in inflammation or contracture, where the implant may be moved or displaced in a cephalic or caudal direction. These cases are generally accompanied by tip problems as well (Fig. 2).

Treatment of Movability and Migration

Treatment modalities differ for each pathogenesis. In cases of subcutaneous implantation, a new subperiosteal pocket for the implant should be made during the revision. When movability and migration are the result of inflammation or contracture, the treatment process becomes complicated (Fig. 3). Therefore, the underlying instigating factors should be initially treated and resolved.

Dorsal Implant Deviation

Deviation occurs more frequently in silicone implants than in other types of ones. The right-handed surgeon must be cautious not to dissect asymmetrically during endonasal approach via

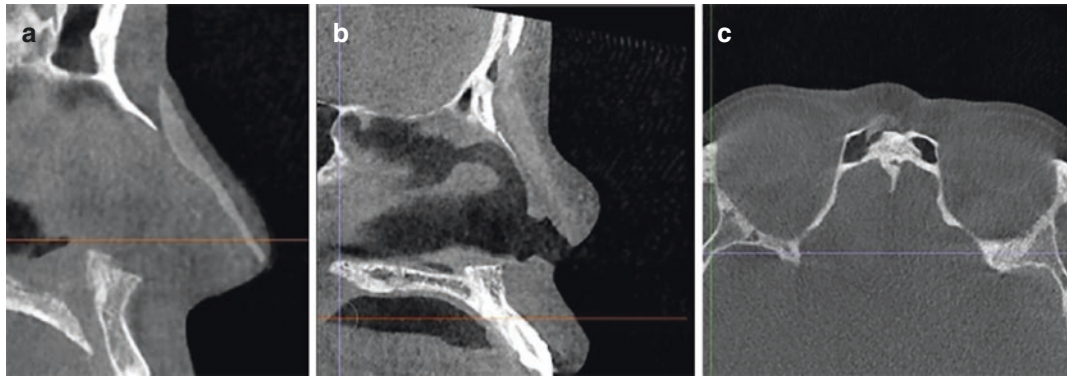

Fig. 2 Migration of implant. (**a**) Caudally migrated implant, (**b**) cephalically migrated implant, (**c**) migrated implant invaded into frontal sinus

one side. Also, extensive or inadequate pocket making may result in unstable insetting of the implant over the course of time. Furthermore, because detailed evaluation of the underlying framework structure may be difficult, it is important to precisely carve and design the posterior surface of the implant during surgery.

Potential causes of deviation are listed below:

1. Inadequate pocket formation for dorsal implant during surgery.
2. Inadequate correction of the deviated nasal framework under the implant.
3. Asymmetric or deviated capsule formation due to seroma or hematoma.
4. Discordance between the nasal structural framework and posterior aspect of the implant.
5. Long-term effects of asymmetric facial muscle movements and contractions.
6. Habitual behavior of the patient including frequent touching, moving, or massaging of the nose.

Treatment of Dorsal Implant Deviation

The presence of a hematoma immediately after surgery disrupts the stable formation of a peri-implant capsule, and consequently hinders the stable inset of the implant. Therefore, it is paramount to remove any fluid including hematoma, around the implant in the early days after surgery to prevent deviation. Deviation that occurs gradually over time after surgery can be seen often in patients with asymmetric facial muscle movements or asymmetrical nasal bone base. Delayed implant deviation is most likely attributed to asymmetry of the face or nasal framework (Fig. 4).

When signs of implant deviation are present immediately following surgery, patients are most likely very disconcerted, and the performing surgeon will likely be under incredible stress. Deviation of the implant may be classified as proximal, distal, or total deviation of the entire nose. Correction of the deviation may be carried out at 6 months, or when there is proximal deviation of the silicone implant, early intervention within 3 months after surgery may be done by way of intranasal capsulotomy with a closed approach (Fig. 5). Distal deviation of the implant is often accompanied by septal or tip deviation thus, an open approach is usually recommended for correction of these deformities. The author experienced 20 cases of dorsal implant deviation out of approximately 4300 patients over the last 10 years. Of these, 80% of the cases were corrected promptly with good results by intranasal capsulotomy in the early stages. Intranasal capsulotomy was insufficient in the remaining 20% of cases and required correction with an open approach (Figs. 6 and 7).

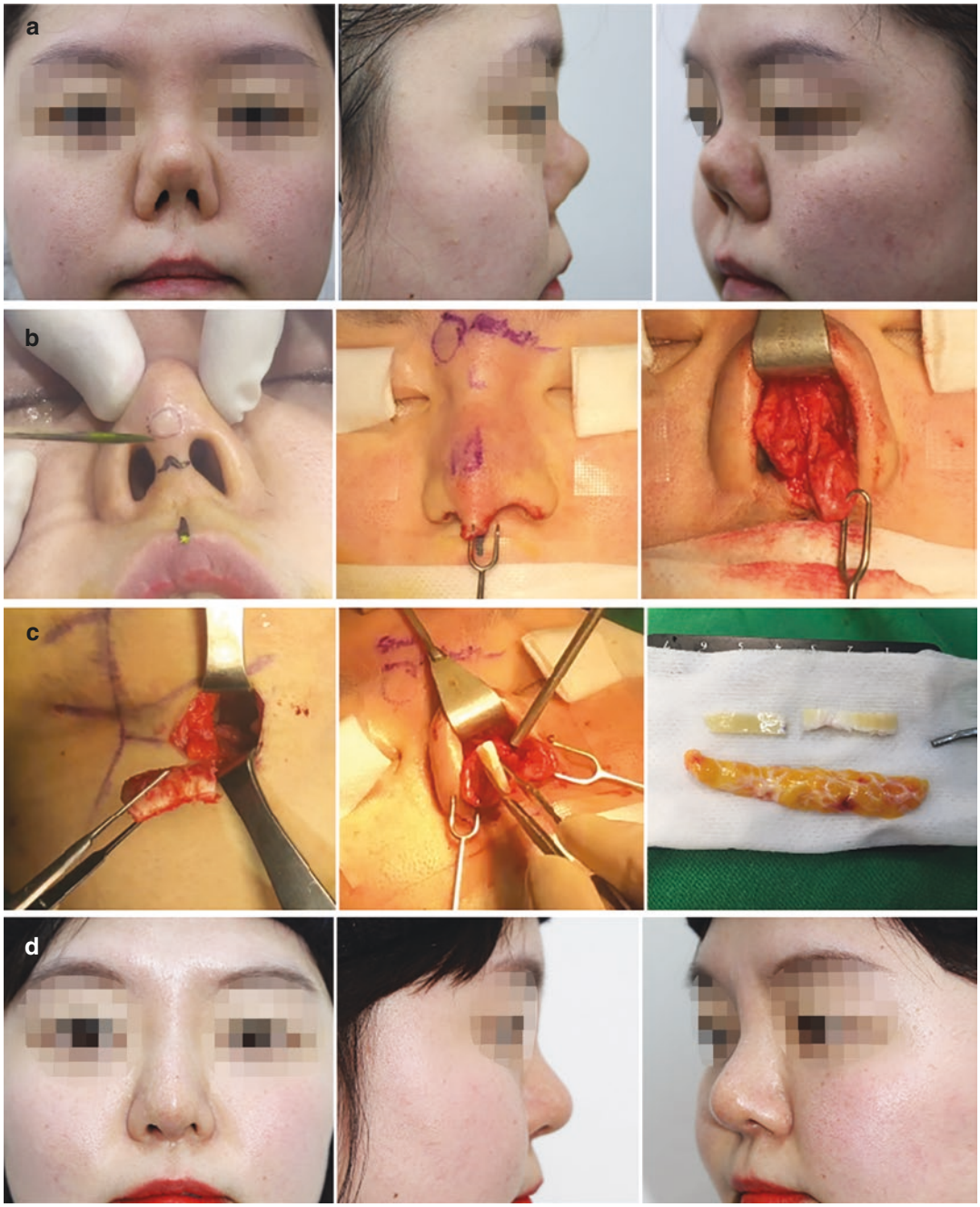

Fig. 3 The implant was cephalically migrated due to severe contracture in this case. (**a**) Preoperative views, (**b, c**) intraoperative photos, (**d**) postoperative views

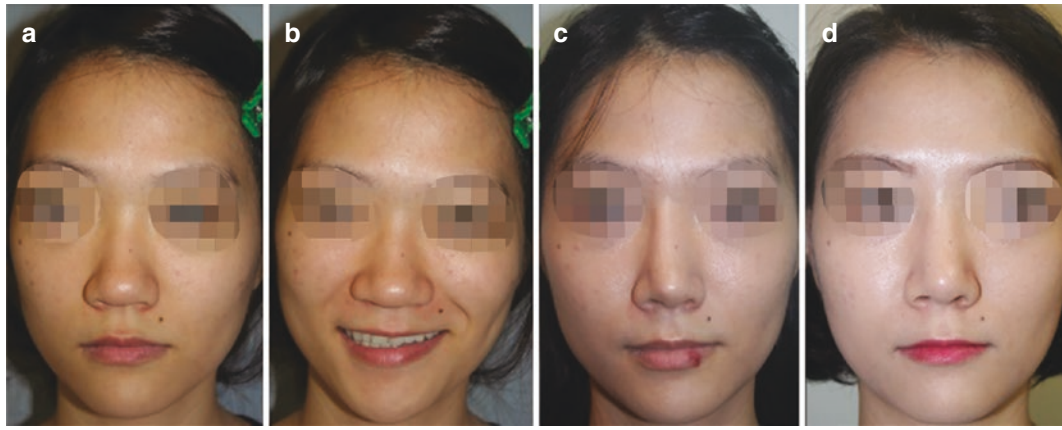

Fig. 4 Facial asymmetry can affect implant deviation in the long run. (**a**) Preoperative view, (**b**) preoperative smiling view, (**c**) Implant deviation was shown after operation, (**d**) minor correction was done for deviation

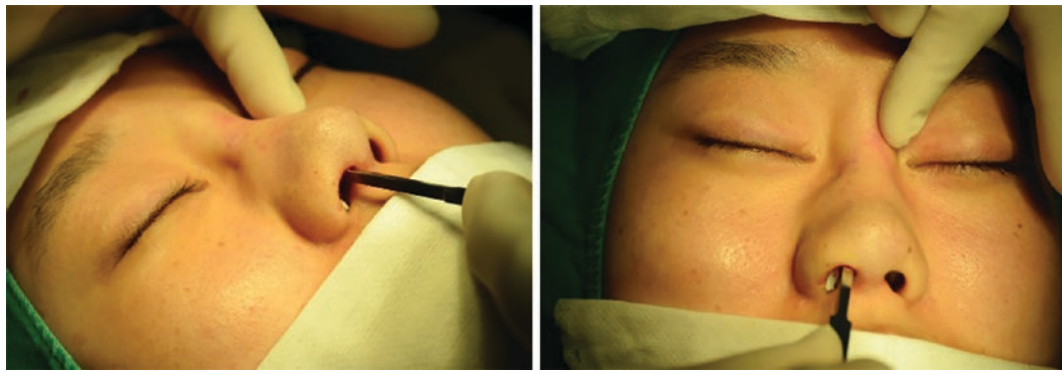

Fig. 5 Capsulotomy can be effective to correct minor implant deviation of implant as simple revision

Dorsal Implant Demarcation, Dorsal Irregularity and Envelope Thinning

Causes of Dorsal Implant Demarcation

The potential causes of "implant visibility" or an "operated look" after rhinoplasty are as follows (Fig. 8):

1. Excessively oversized implant size.
2. Patients with very thin skin.
3. Subcutaneous implantation.
4. Too wide or too narrow implant in relation to the bony base width.
5. Severe calcification of old silicone implant.
6. An implant situated on the wide bony base.
7. Visible margin of the implant caused by contracture of the silicone capsule.

Cause of Dorsal Skin Irregularity

The nasal envelope over the keystone area (middorsal portion) is the thinnest and even minor irregularities may be evidently visible. In addition, transition zone from thin skin to thick skin at supratip area is also vulnerable to dorsal irregularity. The dorsal aesthetic contour may be interrupted by these irregularities (Fig. 9). Dorsal irregularities may also result from the rough and irregular anterior surface of dorsal implants or

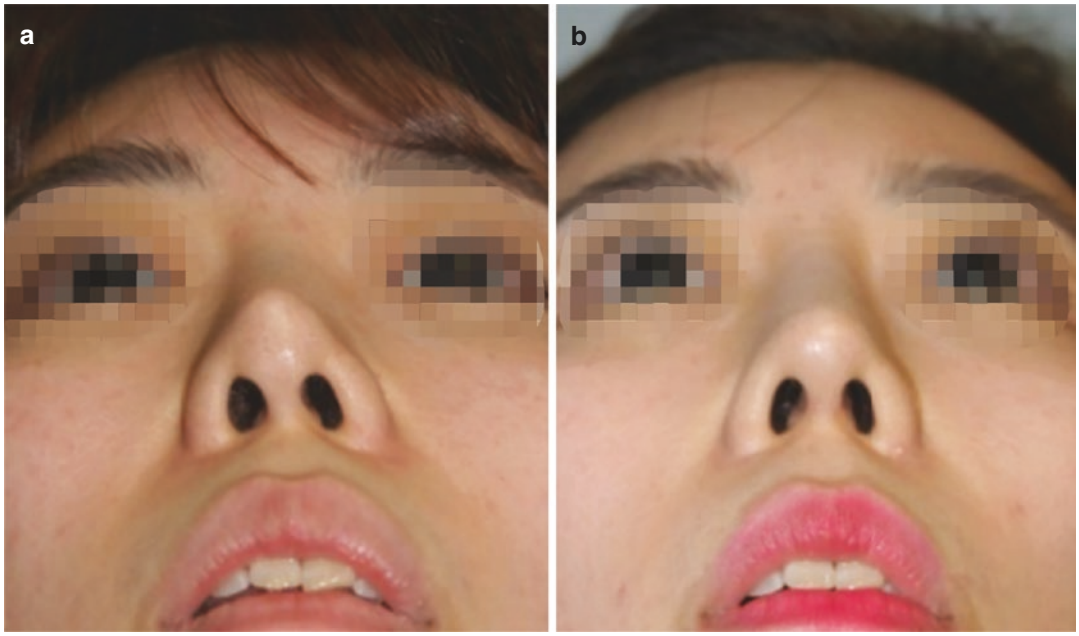

Fig. 6 Correction with open approach. (**a**) Preoperative view and (**b**) postoperative view

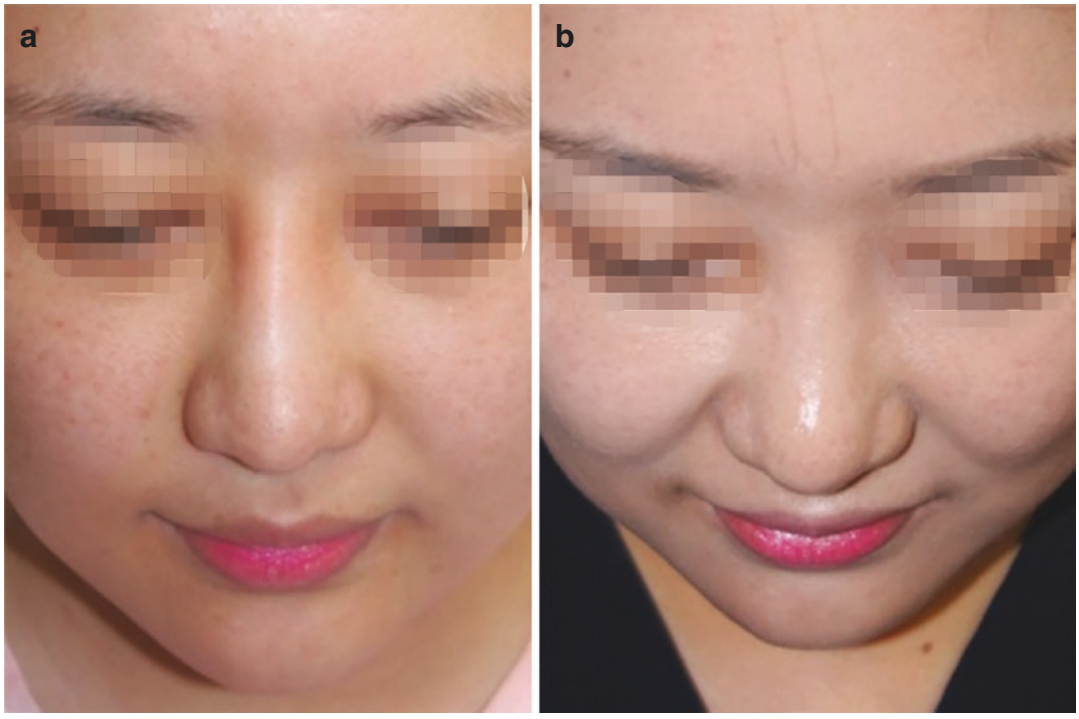

Fig. 7 Correction with open approach. (**a**) Preoperative view and (**b**) postoperative view

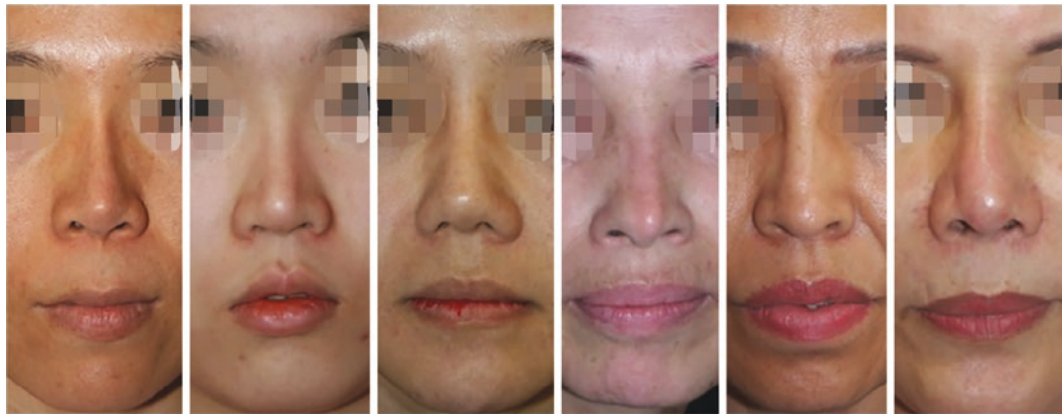

Fig. 8 Various features of dorsal demarcation

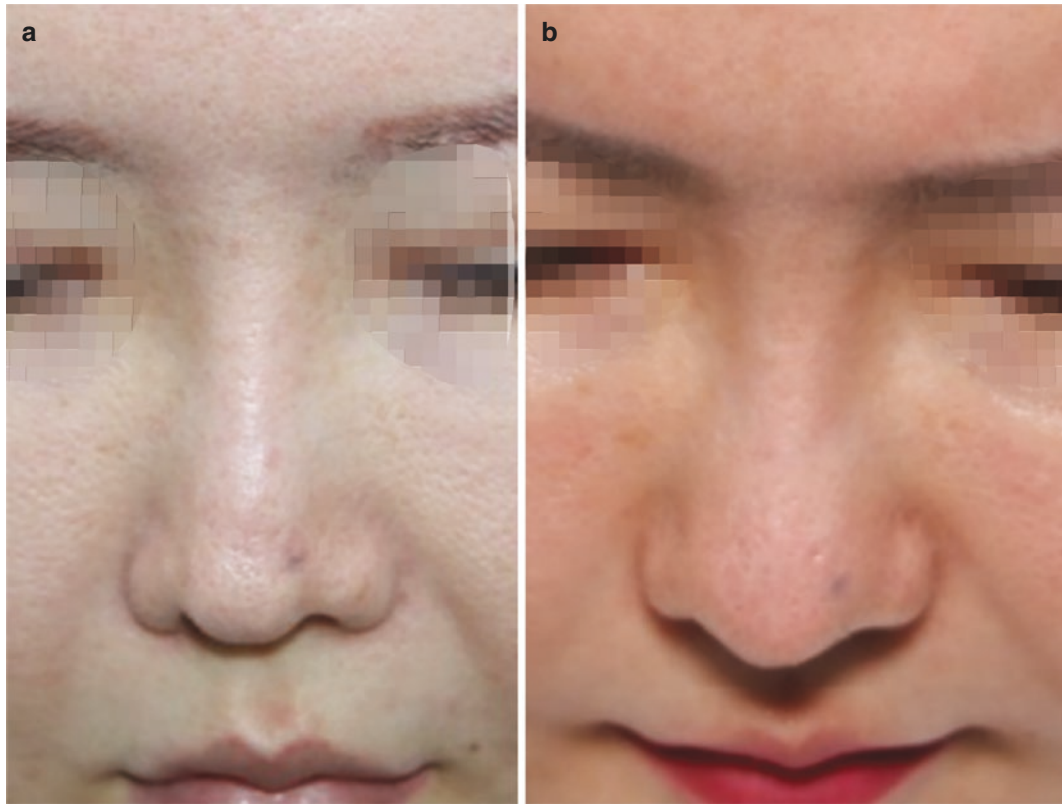

Fig. 9 (**a**) Skin irregularity at supratip area due to repeated damage on nasal envelope and (**b**) postoperative view

calcified implants. Calcification directly affect to dorsal irregularity and may result in changes in skin texture and visibility of the implant contour in cases of prolonged implantation. Calcification usually manifests in the beginning as microcalcifications approximately 5 years after rhinoplasty and differs from the characteristics of silicone implants. In my experiences, harder implants tend to have higher chances of calcification. Visible calcification, which may cause skin problems, can be seen in a patient who had undergone rhinoplasty more than ten years ago (Fig. 10).

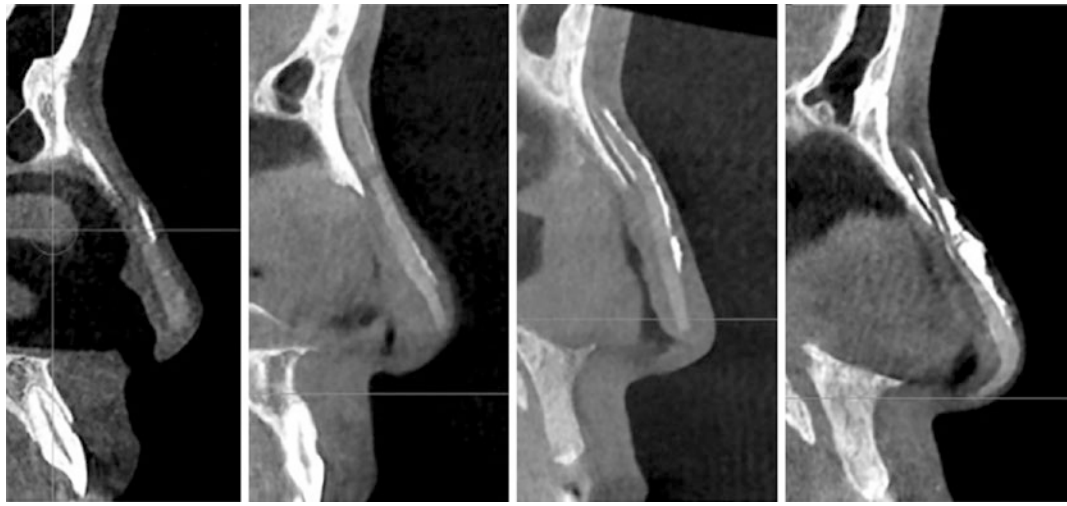

Fig. 10 Various features of calcification on CT scan

Calcified capsules and silicone implants lose their original elasticity and consequently become hard and irregular. As a result, the continuous irritation and stimulation on the nasal envelope may lead to complications such as dorsal irregularity, redness and thinning of the nasal skin (Fig. 11). Therefore, during revisional surgery of the patient with an old implant, reinforcement of the dorsal skin thickness with the removal of calcified implant and capsule should always be considered (Fig. 12).

Irregular deformities of dorsum are often observed as a result of technical error during surgery, such as anterior surface carving of the implant, or usage of a distally thick implant or two-piece silicone implant. Distally thick implants may lead to an irregular dorsal contour such as supratip breakage or fullness in long term. These deformities might be aggressive, concomitant with loss of tip projection. Supratip breakage is often caused by a disruption in the continuity of the dorsal implant and tip graft. Surgeons must be aware that the supratip area is difficult to manage in secondary operations because this area is the transition zone of the dorsal thinner skin into thicker tip skin (Figs. 13 and 14). In some cases, the cause of dorsal irregularity was attributed to technical mistakes such as the presence of implant pieces left inadvertently

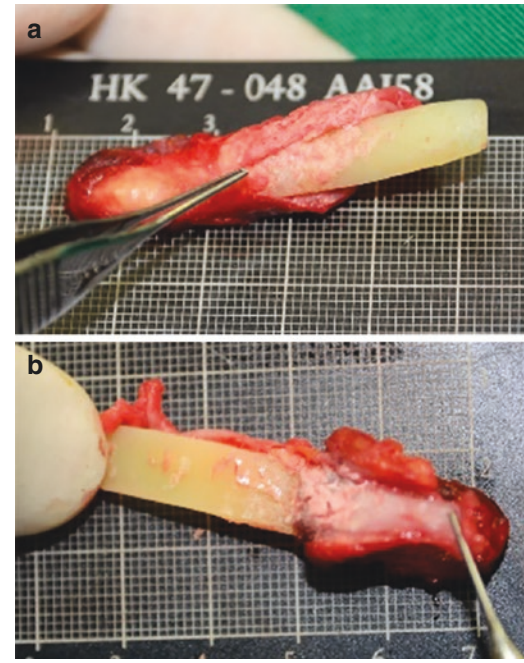

Fig. 11 Calcification of old silicone and capsule. (**a**) Anterior surface and (**b**) posterior surface

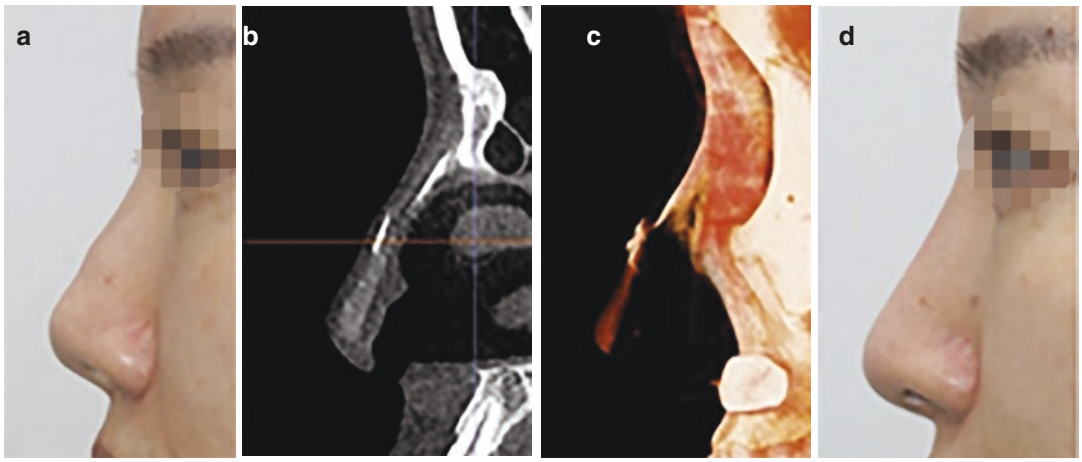

Fig. 12 (**a**) Palpable nodule on dorsum in lateral view, (**b, c**) calcification over the silicone was shown on CT scan, (**d**) postoperative view. Calcified silicone and capsule were removed and replaced with deep temporal fascia for nasal envelope reinforcement

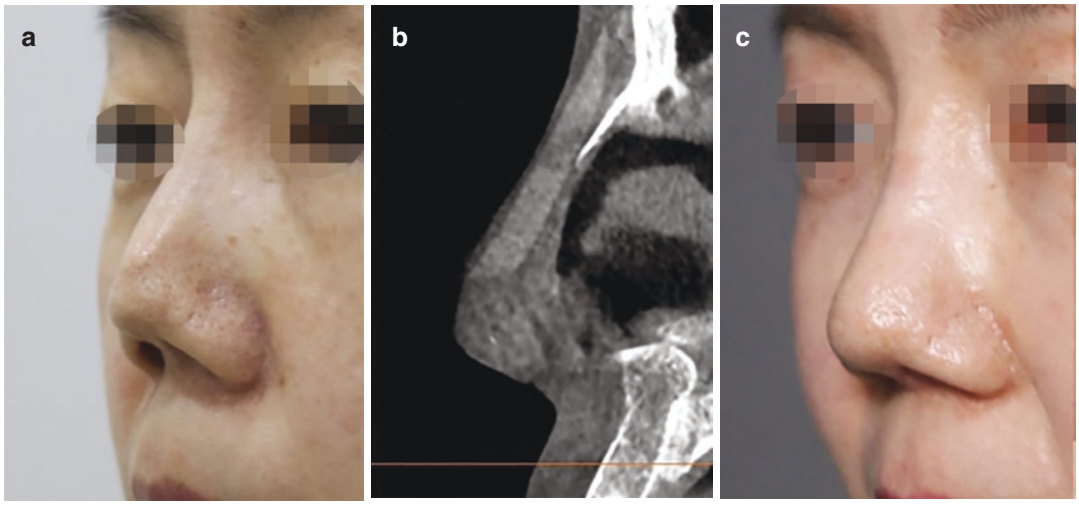

Fig. 13 Supratip demarcation was shown due to caudally thick implant. (**a**) Preoperative view, (**b**) preoperative CT scan, and (**c**) postoperative view

during prior surgery. These technical errors should be prevented during surgery with copious meticulous irrigation and visual confirmation of a clean surgical pocket (Fig. 15). Rarely, an oversized implant may lead to sinking of the underlying dorsal septal lining due to excessive pressure, which may eventually lead to dorsal contour deformities such as saddle nose (Fig. 16).

Goretex implants are pliable and show excellent adherence to surrounding tissue. Because of these characteristics, the implant borders may be more discernible and carving of the Goretex implants should be done scrupulously (Fig. 17). Also, an incomplete humpectomy may become more pronounced over time as the Goretex implant loses its initial height. (Fig. 18).

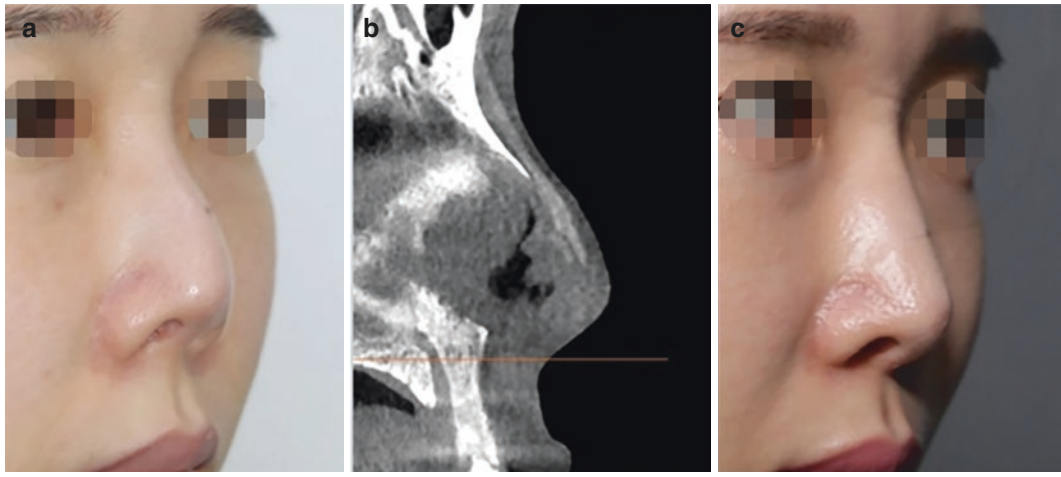

Fig. 14 Supratip fullness was shown due to two pieces of silicone. (**a**) Preoperative view, (**b**) preoperative CT scan, and (**c**) postoperative view

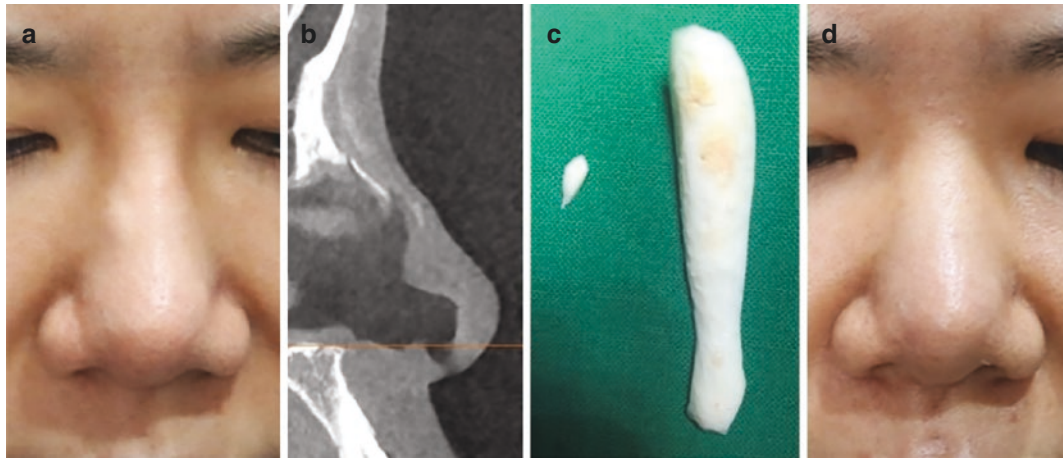

Fig. 15 Palpable mass was shown in lateral wall. (**a**) Preoperative view, (**b**) preoperative CT scan, (**c**) removed silicone implant and fragment, and (**d**) postoperative view

Dedicated removal of Goretex is recommended in secondary rhinoplasty because remnant pieces may be a cause of chronic seroma or inflammation after surgery (Fig. 19).

Previously injected fillers may be a cause of dorsal irregularity after surgery. Absorbable fillers are usually dissolved with hyaluronidase prior to surgery, however, occasionally the surgeon may observe some remnant filler usually at the tip during surgery. Hyaluronic acid-based fillers, when injected, form a very thin capsule, and dorsal irregularity can be minimized by not removing these capsules excessively (Fig. 20). Irregular injection and ununiform distribution of foreign bodies or nonabsorbable filler into the skin may be impossible to remove completely (Fig. 21). Nasal thread lifts can be a quick noninvasive surgical alternative to rhinoplasty but may cause irregularity and depression by dermal tethering, and complete removal of the thread may be dif-

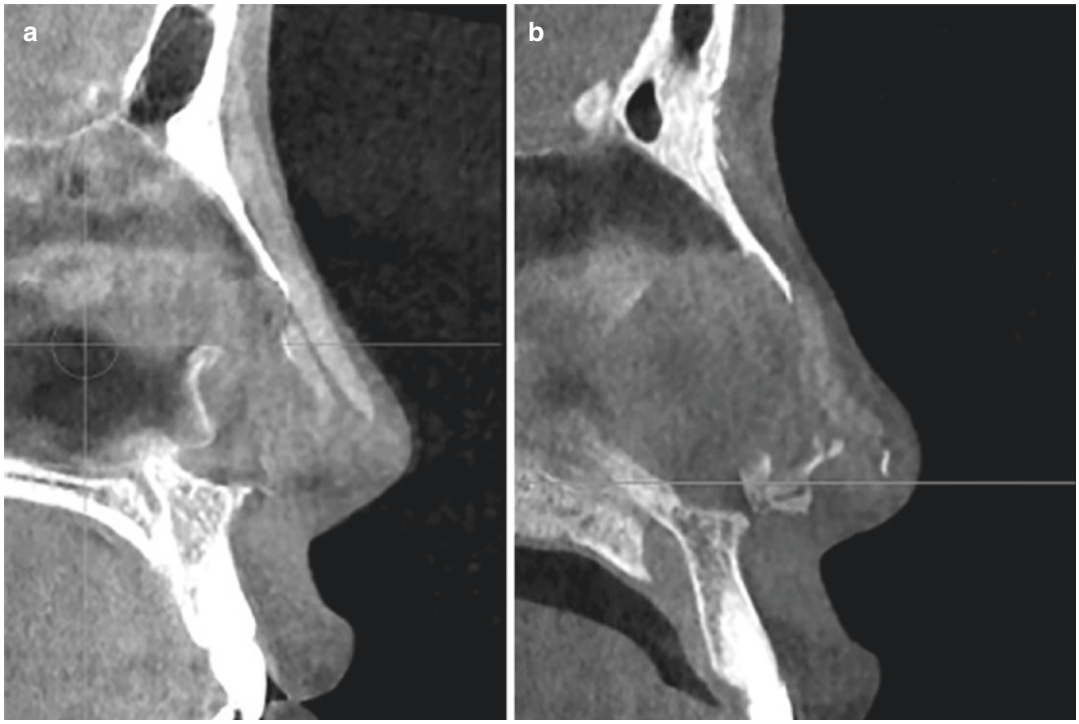

Fig. 16 Cartilaginous vault can be pressed by excessively thick implant. (**a**) Silicone and (**b**) goretex

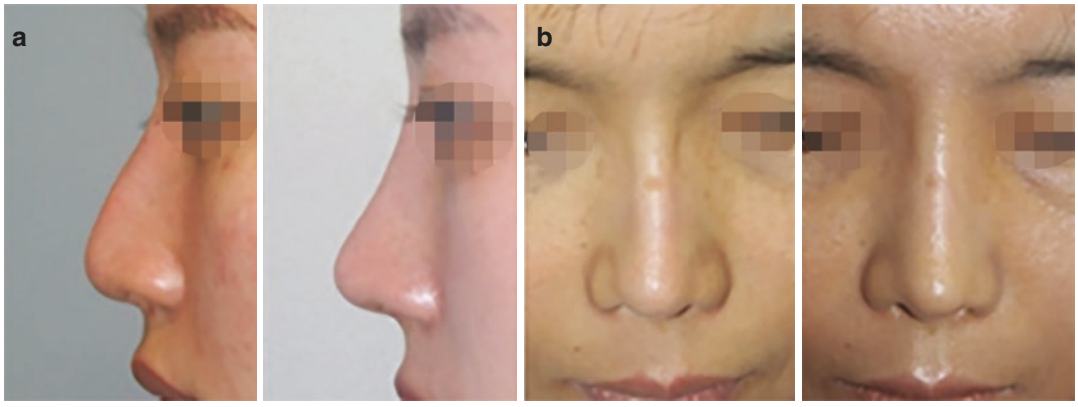

Fig. 17 Goretex implant should be carefully handled not to make unnatural dorsum. (**a**) Goretex implant was switched into silicone implant with tip plasty before and after operation (**b**) goretex is not always suitable for patients with thin skin. Her gortex implant was switched into silicone implant with ADM sheet before and operation

ficult during rhinoplasty (Figs. 22 and 23). Therefore, a thorough patient history taking is required to prevent unexpected difficulties during surgery and is mandatory for predictable outcomes.

Treatment of Demarcation, Irregularity, and Thinning

A nasal envelope that has been operated on numerous times may thin out, lose elasticity, and

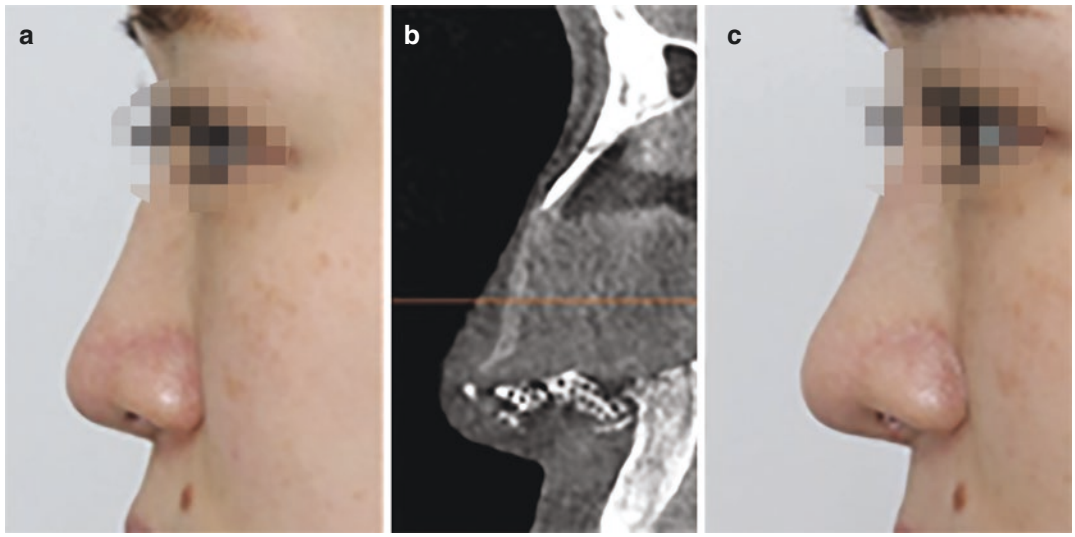

Fig. 18 Iatrogenic hump was shown after rhinoplasty using goretex implant. (**a**) Preoperative view, (**b**) preoperative CT scan, and (**c**) postoperative view with autologous tissue

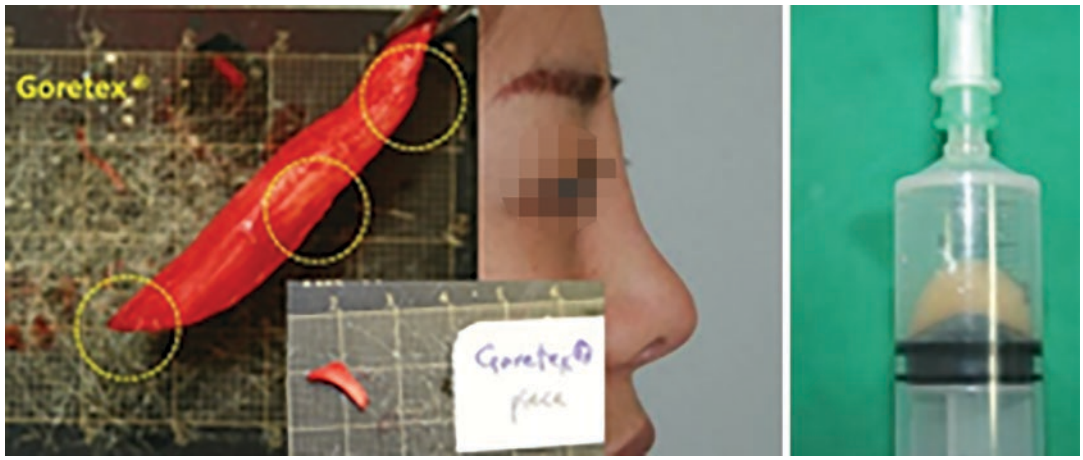

Fig. 19 Goretex implant should be removed completely without remnant during secondary operation. Otherwise, chronic seroma can be followed

may become tightly adhered to the underlying bony or cartilage framework. Therefore, hydrodissection using local injections may facilitate undermining and dissection during operation.

1. Changing the implant (material, size, and shape)—For example, an implant with excessive height may be exchanged for a lower height implant. The type of implant may be changed, or an alloplastic implant may be changed with an autologous graft. The design of the implant (i.e., width and height), and reinforcement of nasal envelope are factors of more paramount importance than the type of implant (Fig. 24).

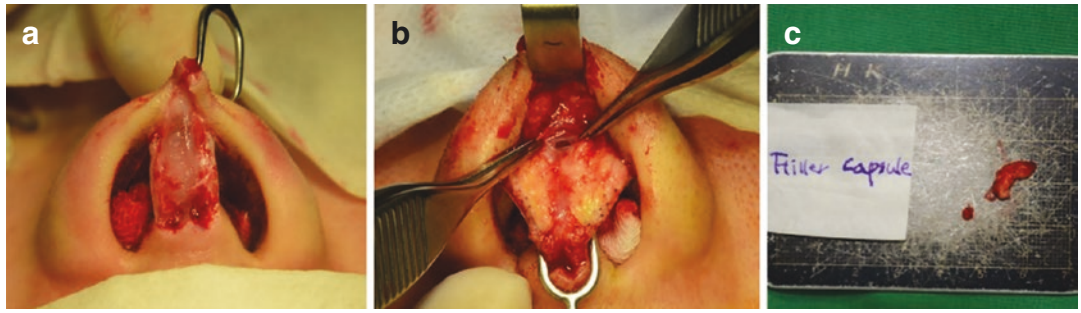

Fig. 20 (**a**) HA filler was found incidentally during open approach, (**b**) HA filler was surrounded by a thin capsule, and (**c**) removed capsule

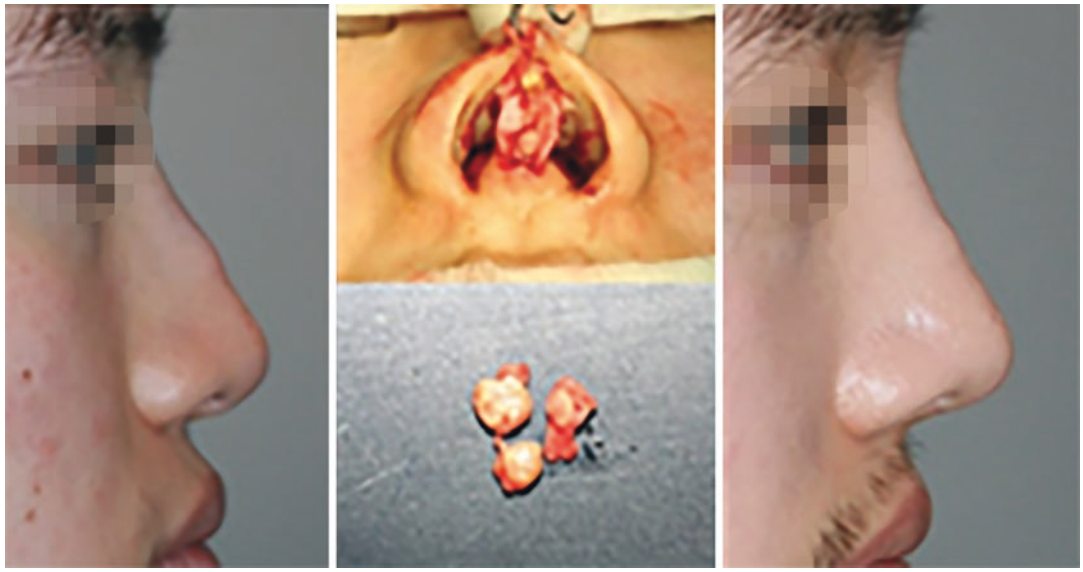

Fig. 21 Nonabsorbable filler such as calcium hydroxyapatite can make dorsal irregularity

2. Changing insertion plane (from superficial to deep)—If the implant is situated in a superficial plane, a deeper neo-pocket should be made by subperiosteal dissection.
3. Old, calcified silicone implants and capsules should be removed and skin reinforcement should be considered (Fig. 25).
4. Refinement of dorsal aesthetic line with osteotomies for wide nasal bone—When a dorsal implant is used without correction of the wide nasal bone framework, the dorsal aesthetic line in front and lateral, may look unnatural. In these cases, an osteotomy must be performed to narrow bony structure (Fig. 26).
5. Reinforcement of nasal envelope using additional grafts—If a patient has thin skin or soft tissue problems, skin reinforcement with grafts such as deep temporal fascia, dermofat, or ADM should be considered (Figs. 27 and 28).

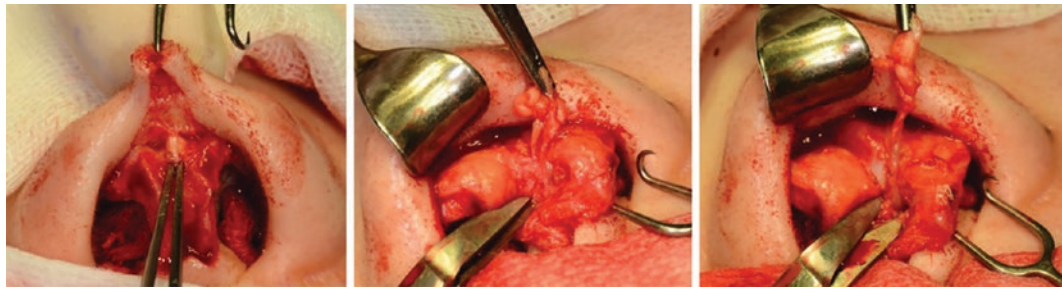

Fig. 22 Previous thread is tightly tethering the tip skin

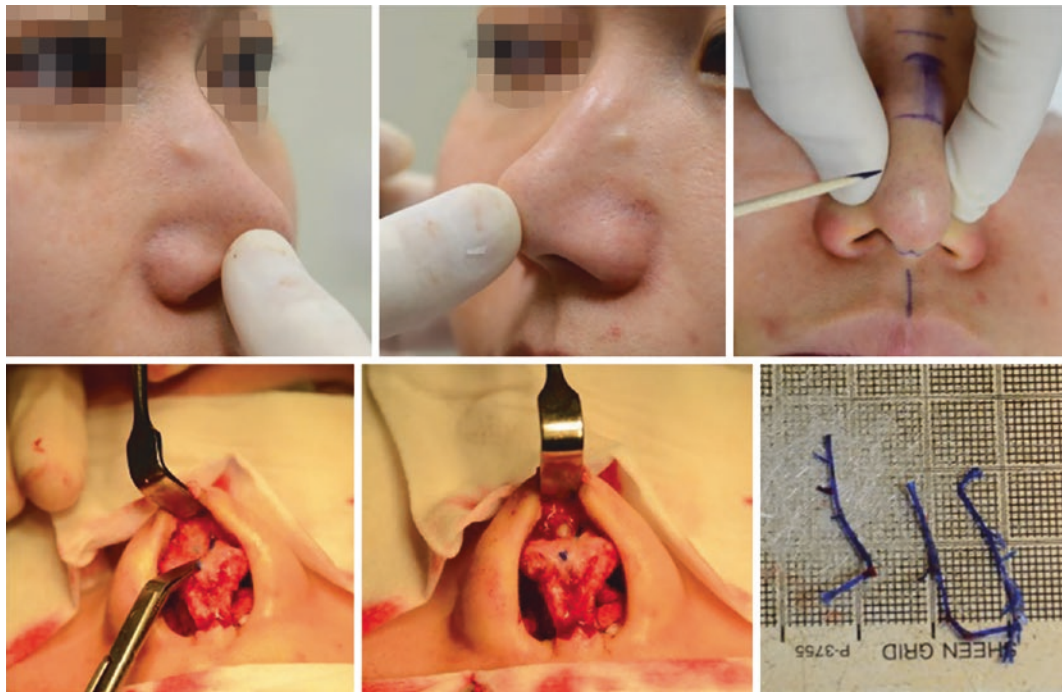

Fig. 23 Large PDO thread was visible through the nasal skin

6. Usage of the previous capsular flap—Healthy capsule can be used for reinforcement of the nasal envelope. However, the use of the previous capsular flap in secondary revision has limitations. A previous capsular flap should not be used when there is capsular thickening or contracture due to inflammation, or calcifications or biofilms are observed around the capsule (Figs. 29 and 30).
7. Fat graft or filler injection—Fat graft or filler injection can be used for minor revision after operation (Fig. 31). Triamcinolone injection may be used to correct bumps and irregularities caused by remnant permanent fillers.

Nasal Skin Redness

Potential causes of dorsal skin redness are as follows:

1. Nasal skin injury due to multiple surgeries on the nose.
2. Prolonged time lapse after implantation with excessively large, wide, or hard type silicone implants.
3. Subcutaneous implantation close to nasal skin envelope.
4. Thinned skin in old patient with calcification of the silicone surface and capsule (Fig. 32).

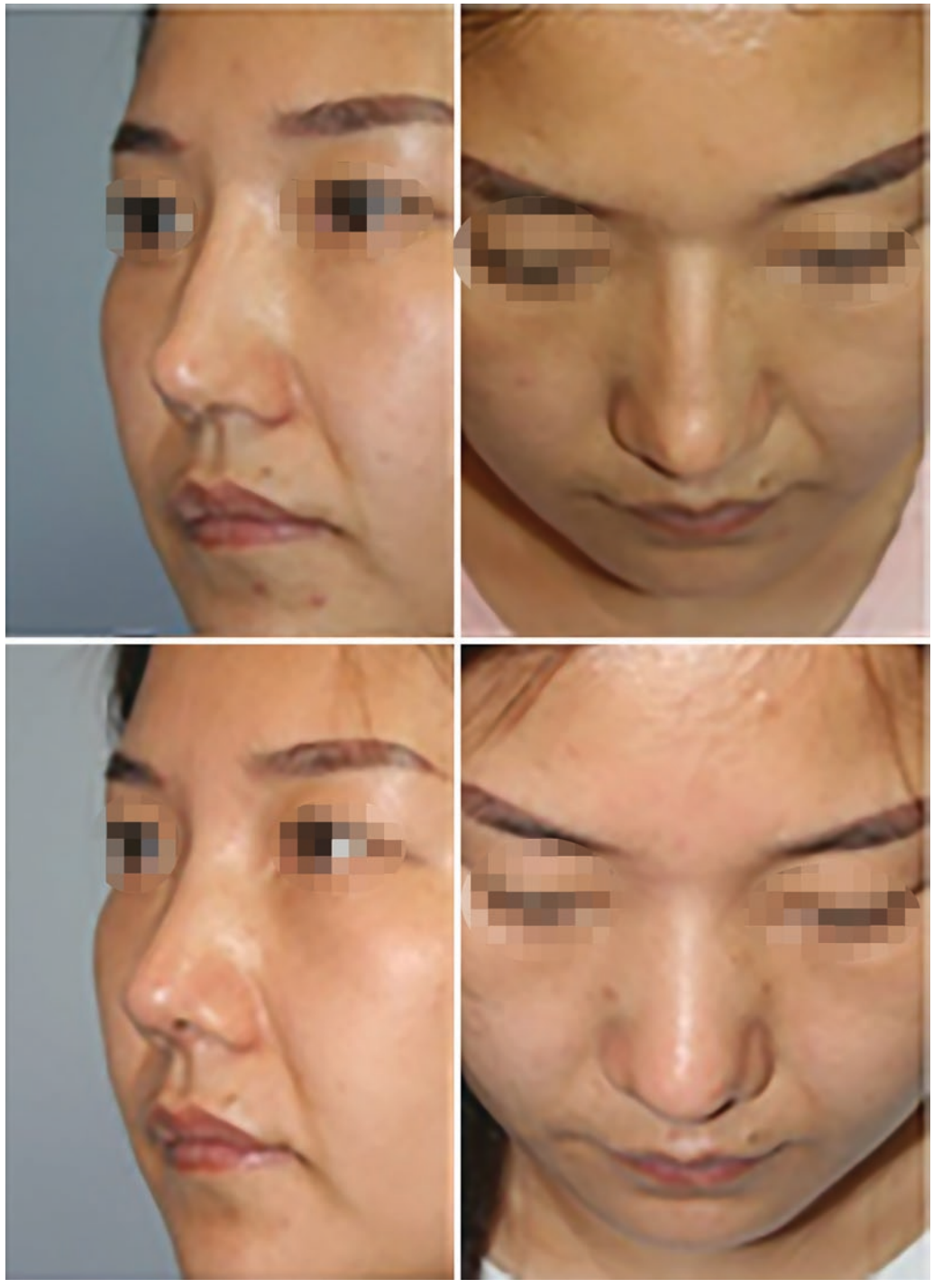

Fig. 24 Demarcation can be corrected with implant change. Previous goretex implant was switched into a silicone one. Above, before operation. Below, after operation

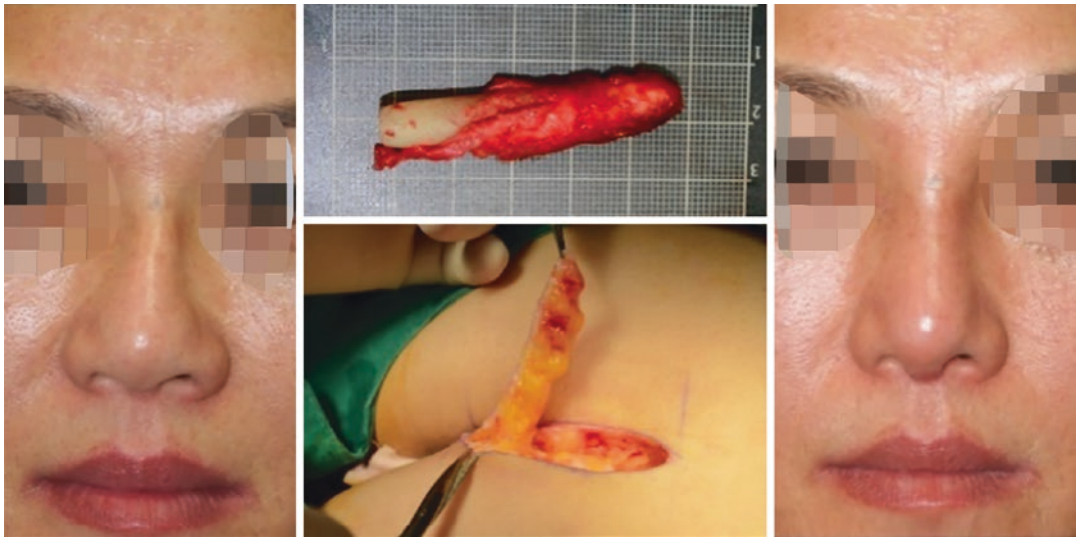

Fig. 25 A case with old, calcified silicone. Silicone and capsule were removed and replaced with autologous tissue

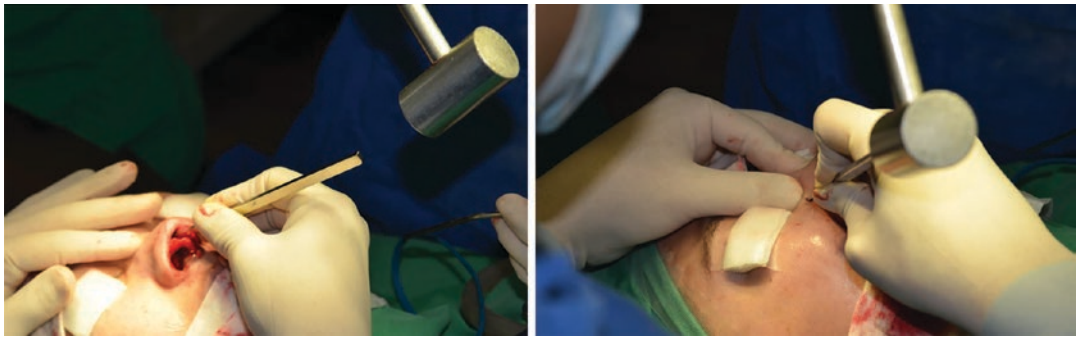

Fig. 26 Osteotomies are a good option to correct the wide bony base

5. Foreign body or permanent filler injection history (Fig. 33).
6. Thin, erythematous skin quality as a preexisting condition.

Potential Causes of Tip Skin Redness

Nasal tip redness may be a transient symptom that may vary with changes in temperature or other external stimuli. Although most of the time, transient nasal tip redness does not pose a serious problem, continuous redness may indicate a significant clinical problem. Potential causes of nasal tip skin redness are as follows:

1. Subcutaneous placement of implant or excessive pressure at nasal tip irrelevant to implant type (Fig. 34).
2. Presence of a foreign body or fillers at tip (Fig. 35).
3. Chronic inflammation.
4. Calcification of an old implant and its capsule.

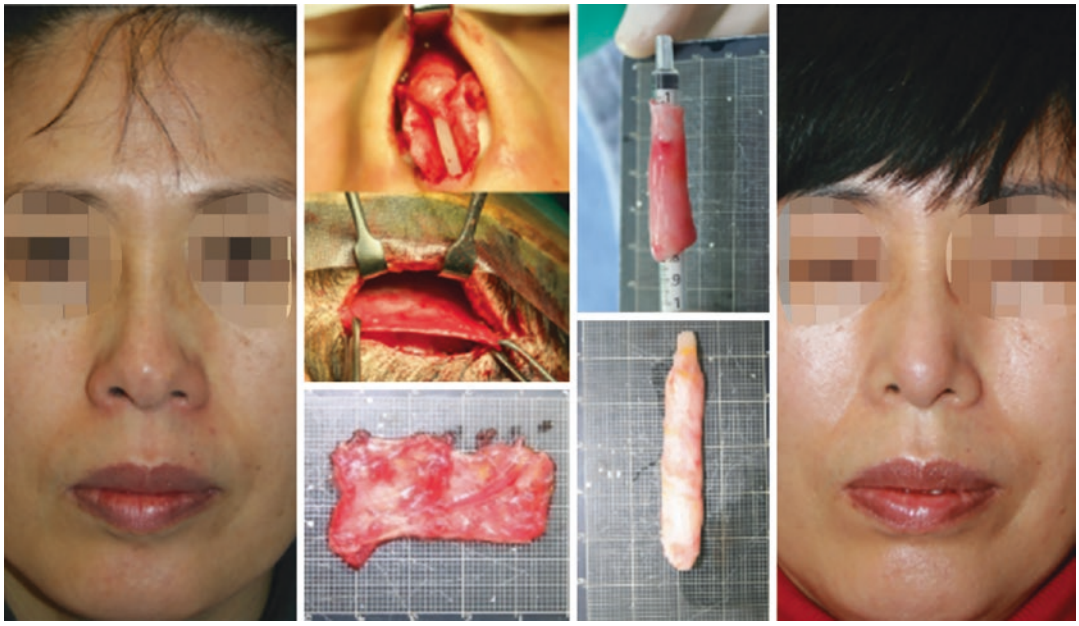

Fig. 27 Deep temporal fascia can be used to reinforce thin nasal skin with or without implant

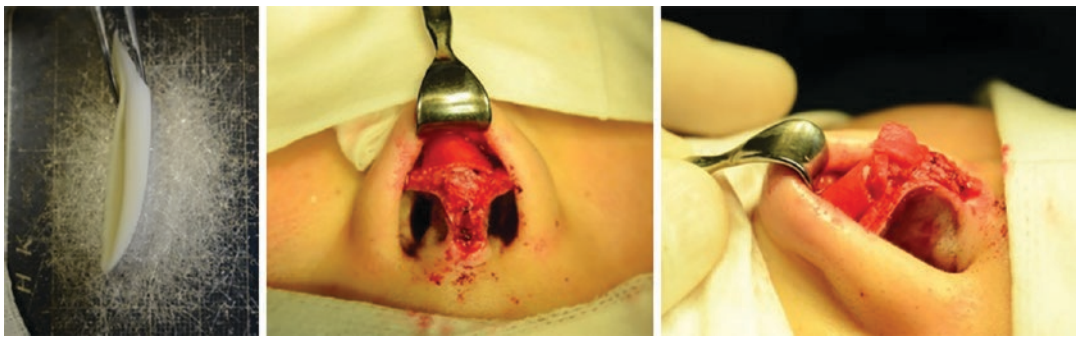

Fig. 28 Acellular dermal matrix (ADM) can be one option to reinforce thin nasal skin with or without implant

5. Habitual touching of the nasal tip.
6. Preexisting skin conditions such as acne or rosacea.

Treatment of Nasal Skin Redness

The most ideal treatment for dorsal skin or nasal tip redness is reinforcement of erythematous skin envelope with autologous material. However, treatment may be difficult in cases where complete removal of foreign material from the SSTE is impossible or due to patient skin quality. Repetitive and direct laser therapy over the nasal skin area after rhinoplasty may cause a persistent erythematous skin reaction or skin damage, therefore, patients should be advised to avoid them. Skin redness might not be alleviated and may persist even after treatment varying on skin conditions and severity of damage.

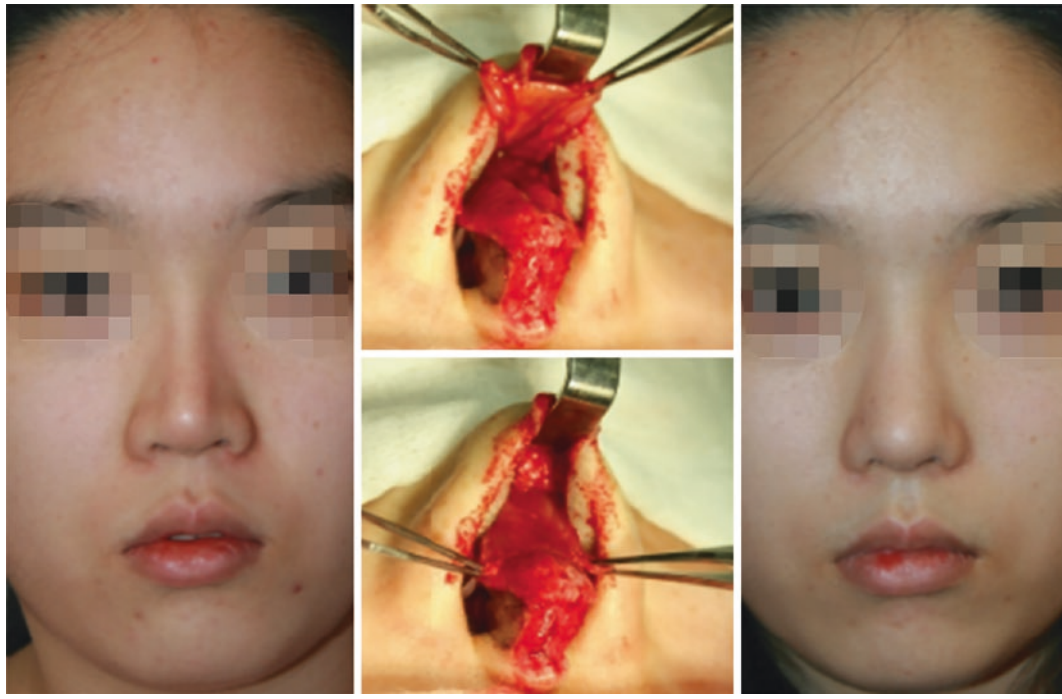

Fig. 29 A case with a narrow implant located superficially. Intraoperative photos showing supplement envelope using capsular flap by silicone implant

Tip Hardness and Discomfort

The nasal tip is naturally exposed to frequent stimuli such as touching, blowing, and rubbing in ordinary life. Occasionally, patients may seek revisional surgery complaining of tip immobility, hardness, and discomfort due to a previous operation. If the nasal tip is excessively firm, patients may experience a foreign body sensation or discomfort even when smiling or talking. Tip hardness after rhinoplasty can vary with the surgical methods by each surgeon. Tip hardness will exacerbate relative to the strength of union between the tip complex and the caudal and dorsal septal strut.

Causes of Tip Hardness and Discomfort

Patients complain of nasal tip hardness with limitations in tip mobility in the following cases:

1. When the dorsal implant extends over the nasal tip.
2. Usage of an L-shaped nasal implant (Fig. 36).
3. Tip surgery with rigid materials such as irradiated homologous costal cartilage (IHCC), medpor, or mesh (Fig. 37).
4. Tip surgery with a type of septal extension graft.
5. Sensitive patients may complain of discomfort even just with columellar strut and onlay grafts.
6. Contracture due to chronic inflammation.
7. A history of multiple surgeries on the nose.

Treatment of Tip Hardness and Discomfort

Depending on surgical methods, there may be limitations in nasal tip mobility which could result in tip hardness (Fig. 38). Patients who have had surgery with a septal extension graft

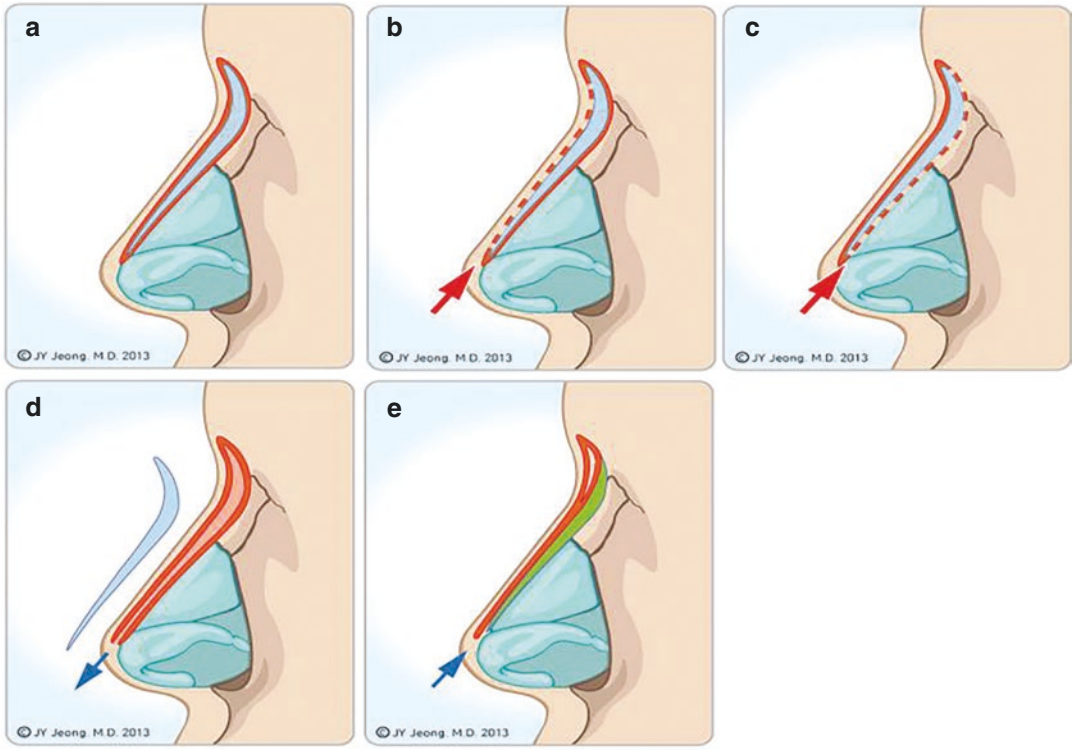

Fig. 30 Illustration of silicone-induced capsular flap. (**a**) Previous silicone and capsule, (**b**) dissection between nasal envelope and anterior capsule, (**c**) dissection between posterior capsule and inner framework, (**d**) removal of previous silicone implant, and (**e**) placement of new silicone implant under the posterior capsule (Jeong JY, Oh SH, Suh MK, Kim CK, Kim K. Effective Use of a Silicone-induced Capsular Flap in Secondary Asian Rhinoplasty. Plast Reconstr Surg Glob Open 2014; 2:e172)

may complain of tip hardness with ensuing arrow tip or even smiling deformity (Fig. 39). Therefore, surgical correction is usually mandatory for relief of symptoms. It is important that the tip complex should be a separate structure from the L-strut or caudal strut as much as possible.

Visible Implant onto the Tip

Concomitant with symptoms of hardness and discomfort, other problems such as tip skin redness, skin thinning, demarcation, extending to varying degrees of tip, columellar and nostril deformities may arise (Fig. 40). These problems are often observed in I-shaped implants that extend over into the tip area, or in L-shaped implants. Implant tip visibility is closely related to tip skin thickness and the solidity of the grafted material and can even be seen in autologous tip grafts. Hard and stiff material will give a significant and continuous pressure over the overlying skin resulting in thinning of the subcutaneous and dermal layers and consequent demarcation of the material margin. Correction becomes more complicated because surgical treatment involves multiple modalities including removal of the implant, skin reinforcement, and framework restoration. Skin reinforcement alone is usually inadequate. Crushed, diced or morselized cartilage can be used to fill up the dead space. In some cases, it may be necessary to use pull out sutures to fix dermal or fascial grafts into defected space.

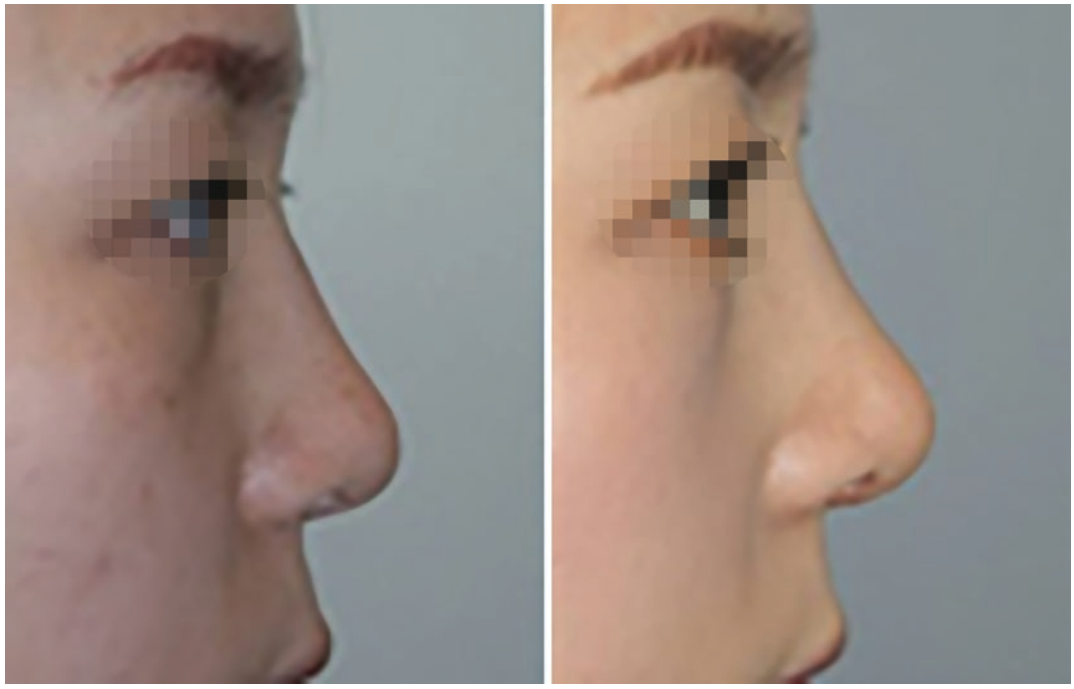

Fig. 31 Minor irregularity can be corrected with filler or micro-fat injection

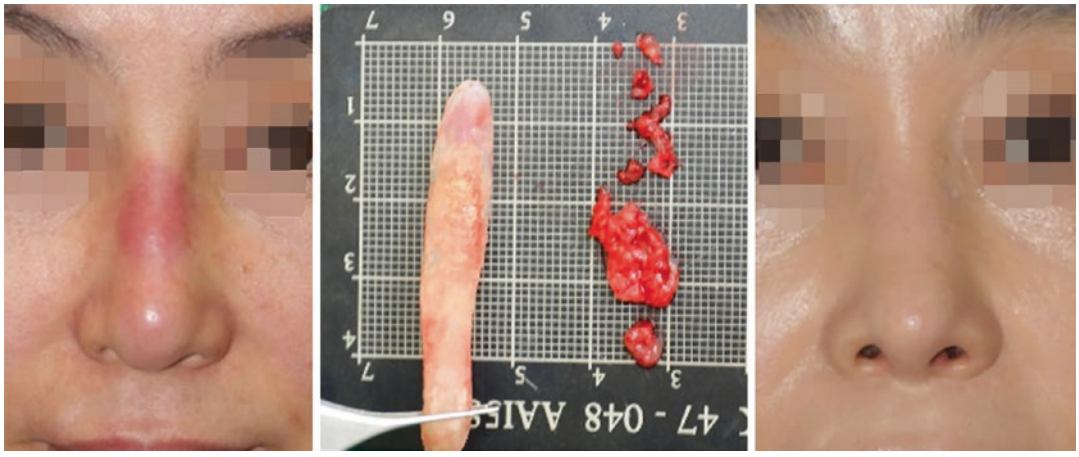

Fig. 32 Calcified silicone stimulated nasal skin and showed redness on nasal skin. This case was corrected with dermofat graft from sacrococcygeal area

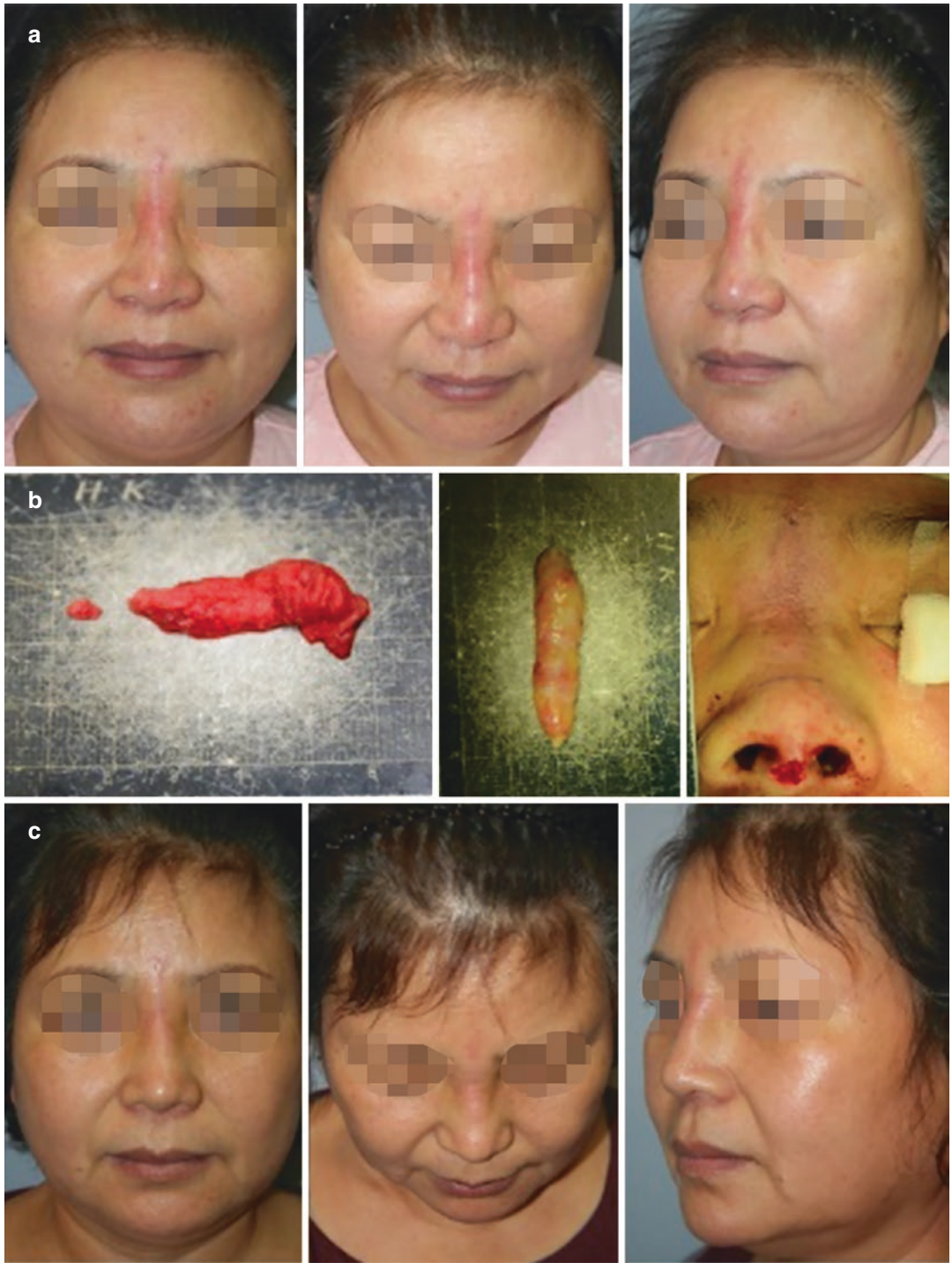

Fig. 33 (**a**) Preoperative view of patient with previous injection of foreign material, (**b**) the removed foreign bodies. Intraoperative view showing correction of nasal dorsum with dermofat graft, and (**c**) postoperative view

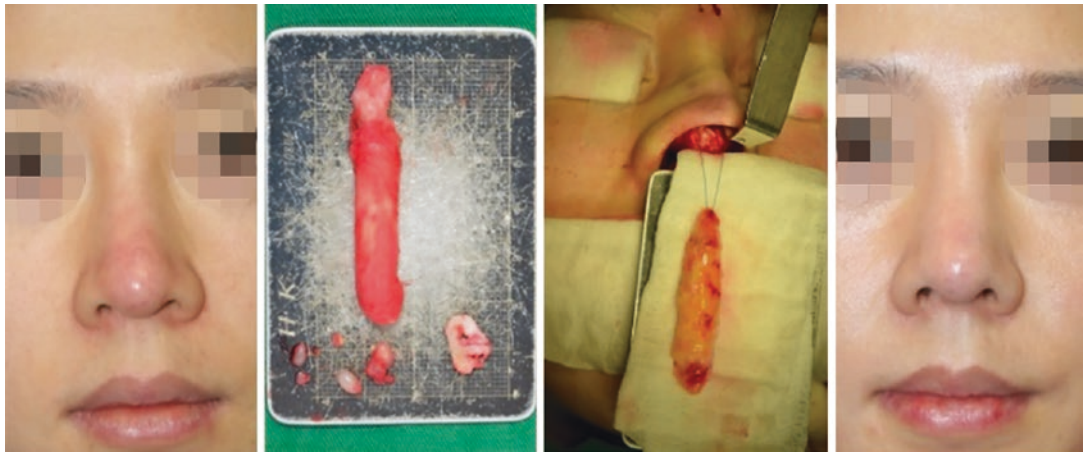

Fig. 34 A case with continuous rash and redness on nose after repeated revisional rhinoplasty. Goretex implant and foreign bodies were removed and dermofat graft was used for dorsum

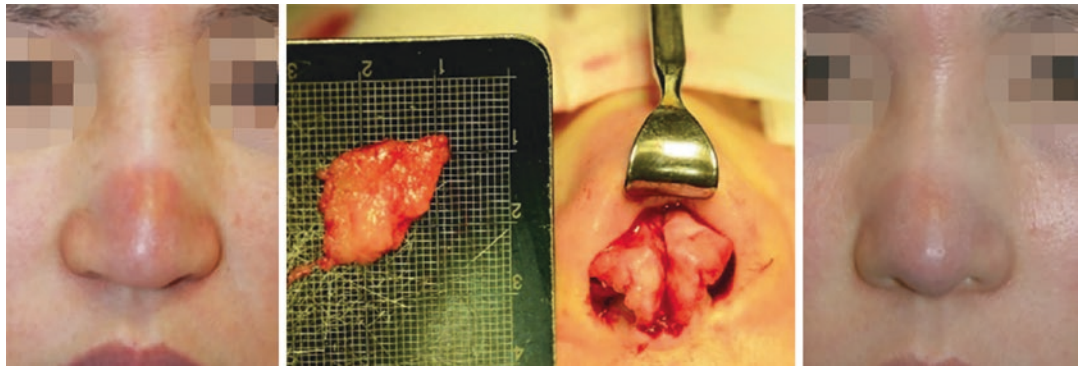

Fig. 35 Persistent supratip redness due to foreign material injected a long time ago

Fig. 36 Large L-shaped implant was switched into tapered tail-shaped one in secondary rhinoplasty

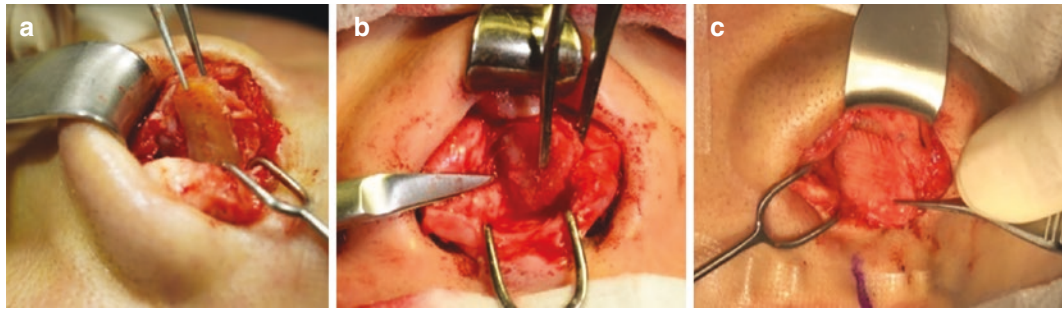

Fig. 37 (**a**) Irradiated homologous costal cartilage (IHCC), (**b**) polyethylene (medpor), and (**c**) polycaprolactone (PCL)

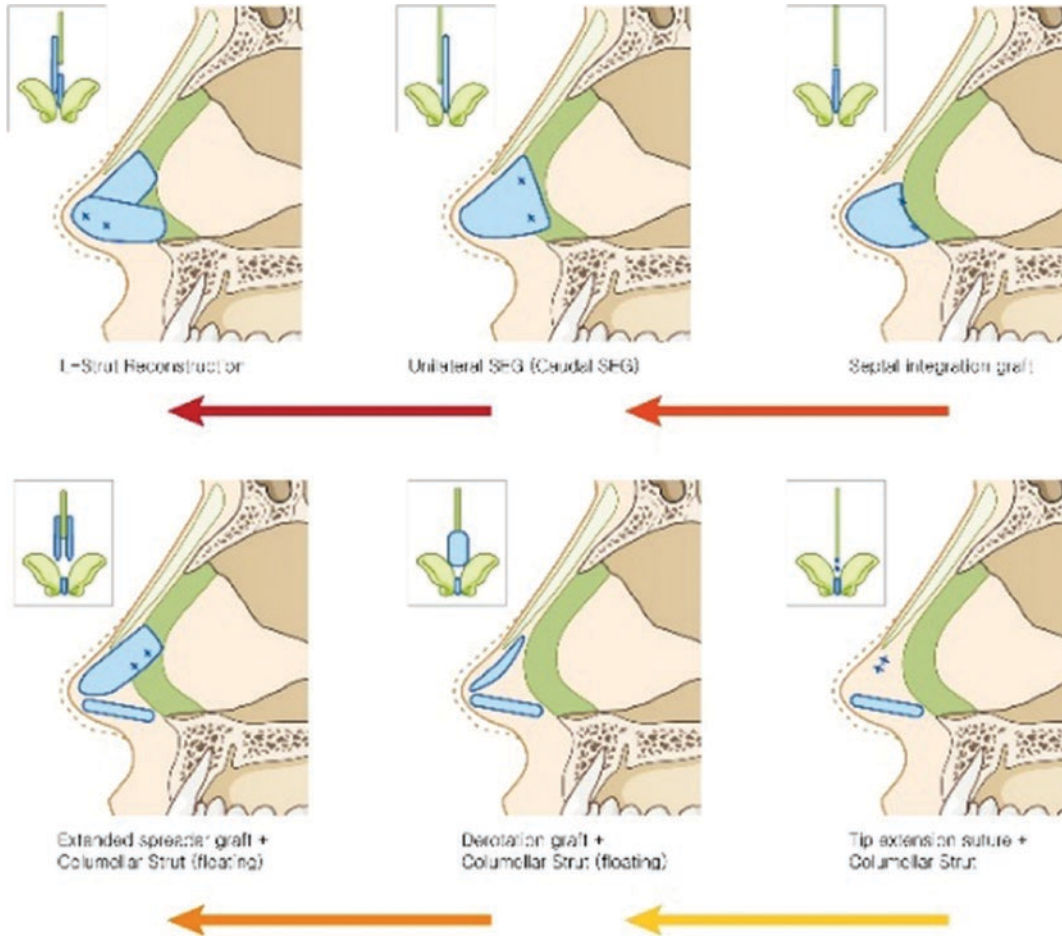

Fig. 38 A degree of tip hardness differs from surgical method

Fig. 39 Arrow tip while smiling after septal extension graft

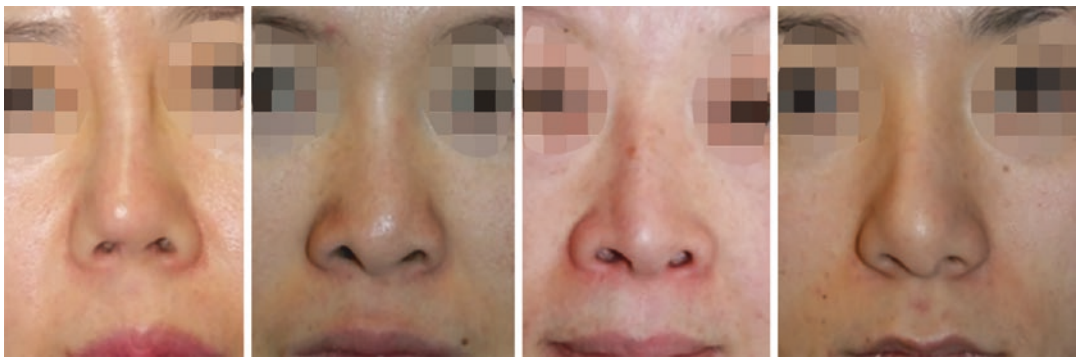

Fig. 40 Variable features of tip demarcation

Implant Exposure Through the Nasal Skin

When chronic inflammation or contracture is left untreated, or when there is an aggravation of irritation by the implanted material to overlying nasal envelope, implant exposure at the external or vestibular skin may occur with localized inflammation (Fig. 41). Generally, various other deformities that are difficult to treat manifest alongside exposure. The perforation of the skin in conjunction with skin thinning will negatively impact prognosis and affect successful treatment. Therefore, it is very important that problematic issues be

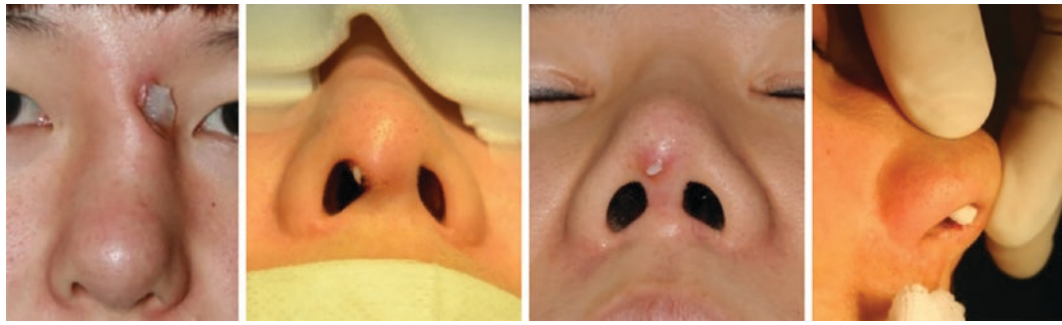

Fig. 41 Variable features of implant exposure

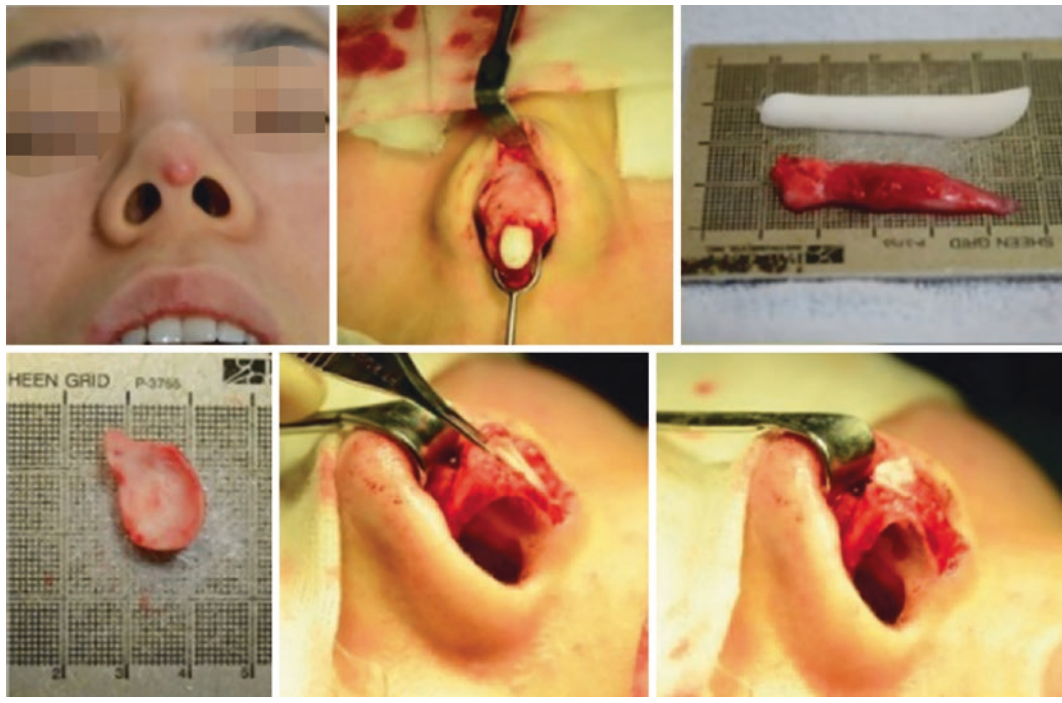

Fig. 42 A case with impending extrusion of silicone implant through the tip skin. Correction was done with ear cartilage after removal of implant and thickened capsule

addressed before implant exposure (Fig. 42). Treatment for exposure includes prompt removal of the prosthetic implant with autologous reconstruction and a staged treatment process may be necessary depending on severity. Primarily, with severe infection, inflammation and prolonged exposure, the implant should be removed, and inflammation should be controlled. Then, the cosmetic aspects should be addressed in a secondary surgery. Using the prosthetic implant should be avoided in reconstruction, and autologous grafts with fascia, dermis, or cartilage may be helpful to reconstruct and reinforce the damaged skin to prevent further deformities.

Implant Exposure Through the Intranasal Mucosa

The causes of implant exposure to the intranasal mucosa are the same as exposure to the nasal skin (Fig. 43). However, diagnosis might be delayed when there is exposure to the intranasal mucosa (Fig. 44). Due to the rising propensity for open rhinoplasty and increasing uses of various materials such as medpor, mesh, and scaffolds, the incidence of septal problems is rising, and treatment is becoming more complex. Inappropriate or aggressive septal management such as mucoperichondrial tearing, nasal packing, or trans-septal suturing increases the risk of septal perforation. Therefore, using an endoscopy for direct visualization to evaluate the intranasal cavity is advisable after surgery (Fig. 45). Treatment includes the removal of all implanted materials and immediate or staged reconstruction with autologous tissue.

Inflammation and Infection

Inflammation after rhinoplasty is a major issue, leading to severe complications and irreversible disaster if not treated properly. The causes of inflammation and infection after rhinoplasty are similar to the causes after any surgical procedure, but their etiologic factors in rhinoplasty can be explained in detail as shown in Table 1. Furthermore, it may be difficult to clearly identify the specific cause of inflammation immediately, so in the clinical setting, it is more important to alleviate and treat the inflammation promptly rather than to identify the cause. Thus, the aim of treatment is to curtail the duration of the inflammation

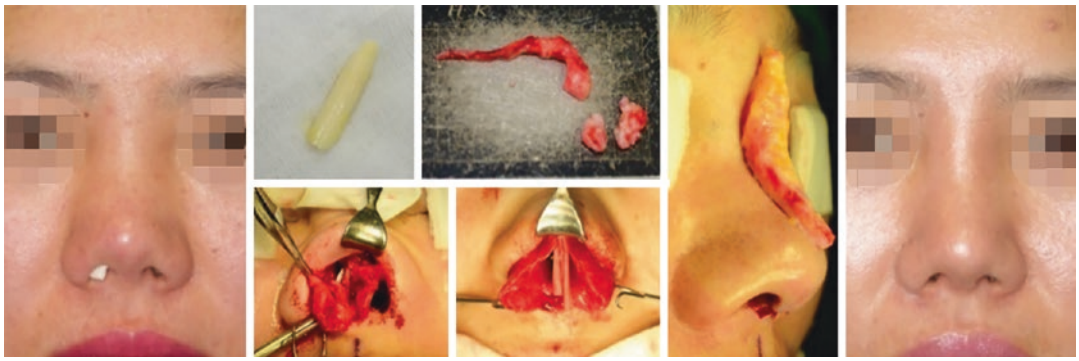

Fig. 43 A case with extrusion of silicone implant through the vestibular skin. Correction was done with septal cartilage and dermofat graft after removal of implant and thickened capsule

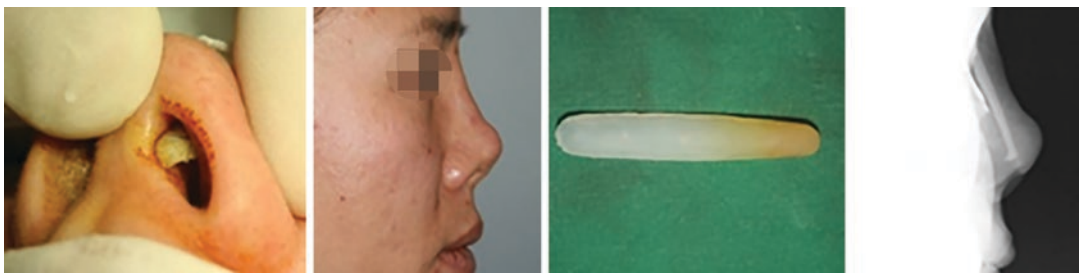

Fig. 44 Persistent exposure of implant caused contracted nose and discoloration of exposed implant. Although implant has been exposed for a long time, patient did not recognize it

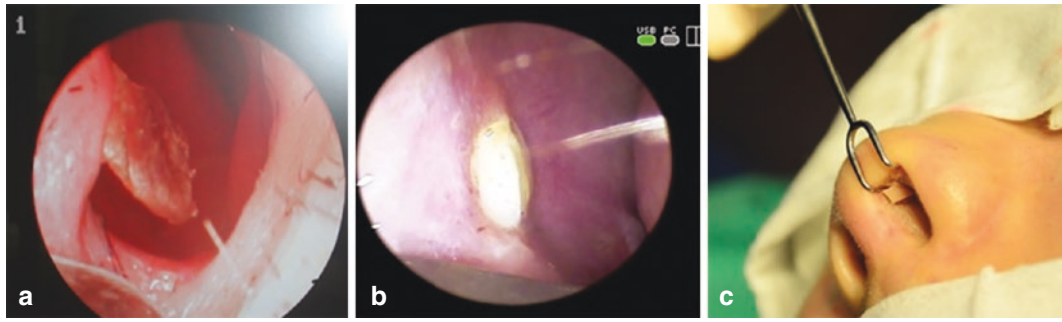

Fig. 45 (**a**) Medpor exposure, (**b**) PCL mesh exposure, and (**c**) silicone implant exposure

Table 1 Various predisposing factors causing inflammation in rhinoplasty

Causes	Predisposing factors
Contamination	Instruments and implant Operation environment Patient Surgeon and assistant
Tissue damage	Prolonged operation time Swelling/hematoma d/t previous operation, trauma Hx d/t foreign body or filler injection
Surgical mistakes	Prolonged operation time Aggressive handling (or retraction) Incorrect procedure Invasive management Improper bleeding control
Foreign body	Nasal implant (silicone/gore-tex®/medpor®/alloderm) Unknown foreign material Fillers Threads
Patient's condition	Multiple operations Previous medical history Smoking/alcohol Intranasal disease (chronic rhinitis, sinusitis) Poor hygiene (oral, nasal) Patient's habits

period and prevent the formation of abnormal scar tissue or contracture. The aim of treatment is applicable to other operations but because the nose is a small organ with relatively thin soft tissue, the results of untreated or delayed treatment can bring more devastating consequences.

Rhinoplasty falls in the category of clean contaminated surgery and the rate of infection is relatively low. Although the reported rates of inflammation and infection related to implants vary widely, in reference to available literature, the mean rate is approximately 2.5–5.3%. According to the author's experiences, among the approximately 2300 total patients available for serial clinical assessment, from serious to minimal inflammations were observed in 34 patients (1.48%). Viral infections comprised approximately 0.61% of total cases (Table 2).

With the exclusion of incidences directly or indirectly related to individual patient factors such as underlying disease and sterilization problems, the following factors can contribute to the risk of inflammation after rhinoplasty:

1. Prolonged operation time.
2. Excessive size of implant after humpectomy or bony reduction.
3. Poor intranasal hygiene (heavy smoker and intraoral device).
4. The presence of intranasal disorders such as chronic sinusitis and rhinitis.
5. Dorsal / septal hematoma—increased susceptibility to inflammation and infection.
6. Abnormal, continuous physical stimulations (habitual touching, rubbing, blowing, or picking).
7. History of permanent filler injection or unknown foreign body material.
8. Secondary surgery or history of successive revision rhinoplasties.
9. Concomitant septal work (septoplasty) and rhinoplasty using implant.

The incidence of inflammation in Asian rhinoplasty is closely correlated with the use of implants. However, according to the author's 17-year experience with rhinoplasty, the causes of inflammation and infection were mainly attributed to improper surgical technique, vascular insufficiency, and other patient factors including psychological state and smoking as described in Table 1, and not necessarily by the implant itself. As demonstrated in numerous studies, smoking has a significant effect on healing and moderation of inflammation. Also, usage of excessively oversized implants should be avoided, and care should be taken not to cause unnecessary damage by overaggressive manipulation on tissues to avoid complications.

Inflammation Related to Implants

In general, acute symptoms of inflammation related to implants appear within a week after surgery. Localized tenderness and heating sensations occur approximately 3–5 days after surgery accompanied by general symptoms such as fever, chills, and malaise. The dorsal skin usually shows erythematous and painful swelling (Fig. 46). Purulent drainage from the nasal dorsum usually includes traces of blood, inflammatory, and necrotic cells.

Purulent exudates should be cultured to evaluate and guide antibiotic treatment but, symptoms of acute inflammation related to dorsal implants should be addressed for early removal of the implant and control of the inflammation. If the inflammation is controlled by irrigation and implant removal within 2 weeks after onset of symptoms, not only inflammation symptoms are usually controlled 2–3 days after removal, but also autologous cartilage grafts used for tip work and structural framework can be salvaged. Antibiotic treatment alone can alleviate acute symptoms of inflammation but can mask the severity of the underlying inflammation. This may cause tissue damage and increased scar tissue in the long run, leading to more difficulties in

Table 2 The incidence of inflammation and infection during author's own rhinoplasty for recent 3 years

Cases	No.	Inflammation and infection			Viral infection
		Dorsum	Tip	Septum	
Primary	1777	10	3	3	11
Secondary	537	8	6	4	3
Total	2314	18	9	7	14
%	100	0.78	0.39	0.3	0.61

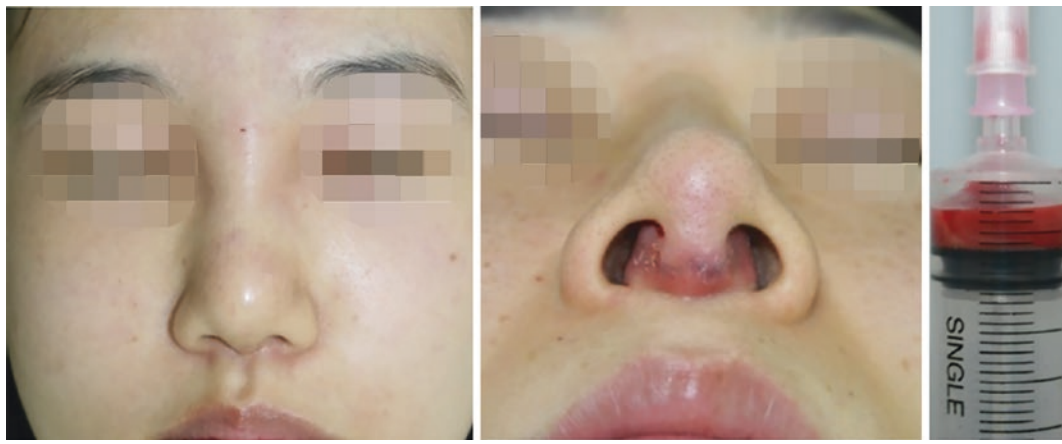

Fig. 46 Acute inflammation

management and increase the risk of contracture. When symptoms of acute inflammation completely subside with sufficient treatment including implant removal, a revision surgery with an implant may be attempted after at least 6 months. However, it is recommended that autologous graft materials are used in case with inflammation history.

Persistent swelling or swelling with a wax and wane pattern is highly indicative of chronic inflammation (Fig. 47). If the implant is removed after more than two weeks after surgery, treatment should consist of complete removal of implant and rigorous irrigation and gentle curetting to eliminate any traces of inflammatory granulation tissue that may be a cause of chronic inflammation. Even with such measures, patients may experience persistent pericapsular seromas or cysts. Caution should be taken to avoid the formation of irregular scar tissue at the nasal root area due to tearing or displacement of the capsule during removal. If the inflammation is confined within the capsule in chronic patients, a one-stage revision surgery can be performed with total capsulectomy (Fig. 48). If the inflammation has extended to adjacent soft tissue, treatment should aim to control soft tissue inflammation, and when symptoms of chronic inflammation manifest, all implant materials should be removed in their entirety and inflammatory granulation should be debrided to salvage soft tissue. When inflammation is under complete control, a staged revision to shape the nose can be done (Fig. 49).

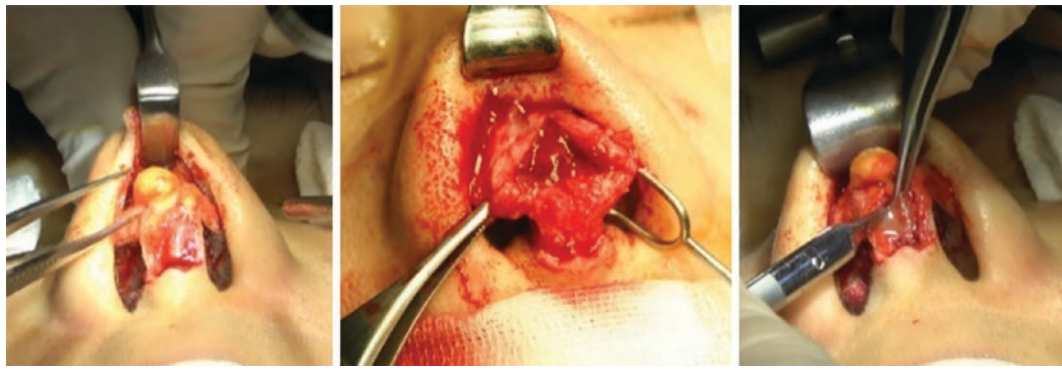

Fig. 47 Chronic inflammation. Turbid, purulent discharge was observed

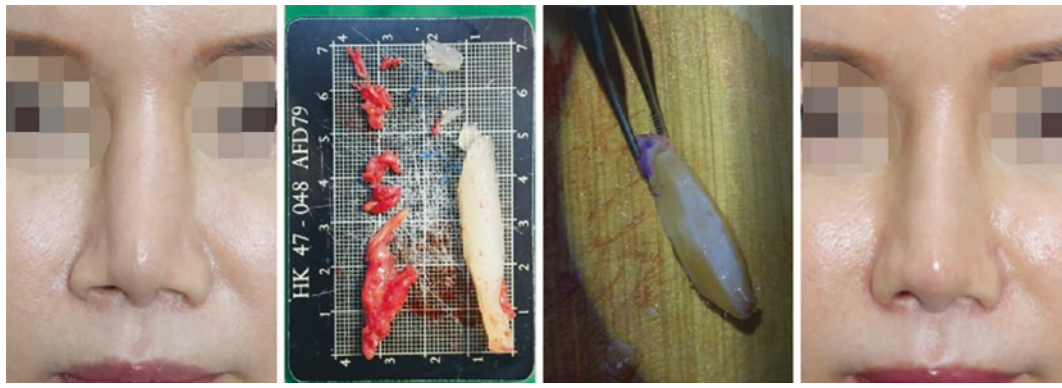

Fig. 48 Chronic swelling on dorsum should be suspected as inflammation. Previously used implant and capsule were removed and replaced with autologous rib cartilage

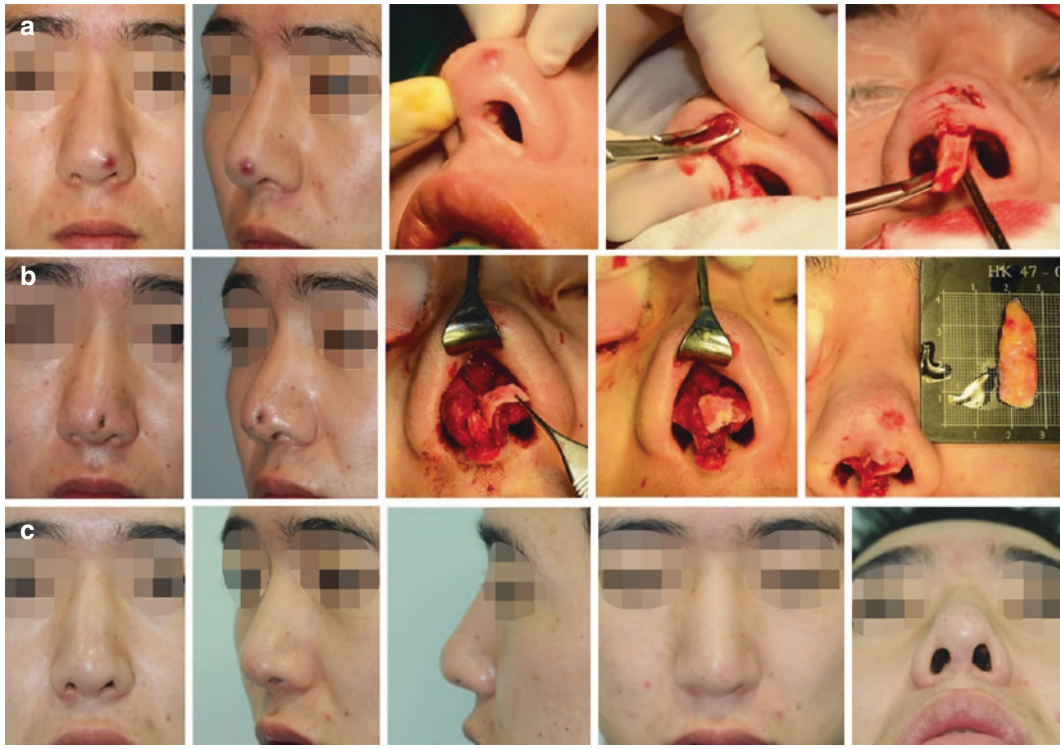

Fig. 49 A case with staged operation. (**a**) Purulent discharge on tip due to chronic inflammation. First stage operation was done to remove goretex implant and granulation tissue, (**b**) Two weeks later after inflammation subsided, second stage operation was done for tip reconstruction using ear cartilage and dermofat graft, and (**c**) final postoperative view

Biofilms in the Operated Nose

Staphylococcus epidermidis is known as the main cause of biofilms. This bacterial strain is strongly resistant to antibiotics and can cause inflammatory reactions that cannot be cultured in a laboratory. Biofilms cause severe capsular contracture by stimulating the capsule and facilitating fibrotic reactions in a continuous manner which exacerbates inflammation and subsequent tissue deformity by sustained maturation steps. (Fig. 50). Unless the etiologic factors are removed, the excessive proliferation of fibrosis continues by the signaling pathway observed in fibromatosis, Dupuytren's disease, and hypertrophic scars. Confirmation of a biofilm with culture studies remains unclear, but clinical manifestations can help predict its presence and molecular studies such as PCR (polymerase chain reaction) and electron microscopy can be utilized if needed.

Inflammation: As an Initiator for Contracture

Contracture deformity in rhinoplasty is closely related to silicone implants and their capsules. Inflammation caused by dorsal implants is continuously exacerbated by biofilms and granulation tissue within the capsule, leading to increased severity of fibrosis and capsular thickening. Consequently, the elasticity of the capsule is compromised which eventually predisposes the capsule to shorten. A traction force on the alar cartilage, or entire distal mobile framework, results in upturned tip deformity, alar notching, and nostril show (Fig. 51). Chronic inflammation due to implants (medpor, mesh, or scaffold) in septum can lead to more devastating deformities. When the elastic nature of the membrane is compromised, the membranous septum, void of cartilage framework, shortens, and the columella

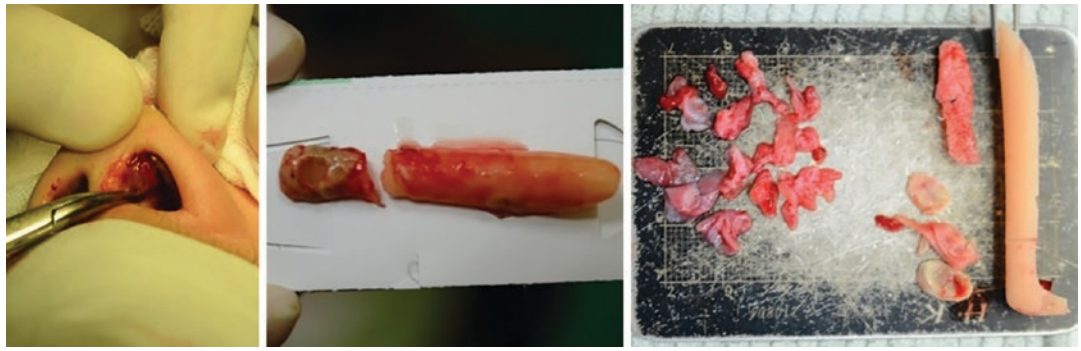

Fig. 50 Chronic inflammatory capsule and silicone implant are closely related to contracture. The principle of correction is the total removal of all foreign material and granulation tissue

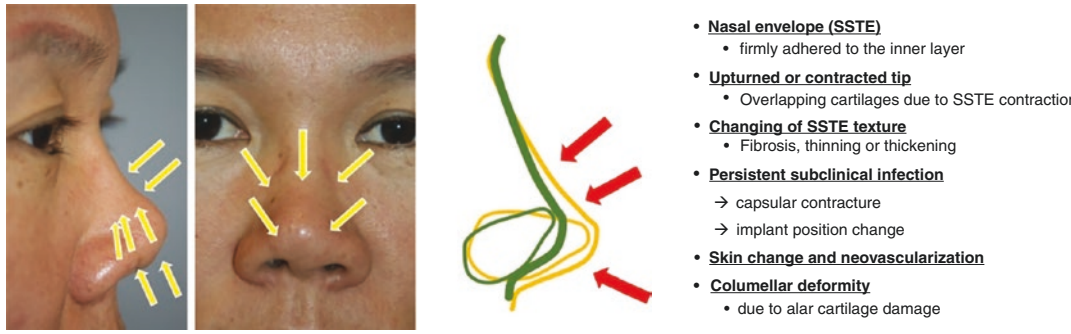

Fig. 51 The pattern of nasal contracture

retracts with scarring and fibrosis and the entire tip complex is retracted in the cephalic direction (Fig. 52).

Inflammation Due to Autologous Graft Failure

Inflammation can also occur in patients who have undergone rhinoplasty using only autologous materials. However, the prognosis is generally better, and treatment is less complex. Causes that can contribute to autologous graft inflammation and failure include contamination of the graft, hematoma, chronic smoking, multiple rhinoplasties, aggressive handling of graft materials, and tissue damage due to prolonged surgical time. Early wound healing is important because delayed wound healing due to such tissue injury can serve as a precondition for scarring and contracture. When inflammation or infection of the tip grafts is suspected, prompt surgical intervention can help efforts to alleviate inflammation and salvage the grafts (Fig. 53). As mentioned previously, attempts to control inflammation through the sole use of antibiotics cannot manage chronic inflammation and permanent deformity to the nasal tip. Therefore, surgical intervention should always be contemplated. Septal inflammation can result in especially dire consequences and serious deformities. Efforts should be made to prevent septal hematomas during surgery and prompt treatment and inflammation control should be implemented when suspected (Fig. 54).

Viral Infection around Nose

Eczema herpeticum or Karposis varicelliform eruptions of the perinasal skin are the most common viral infections affecting the nose. Infection with the herpes simplex or coxsackie A16 virus is the cause and symptoms appear suddenly around

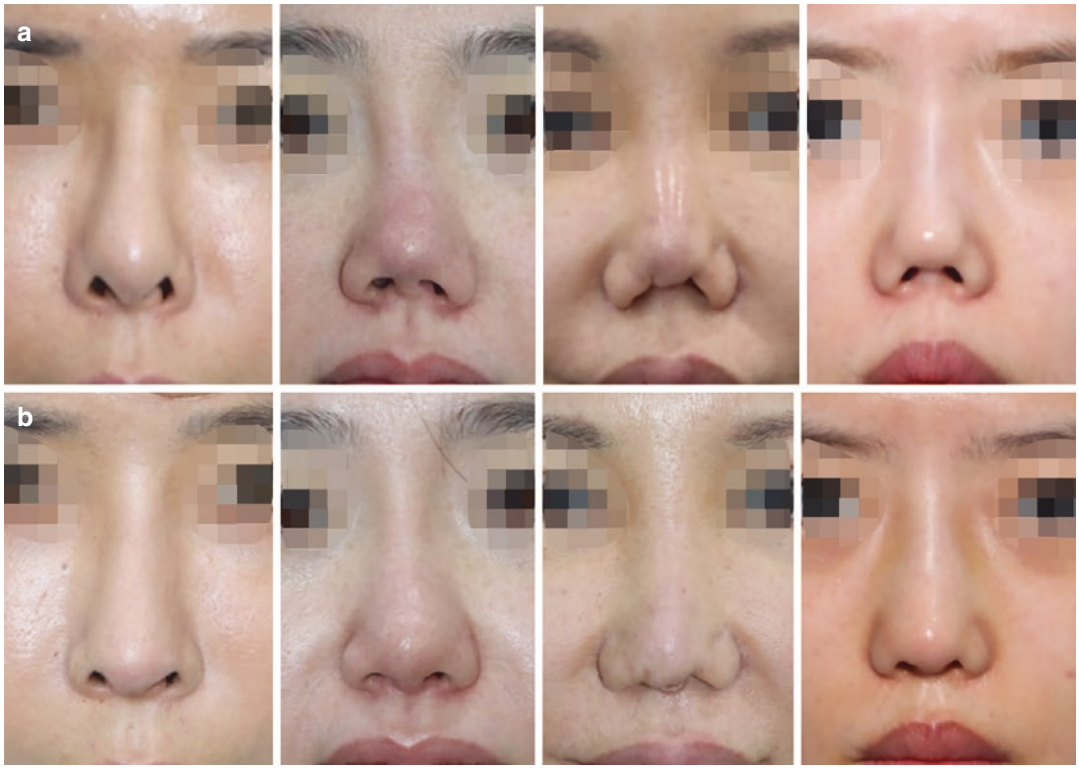

Fig. 52 Variable features of contracted nose. (**a**) preoperative view and (**b**) postoperative view

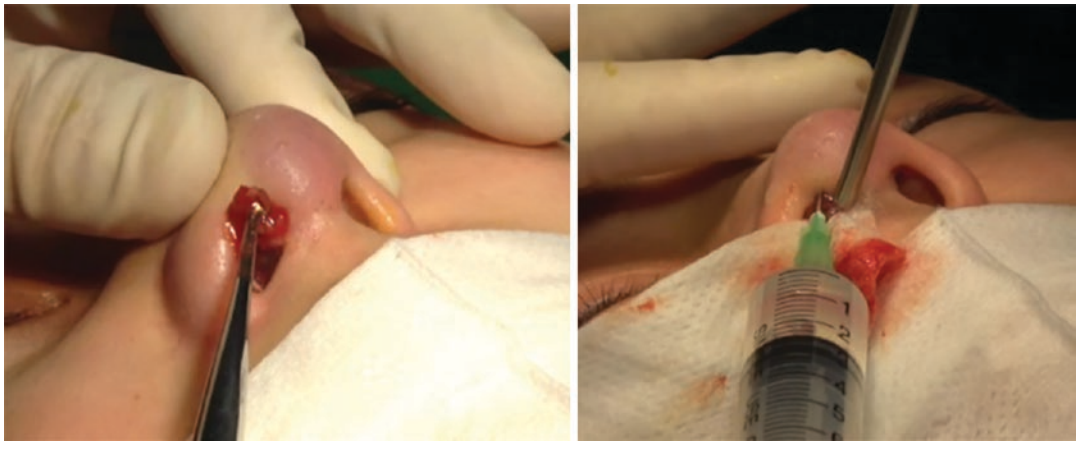

Fig. 53 Failure of autologous graft showing discharge and granulation tissue. Early intervention with curettage and irrigation is necessary for salvage the grafts

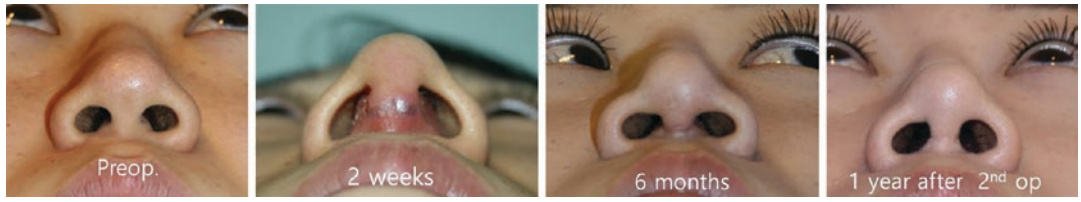

Fig. 54 Serial photos showing inflammation in septum developed after septoplasty

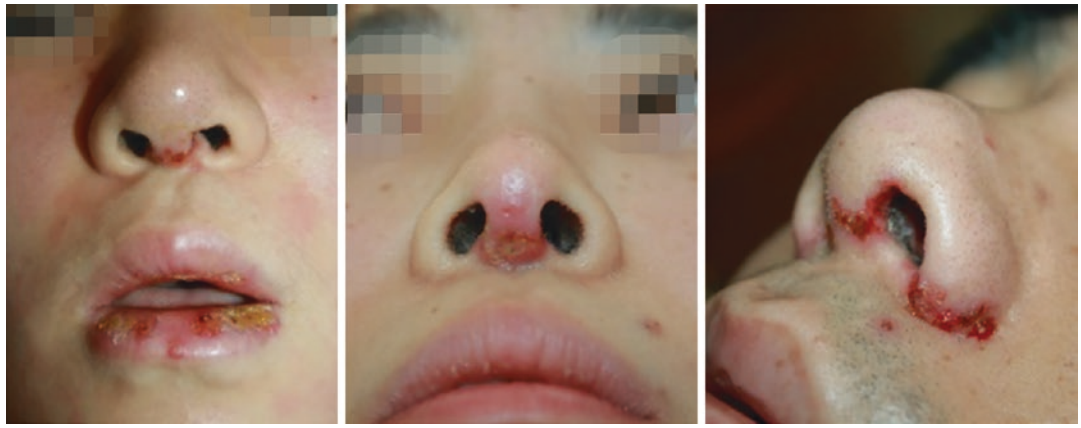

Fig. 55 Variable features of viral infection (Eczema herpeticum)

the nasal area or at the incision site (Fig. 55). Skin lesions appear approximately one week after surgery and patients who have a recurrent history of perioral, intraoral, or intranasal herpes eruptions are usually afflicted, although infections can be observed in patients who do not have a history as well. Viral presentations include sudden disruption of the incision site after removal of sutures, erythematous lesions at the incision site accompanied by pain, tenderness, and umbilicated vesicular lesions that can lead to multiple ulcerations in severe cases. The lesions are usually refractory to treatment by disinfection or sterilization, IV antibiotics, or bacterial ointments. Antiviral agents such as acyclovir or famciclovir and antiviral topical ointments can be used effectively for treatment. Oral antiviral agents taken for approximately 5–7 days can usually eliminate any symptoms uneventfully without any scar (Fig. 56). However, delayed diagnosis of viral infection after the surgery can lead to secondary bacterial infections that can cause permanent scarring and deformation. Although the occurrence is rare, the surgeon should be aware of such possible complications to prevent disfiguring sequelae. Diagnosis can be confirmed with viral analysis and pathohistologic tests, but prompt diagnosis based on the clinical presentation of symptoms is more important. In addition, oral antiviral prophylaxis 3–5 days prior to rhinoplasty is recommended in patients with a history of herpes infections.

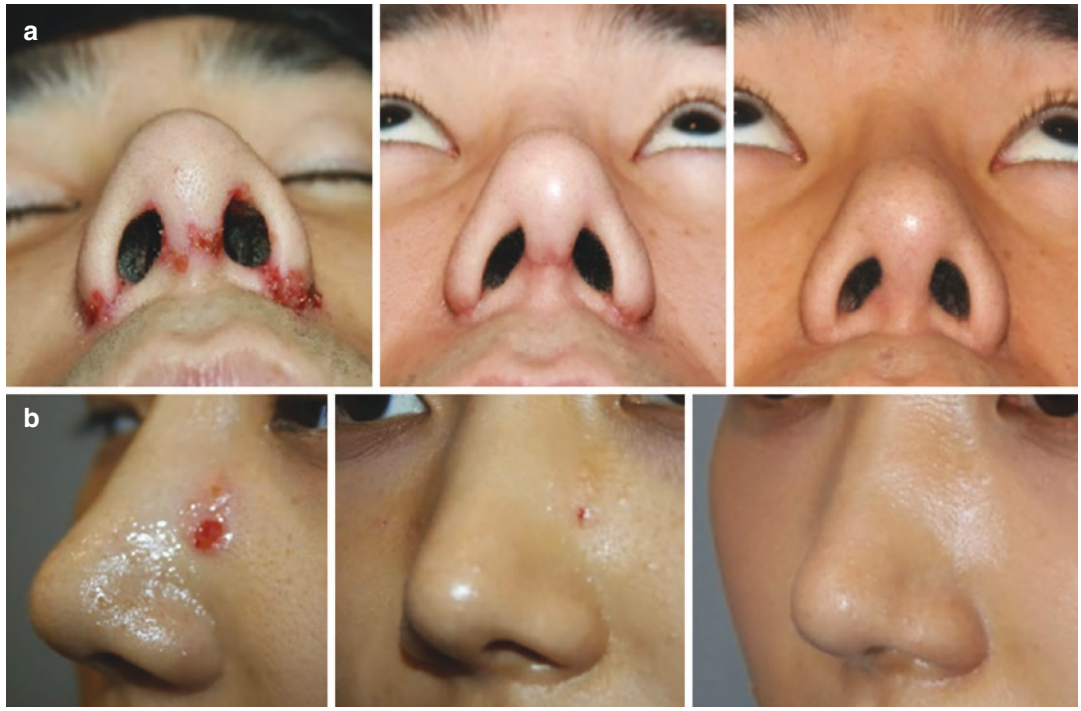

Fig. 56 A follow-up of viral infections after the operation around. (**a**) Columella and alar base and (**b**) incision site for percutaneous lateral osteotomy

Further Reading

Albu S, Lucaciu R. Prophylactic antibiotics in endoscopic sinus surgery: a short follow-up study. Am J Rhinol Allergy. 2010;24:306–9.

Baran CN, Peker F, Ortak T, et al. A different strategy in the surgical treatment of capsular contracture: leave capsule intact. Aesthet Plast Surg. 2001;25:427–31.

Bateman N, Jones NS. Retrospective review of augmentation rhinoplasties using autologous cartilage grafts. J Laryngol Otol. 2000;114:514.

Cabouli JL, Guerrissi JO, Mileto A, et al. Local infection following aesthetic rhinoplasty. Ann Plast Surg. 1986;17:306–9.

Canty PA, Berkowitz RG. Hematoma and abscess of the nasal septum in children. Arch Otolaryngol Head Neck Surg. 1996;122:1373.

Cervelli V, Bottini DJ, Gentile P, et al. Reconstruction of the nasal dorsum with autologous rib cartilage. Ann Plast Surg. 2006;56:256–62.

Cochran CS, Gunter JP. Secondary rhinoplasty and the use of autogenous rib cartilage grafts. Clin Plast Surg. 2010;37:371.

Coleman SR. Structural fat grafts: more than a permanent filler. Plast Reconstr Surg. 2006;118:108.

Conrad K, Gillman G. A 6-year experience with Gore-tex® in rhinoplasty. Plast Reconstr Surg. 1998;101:1675.

Daniel RK. Diced cartilage grafts in rhinoplasty surgery. Plast Reconstr Surg. 2004;113:2156.

Daniel RK. Mastering rhinoplasty. 2nd ed. New York: Springer; 2010.

Deva AK, Merten S, Chang L. Silicone in nasal augmentation rhinoplasty: a decade of clinical experience. Plast Reconstr Surg. 1998;102:1230.

Dominic SR. Elemental analysis and clinical implication of calcification deposits associated with silicone breast implants. Ann Plast Surg. 1999;42(2):117–23.

Godin MS, Waldman SR, Johnson CM. Nasal augmentation using Gore-tex®: a 10 year experience. Arch Facial Plast Surg. 1999;1:118.

Goldman MP, Bennet RG. Treatment of telangiectasia: a review. J Am Acad Dermatol. 1987;17:167.

Graham BS, Thiringer JK, Barrett TL. Nasal tip ulceration from infection and extrusion of a nasal alloplastic implant. J Am Acad Dermatol. 2001;44:362.

Gruber RP. Early surgical intervention after rhinoplasty. Aesthet Surg J. 2001;2:549.

Gryskiewicz JM, Hatef DA, Bullocks JM, et al. Problems in rhinoplasty. Clin Plast Surg. 2010;37:389.

Guyuron B. Rhinoplasty. 1st ed. New York: Saunders; 2012.

Jeong JY. Rebuilding nose: rhinoplasty for Asian. 1st ed. Seoul: Medic Medicine; 2018.

Jeong JY, Oh SH, Suh MK, Kim CK, Kim K. Effective use of a silicone-induced capsular flap in secondary

Asian rhinoplasty. Plast Reconstr Surg Glob Open. 2014;2:e172.

Jeong JY, Terence G, Kim J. Understanding the anatomy of the transverse Nasalis aponeurotic fibers and its importance in Asian rhinoplasty. Ann Plast Surg. 2018a Nov;81(5):516–22. https://doi.org/10.1097/SAP.0000000000001564.

Jeong JY, Ha Y, Kim S, Yang HJ, Oh S-H. Availability and safety of osteotomy in esthetic rhinoplasty of east Asian patients. Ann Plast Surg. 2018b;81(2):141–5.

Jung DH, Kim BR, Choi JY, et al. Gross and pathologic analysis of long-term silicone implants inserted into the human body for augmentation rhinoplasty: 221 revision cases. Plast Reconstr Surg. 2007;120:1997–2003.

Kim HS. Dorsal augmentation in secondary rhinoplasty. J Korean Soc Aesthetic Plast Surg. 2008;14:79–98.

Kim DW, Toriumi DM. Nasal analysis for secondary rhinoplasty. Facial Plast Surg Clin North Am. 2003;11:399.

Kim H, Hwang SM, Ahn SM, Lim KR, Song JK, Jeong JY. Herpes simplex virus infection after corrective rhinoplasty through external approach: two case reports. Arch Craniofac Surg. 2012;13(1):68–71.

Mäkitie A, Aaltonen LM, Hytonen M, et al. Postoperative infection following nasal septoplasty. Acta Otolaryngol Supl. 2000;543:165–6.

McCurdy JA Jr. Considerations in Asian cosmetic surgery. Facial Plast Surg Clin North Am. 2007;15:387–97. vii

Noe JM, Finely J, Rosen S, Arndt KA. Postrhinoplasty "red nose": differential diagnosis and treatment by laser. Plast Reconstr Surg. 1981;67:661.

Pajkos A, Deva AK, Vickery K, et al. Detection of subclinical infection in significant breast implant capsule. Plast Reconstr Surg. 2003;111:1605.

Perrotti JA, Castor SA, Perez PC, et al. Antibiotic use in aesthetic surgery: a national survey and literature review. Plast Reconstr Surg. 2002;109:1685–93.

Prantl L, Schreml S. Clinical and morphological conditions in capsular contracture formed around silicone breast implants. Plast Reconstr Surg. 2007;120(1):275–84.

Prantl L, et al. Clinical and morphological conditions in capsular contracture formed around silicone breast implants. Plast Reconstr Surg. 2007 Jul;120(1):275–84.

Rockwell WB, Casey HD, Cheng CA. Breast capsule persistence after breast implant removal. Plast Reconstr Surg. 1998;101:1085–8.

Rohrich RJ, Adams WP Jr, Gunter JP. Dallas rhinoplasty. 3rd ed. St. Louis: QMP; 2014.

Sclafani AP, Romo T, Jacono AA, et al. Evaluation of acellular dermal graft (Alloderm) sheet for soft tissue augmentation: a 1 year follow up of clinical observations and histological findings. Facial Plast Surg. 2001;3:101.

Shin DM, Minn KW. The effect of myofibroblast on contracture of hypertrophic scar. Plast Reconstr Surg. 2004;113:633.

Suh MK. Dorsal augmentation using autogenous tissues. Facial Plast Surg Clin North Am. 2018;26(3):295–310.

Tham C, Lai YL, Weng CJ, Chen YR. Silicone augmentation rhinoplasty in an oriental population. Ann Plast Surg. 2005;54:1.