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Review Article

The ideal technique nasal tip surgery for Asians, understanding best technique, and post-operative improvement: Systematic review/meta-analysis

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ABSTRACT

Introduction: Asian nose is characterized by thick skin, abundant soft tissue, and weak cartilage framework, resulting in underprojection of the nasal dorsum and tip. Anatomical knowledge consideration is needed to achieve an ideal and natural-looking Asian nasal tip. Various nasal tip surgery techniques for Asian nose have been introduced recently. However, a comparison of techniques and postsurgical results has not yet been undertaken.
Objective: This systematic review aims to highlight the basic understanding of nasal tip dynamics aesthetic Asian nose and analyze related studies in search for the best technique and post-operative improvement for Asian tip-plasty.
Method: Two independent reviewers conducted a comprehensive database search from four major medical databases (PubMed, Scopus, EBSCOhost, and EMBASE). Methodology quality and risk of bias in each study were assessed with the Risk of Bias In Non-randomized Studies - of Interventions (ROBINS-I tools).
Result: The initial literature search (May–July 2023) yielded 53 articles, of which 26 were removed (duplicated). The title and abstract screening reduced the count to 6 articles, and two were

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excluded for specific reasons. Finally, four articles were included in the systematic review and proceeded to methodological quality check and risk of bias assessment.
Conclusion: New techniques such as combining spreader graft, septal extension graft, and columellar strut graft for Asian tip-plasty show promising effect after surgery. Increasing nasal length, projecting the tip, and strengthening the nasal tip framework become key points for Asian tip-plasty.

Introduction

Nasal tip surgery is performed to refine and balance the nasal proportions and appearance, yet balancing the nasal tip is the most important procedure in rhinoplasty. Recently, many surgical techniques have been adopted, with nasal lengthening and tip augmentation being the most important procedure in Asian rhinoplasty. Asian noses have thick skin, abundant soft tissue, and a weak cartilage framework, resulting in a characteristic type with a less refined nasal dorsum and tip. The suture technique alone in nasal tip surgery has been proven to fail to preserve prominent tip projection in a weak cartilaginous framework. These anatomical traits present a hurdle for surgeons who perform nasal tip surgery in Asian patients. Furthermore, the small size of the nasal tip is a factor requiring meticulous surgical techniques. Surgeons must have a basic knowledge of nasal tip analysis, proportional assessment of the face, and nasal tip dynamics toward basic ethnicity to achieve an ideal and natural look for each patient. Consideration of tip rotation, projection, and definition is vital in performing nasal tip surgery. Understanding Asian nasal tip anatomy helps the surgeon choose the best surgical and graft technique to achieve a refined aesthetic Asian nasal tip that looks ideal and natural. Various nasal tip surgery techniques for Asians have been introduced recently, but the best technique to achieve a natural look and post-operative improvement is still to be determined. This systematic review will highlight the basic understanding of nasal tip dynamics for the Asian nose intervention and analyze related studies to determine the best technique and post-operative results in Asian tip-plasty. The author focuses on studies related to nasal tip surgery, especially in Asians, surgical techniques, and compares the post-operative outcomes based on specific nasal angle measurements.[1–3]

Methods

Study eligibility

This systematic review and meta-analysis follows the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The parameters used to determine studies considered for this systematic review were to compare surgical technique, effectiveness, and post-operative outcomes in nasal tip-plasty for Asian.

- P : Asian adult, regardless of age.
- I : Nasal tip-plasty included septal extension graft, spreader graft, shield graft, or a variation of these techniques.
- C : Present preintervention nasal anthropometry (nasal length, nasolabial angle, nasofrontal angle, and tip projection).
- O : Present postintervention nasal anthropometry (nasal length, nasolabial angle, nasofrontal angle, and tip projection).

We included all studies focusing on Asian nasal tip surgery, comparing types of surgery and grafting technique, and using objective post-operative measurement for nasal anthropometrics. We excluded studies focusing on nasal tip suturing techniques and rhinoplasty without nasal tip surgery and articles not in English.

Data sources and search terms

A comprehensive electronic literature search was performed from May to July 2023 using four online databases (PubMed, Scopus, EBSCOhost, and EMBASE). Manual searching from previous articles was also conducted during the literature search. The Boolean search terms are described below:

- Asian Tip Surgery AND
- Nasal Tip Grafting AND
- Nasal Anthropometric AND, also the variation of these terms.

Study selection and data collection process

Study limits placed on literature in human research, non-randomized intervention studies, observational studies, and prevalence studies in the last ten years. Two reviewers (TM and DJD) independently searched the electronic databases and selected 50 articles. Additionally, three articles were identified after a manual search. The selected articles underwent duplication check, followed by abstract and full-text assessment. Two reviewers performed full-text assessment based on the inclusion and exclusion criteria. Data were analyzed with an interrater agreement with Cohen Kappa in SPSS and we used Risk of Bias In Non-randomized Studies-of Interventions (ROBINS-I tools) for the evaluation of study's risk of bias.[4]

Methodologic and quality assessment

We analyzed the methodological quality of the study using the ROBINS-I tools. The methodological quality assessment encompassed:

- Protocol stage: defined confounding and co-intervention
- Stage II: specify participant bias, outcome bias, and measurement.

Outcome measurement was analyzed using RevMan Manager 5.4.1. Heterogeneity of studies was estimated based on I^2 value. We used fixed effect models to estimate homogenous studies and random effect models for heterogeneous studies. We estimated an outcome of the combined studies including estimated mean difference of nasal length, nasolabial angle (NLA), and tip projection index. The new outcome assessment is based on a significant overall effect p-value.

Results

Study search and selection

The initial literature search (May–July 2023) yielded 53 articles [Figure 1]. These were screened by title and abstract by two reviewers (TM, DJD) with interrater agreement by Cohen Kappa result revealed 0.839, defined as strong agreement. Disagreement was resolved with a consensus discussion of both reviewers. Records result from 4 databases (PubMed, Scopus, EBSCOhost, and EMBASE) were 50 articles, and 3 articles from manual searching. Records, after duplicates were removed and further limited, were 26 articles. Records after the title and abstract screening were 6 articles. Records after full-text assessment were 4 articles. Two articles exclude with a reason (Nam et al.[5] and Byun et al.[6]). Nam et al[5] article method was focused on osteotomies rhinoplasty technique despite of nasal tip rhinoplasty, and Byun et al.[6] did not present an objective outcome after surgery. The studies included in the systematic review were 4 articles, then synthesized with the ROBINS-I appraisal tool for observational study. The selection of studies is summarized in Figure 1.

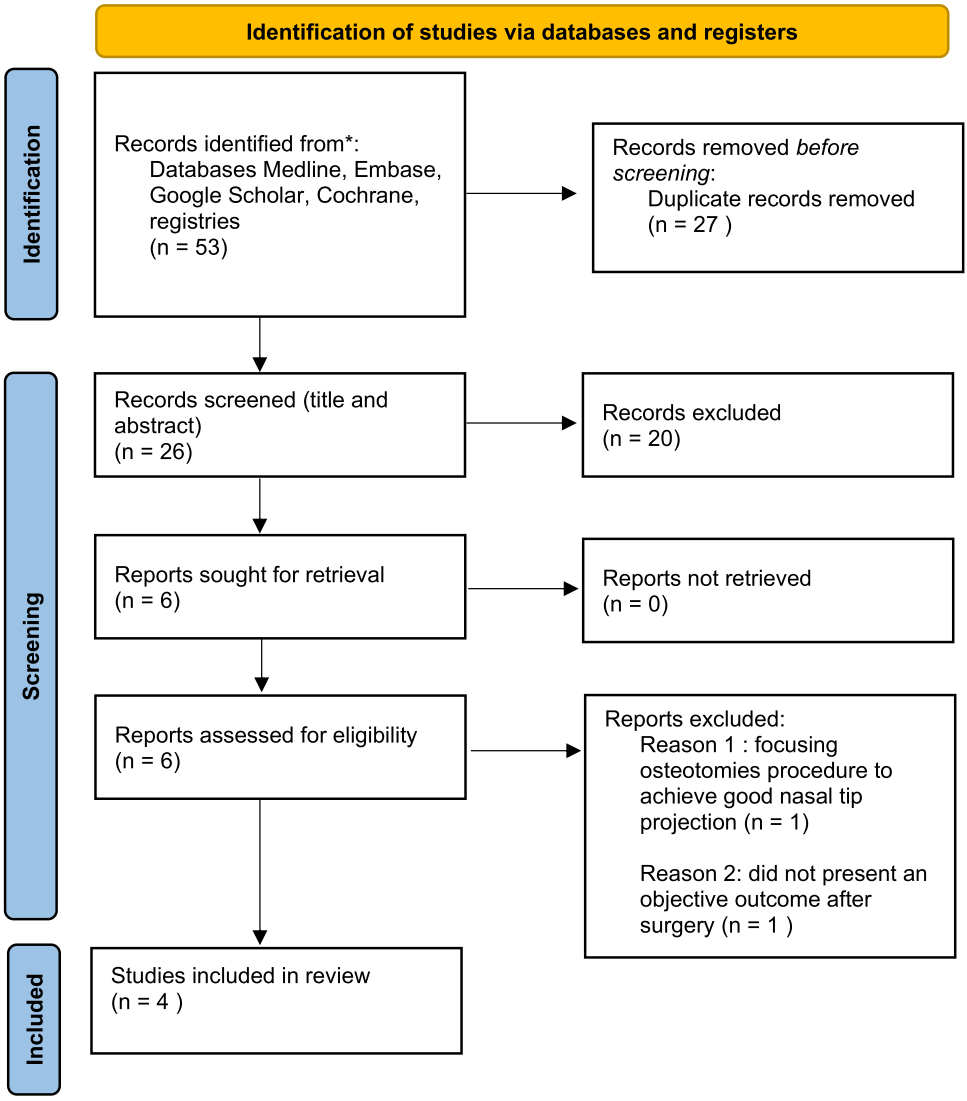

Figure 1. PRISMA flow chart.

Selected studies are non-randomized interventional studies. Of 139 participants with nasal tip surgery, 113 (81%) were female and 26 (19%) male. All studies included septal extension grafts for nasal tip surgery with different techniques of graft placement in the nasal septum.

Methodology quality and risk assessment of bias

The author did bias assessment quality of each study using the ROBINS-I tool. In the protocol stage, only one study by Zhang et al.[7] used strict eligibility criteria (the study did not include patients with complications of primary rhinoplasty surgery such as nasal contracture, heavy saddle nose, also massive nasal trauma that results in the need for massive reconstruction) to avoid the risk of confounding factors that may interfere with the result. Other remaining studies did not describe strict eligibil-

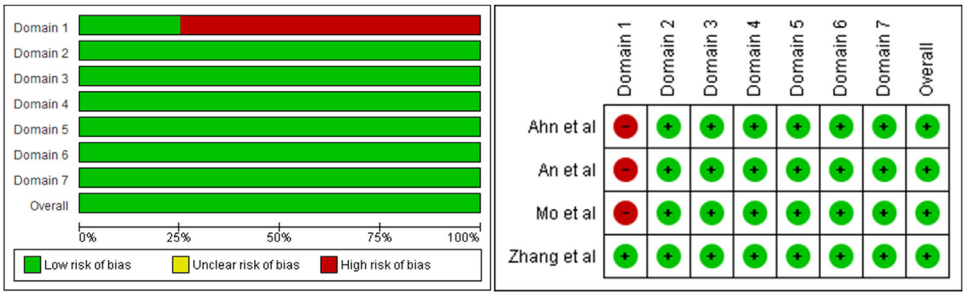

Figure 2. Risk assessment of bias using ROBINS-I.

ity criteria that possibly be confounding factors. In stage II assessment, all studies use consecutive sampling which may reduce the chance of bias on data sampling. Assessing bias in measurement, all studies use standardized objective nasal anthropometric measurement to minimize measurement bias. The studies did not present confidence intervals of the measurements to describe the precision level of the result that may result in random error from the measurement. The overall methodological quality assessment of study shows low risk bias (Figure 2).

The technique of nasal tip surgery

Zhang et al.[7] introduce their own innovation of septal extension graft (SEG) namely with a "double tower" nasal stent using ear cartilage. This technique uses two folded ear cartilage and the shape mimics two-tower sutured to-end caudal-septum cartilage. The authors also prepare other ear cartilage grafts namely cap grafts or shield grafts that will be sutured in the tip of the nose covering the double tower SEG. Ahn et al.[8] use the SEG technique with "sandwich graft," a cartilage-bone complex graft. Sandwich graft is built from vomer and the perpendicular plate of the ethmoid bent with a double layer of septal cartilage and then sutured together to achieve strong SEG. The authors also added an alloplastic implant from the radix to the upper lateral cartilage covering the sandwich graft to achieve a smooth appearance of the nasal tip. Mo et al.[9] used folded ear cartilage as an extended spreader graft, columellar strut graft, and pagoda shape tip on-lay that will be sutured to the nasal tip. The aim of this technique was to strengthen the nasal dorsum, avoid cephalic rotation of the dome, and support nasal tip projection. An et al. used combination of SEG and M-shaped alar cartilage graft to support the nasal tip, (Table 1).

Study result and synthesis of the result

Four studies were assessed to compare pre-operative and post-operative nasal anthropometrics using objective measurements. The author conducted a meta-analysis on three nasal anthropometric outcomes including NLA, and tip projection then calculated the new estimated mean difference of combined studies. The estimated nasal length mean difference of the combined study was 3.37 (confidence interval [CI] 1.56, 5.19) calculated with random effect models. The overall effect for estimated nasal length showed significant improvement in the postintervention group ($p = 0.0003$). The estimated NLA mean difference of the combined study revealed significant results with a new estimated mean difference was 5.63 (CI 0.97, 10.29). The overall effect of estimated NLA shows significant improvement in the postintervention group ($p = 0.02$). Tip projection data were only compared in three primary studies (Ahn et al.,[8] An et al.,[10] and Mo et al.[9]) due to different methods of measurement. The estimated tip projection index of the combined study was 1.09 (CI 0.76, 1.42) assessment using fixed effect models. The result indicated improvement in the estimated tip projection index with a $p < 0.00001$. Meta-analysis of postintervention nasal anthropometrics revealed significant results on the three-parameter outcome (Figure 3).

Table 1
Characteristics of included study.

No	Author	Study Design	Population	Patient Characteristic	Pre-operative nasal anthropometrics	Post-operative nasal anthropometrics	Follow-up duration
1.	Zhang et al	Non-Randomized Intervention Study	38 patients	Adults 18–35 years old, 22 cases of primary surgery and 16 cases of secondary surgery. Not included heavy saddle noses, severe short noses and contracture noses.	- Nasal length: 40.64 ± 4.81 mm - Nasolabial angle (NLA): 95.93 ± 6.12° - Tip projection angle: 87.61 ± 5.81° - Nasofrontal angle (NFA): 138.36 ± 7.25°	- Nasal length: 45.89 ± 5.21 mm - NLA: 101.66 ± 5.17° - Tip projection angle: 86.89 ± 5.21° - NFA: 144.38 ± 6.99	6–12 months
2.	Ahn et al	Non-Randomized Intervention Study	30 patients	Adults with average 31±9 years old, 23 cases of primary surgery, 7 cases of secondary surgery. No specific criteria for exclusion.	- Nasal length: 4.71±0.65 mm - NLA: 94.0±9.3° - Tip projection: 2.66±0.40 mm - NFA 145.7±7.1°	- Nasal length: 5.15±0.53 mm - NLA: 107.2±9.6° - Tip projection: 3.18±0.42 mm - NFA 147.3±5.3	6–14 months
3.	An et al	Non-Randomized Intervention Study	33 patients	Adults 22–46 years old, 29 cases of primary surgery and 4 cases of secondary surgery. No specific exclusion.	- Nasal length: 32.5±91.7 mm - Tip projection index: 14.84±0.9 mm - NLA: 103.6±7.1 º	- Nasal length: 36.04±2.0 mm - Tip projection index: 16.21±0.7 mm - NLA: 103.1±5.0 º	1–36 months
4.	Mo et al	Non-Randomized Intervention Study	38 patients		- Nasal length: 2.27± 0.30 mm - Tip projection ratio: 0.85±0.14 mm - NLA: 90.79±9.33°	- Nasal length: 2.39± 0.32 mm - Tip projection ratio: 0.97±0.15 mm - NLA: 95.09±9.57 º	1–24 months

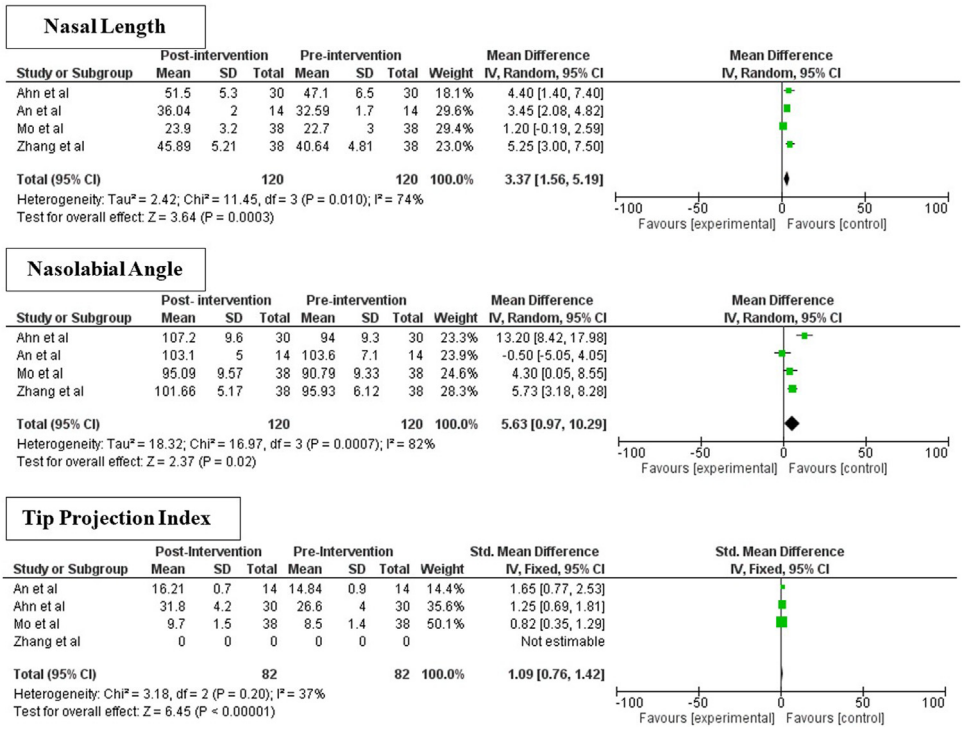

Figure 3. Meta-analysis of the nasal anthropometric outcome including nasal length, nasolabial angle, and tip projection index.

Discussion

Development of a new technique for refining Asian nasal tip surgery has been growing as much as the patient demand for improving facial aesthetics. Pre-operative nasal tip analysis becomes a guide for surgeons in planning the type of graft technique. In the Asian nose, nasal tip is characterized by thick nasal enveloped or underdeveloped middle crus cartilage. Underdeveloped cartilage fails to maintain the nose strength resulting in a weak and narrow framework. This condition often exhibits under-projection of the nasal tip, retracted columella, and wide round nostril. Asian nasal tip deformities could be described in several types which are boxy tip nose, deviated tip nose, and short tip nose. All three types mostly consider nasal tip reconstruction surgery.[11] The tip projection, tip rotation, tip position, and tip definition are baseline knowledge to achieve ideal and natural nasal tip surgery. Tip projection represents the tip height, defined as the distance between the anterior nasal spine to the nasal tip. Tip rotation is depicted as tip angle, measured from the vertical plane of the alar crease to the tip. Tip position refers to the location of the tip along the dorsal line. Tip definition is known as the true aesthetic concept of the tip; the interdome distance determines the tip's width. Lack of nasal tip protrusion and narrow nasal length marked as another feature of Asian tip nose. Tip rotation in the Asian nose is usually needed to improve the nasal length and tip protrusion. The tip definitions were the highlight point created by the dome structure of the nasal tip. The tip-defining points are blunted followed by the wide angle of domal divergence as features of the Asian nose. The thick nasal envelopes particularly camouflage the classification of the nasal tip characterized with a bulbous tip in Asia. These features contribute to tip definition ambiguity in Asian noses.[2,12,13]

The nasal tip can be viewed as a tripod composed of the columella and paired lower-lateral cartilages (Anderson's tripod theory). If one part of the tripod had insufficient support it would alter the tip nose projection. Then the grafting technique position will allow manipulation of the tripod

component namely as nasal tip dynamics. An extended spreader graft between the septum and upper lateral cartilage will open the nasal valve and lengthen the nose. Combination extended spreader graft with an extended SEG in the lower-lateral cartilage to strengthen and lengthen the nasal tip. Columellar strut graft relies on M-arch theory characterized by the "M" figure introduced role of vertical division of lateral crus of alae and medial crus of alae. The vertical divisions had implications on columellar, lobular, and lower-lateral crus presenting tip-defining points. Positioning columellar strut graft shaped as M-arch will increase the length and strength of the medial crura, then maintain a strong framework foundation for tip projection. The four assessed articles in this review explained the different names of nasal tip surgery techniques, but if we look closer at each technique, the purpose of each technique was similar (to strengthen the nasal dorsum using a spreader graft, maintain the projection of nasal tip using SEG, also avoid caudal rotation of columella using columellar strut graft). "Tip nasal cap graft" or "pagoda shape stacked" graft introduced by Zhang et al. and Mo et al. is generally based on the "shield graft" technique with the purpose to define a columellar profile. The graft then craft carefully to fit the columella's normal width. The result of the shield graft defines the "double break" appearance of the columellar, forming "symmetric tip-defining points." Folded ear cartilage graft or double-layered graft using bone graft had a similar purpose to strengthen the nasal tip framework. Various techniques introduced by the four studies analyzed in this review had the advantages of strengthening the nasal tip framework and then increasing tip projection, especially in the Asian nose. Careful pre-operative and post-operative nasal anthropometric examinations are needed to comprehend the improvement of surgical procedures.[2,13–15]

Specific nasal anthropometrics to define ideal and natural-looking nasal tips included the nasofrontal angle (NFA), nasofacial angle (NFcA), nasolabial angle (NLA), and nasal length. The ideal nasal anthropometric of Asians is different from the of Caucasians. Trimartani et al.[3] comparing the facial attractiveness of Caucasian and Southeast Asian by lateral view found several differences. Caucasian had wider nasolabial angles compared with Southeast Asians. Different in the NFA, Southeast Asians had wider nasofrontal (140° vs. 120° respectively) and nasofacial angles (91° vs. 85° respectively) compared with Caucasians. Suhk et al.[13] defined the proportional assessment in Asian aesthetics as based on a triangle assessment constructed by nasal length, nose height, and nasal tip protrusion. The Asian nose has several characteristics of the nasal triangle which are short nasal bridge length, and wider alar made under the projection of the tip nose. Based on this knowledge, the four studies analyzed in this review had successfully conducted careful nasal anthropometric examinations on pre- and post-operatively. This finding will captivate the success of nasal tip surgery to achieve an ideal and natural-looking Asian nose compared with the suture technique for nasal tip. The four studies present as the marked nasal anthropometric improvement after surgery the nasal length, NLA, and tip projection. These three components reveal improvement in the lower structure of the nose and in the projection of the nose. The meta-analysis measure of outcome revealed a significant mean difference in the postintervention group. Previous studies reported that the weakness of Asian nasal cartilage (with an average thickness of 0.2 mm) leads to insufficient support of the tip and sometimes generates graft absorption if we choose the wrong graft or undersized craving graft. Three authors Zhang et al.,[7] Ahn et al.,[8] and Mo et al.[9] added a new technique to strengthen the nasal tip framework which is adding the thickness of graft with double-layered cartilage, bending cartilage without incision, or layering it with bone. Mo et al.[9] added in their study, a trick on bending graft cartilage without incision to develop a mechanically robust unit that maintains support on the graft and strengthens the tip projection. Another explanation of how folded or bending cartilage would strengthen the framework is the principal moment of inertia. The rigid end caudal-septum structure constructed by folding or bending or double-layered graft will act as an axis perpendicular to movement that maintains nasal tip stability and avoids collapse or drawbacks of graft structure after surgery. The post-operative nasal framework examination after an average of 12 months of follow-up marked a satisfactory and good aesthetic result.[7,16,17]

Several explanations above provide knowledge on the best surgical option for nasal tip surgery. However, several factors could compromise tip aesthetic results, including the durability of tip support. Tip support was divided into major structure and minor structure. Major tip structure included (1) size, shape, and flexibility the medial and lateral crura of lower-lateral cartilage, (2) strength of interconnection between medial crura footplate to caudal septum, (3) the inter-domal ligament between

upper-lower-lateral cartilage. The surgeons must consider to protect or repair this interconnective tissue to achieve good durability of the tip support.[18,19]

Other techniques contributing to the correct nasal tip creation were tip rotation and suture technique. Tremp et al.[20] reported an algorithm of nasal tip surgery. The technique includes cranial rotation of tip, lateral crural overlay (LCO), caudal rotation of tip, and transdomal suture. Cranial rotation will allow cephalic resection to correct the boxy tip or overprojected tip. Transdomal suture is a horizontal mattress suture running from the lateral to the medial aspect of the nasal dome resulting in narrowing the tip or supra tip and lengthening the lobule. LCO technique will generate cranial rotation of the tip. This technique is usually done for a long tip nose then results in deprojection and shortening of the nose. Caudal rotation or pushdown technique will result in a downward nasal tip framework mostly suitable for cases of small hump noses. The high septal resection was usually done and then accompanied by lateral and transverse osteotomies for the final procedure. The goal of this procedure is to deproject the tip, pull the bony vault downward, and elongate the nose. However, the four techniques did not fit for the Asian nose profile that needs projection, increased nasal length, and strengthening of the nasal tip framework to support nasal columella caused by underdeveloped nasal tip cartilage. Hence, invigoration of nasal tip framework by using caudal SEG, extended spreader graft, and columellar strut graft were most effective for ideal and natural-looking Asian nasal tip-plasty.[2,14,15]

The limitation of this systematic review is that the included study was in the form of non-randomized intervention research that could possibly generate selection, information, and reporting bias. This condition relies on nasal tip surgery for Asians is a new technique that developed in the recent decade, this condition results in a lack of studies extracted from the medical database. However, the authors minimized the chance of bias with strict eligible criteria, consecutive sampling type, objective measurement, and minimal loss to follow-up. In the end, four of the studies analyzed in this systematic review were categorized as low-level bias studies with good reporting methodology of their study.

Conclusion

Defining the best outcome in nasal tip surgery is balancing nasal length, tip projection, and tip rotation, creating an ideal and natural Asian nose. Nasal tip dynamics understanding such as M-arch theory, tripod theory, and length-projection-rotation become important basic knowledge for surgeons to achieve ideal nasal tip outcomes. Open rhinoplasty techniques for nasal tips discussed in this review show robust durability when implemented for Asian nasal tips. These techniques suggest folding without incision and bending the graft with bone particles will strengthen the nasal tip framework and avoid drawbacks of the graft after surgery, especially for Asian noses. Combining graft techniques such as spreader graft, caudal SEG, and shield graft has proven abundant effects on the Asian nose. For future implementation, a better study conducted with a better methodology such as RCT is needed to strictly limit the bias.

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Declaration of Competing Interest

None declared.

Ethical approval

Not required.

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