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Comparison on functional and esthetic outcomes between single and combined surgery to crooked nose deformities

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Summary *Background:* Nose deviation deformities pose a complex cosmetic and functional problem. The most common surgical intervention to manage such deformities is septorhinoplasty, typically performed by a plastic surgeon or a rhinologist. This study investigated the effect of a combined operation by a plastic surgeon and rhinologist, comparing them with those operations performed singlehandedly by a plastic surgeon.
Methods: From January 2017 to January 2022, 99 patients with deviated noses were treated. Fifty-nine underwent the combined operation, whereas 40 underwent surgery performed by a plastic surgeon. In the combined operation group, the rhinologist performed endonasal septoplasty and turbinoplasty, while the plastic surgeon performed open rhinoplasty, osteotomies, caudal septal deviation correction, camouflage procedure, esthetic enhancement, and dorsal augmentation. Subsequently, the rhinologist checked the airway and applied a nasal tamponade. Treatment outcomes were evaluated using the Rhinoplasty Health Inventory and Nasal Outcomes (RHINO) questionnaire and incidence of postoperative complications.
Results: Of the 79 patients who responded to the RHINO questionnaire, 33 underwent an operation by a plastic surgeon, whereas 46 underwent the combined operation. All cases showed improved scores on the RHINO questionnaire postoperatively, with significantly higher scores in the combined group ($p = 0.032$). Furthermore, the combined group showed more significant

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improvements in function-related questions, despite longer total operation durations. The overall complication rate was 10.1%.
Conclusion: A combined surgical correction for deviated nose by a plastic surgeon and rhinologist could provide better subjective outcomes, especially in functional outcomes.

A crooked or deviated nose refers to any deviation of the nasal dorsum and pyramid from the facial midline.[1] It could be congenital or secondary to trauma or surgical interventions. Correcting the crooked nose remains one of the most challenging and complicated surgical problems, as it involves interventions for both the external appearance and nasal airway function. This challenge is commonly compounded by patient dissatisfaction with their appearance and nasal discomfort.[2-8] Therefore, the surgeon must possess sufficient surgical knowledge, ranging from nasal anatomy to dynamic respiratory function.[1] The aim of corrective surgery may either be anatomical and functional restoration or esthetic improvement.[1]

Nowadays, such surgeries are performed by rhinoplasty surgeons, who may be either plastic surgeons or rhinologists. Due to differences in concerns and training backgrounds, plastic surgeons and rhinologists may face challenges in achieving comprehensively satisfactory results, especially in functional and esthetic improvements. Therefore, combining these two surgical backgrounds may enable patients to obtain satisfactory esthetic and functional results.

This study evaluated the results of a combined surgery performed by a plastic surgeon and a rhinologist in achieving comprehensive correction for crooked nose in terms of anatomical, functional, and camouflage aspects. All-inclusive, regular follow-up was performed at two department clinics. To the best of our knowledge, this is the first study investigating the collaboration between a plastic surgeon and a rhinologist in performing crooked nose correction surgery. The outcomes were evaluated objectively using surgical data, and subjectively using the Rhinoplasty Health Inventory and Nasal Outcomes (RHINO) questionnaire.

Materials and methods

Patient information and data collection

This retrospective study was conducted at Chang Gung Memorial Hospital from January 2017 to January 2022. The study was approved by the institutional review board (IRB ID: 202201512B0) of Chang Gung Memorial Hospital. A total of 99 patients were enrolled, 40 of whom underwent rhinoplasty by a plastic surgeon alone (Y-C Hsiao), and 59 underwent a collaborative operation involving both a plastic surgeon (Y-C Hsiao) and a rhinologist (T-J Lee). The patients in the combined operation group had visited the ENT clinic prior to visiting the plastic surgeon's clinic for deviated nose correction. Conversely, the patients in the plastic surgeon group visited only the plastic surgeon clinic. Demographic data, including sex, age, etiology of the deviated nose, admission details, surgical data, postoperative follow-up details, and associated management, were collected. Patients with a follow-up period of less than 6 months, mental disorders, general anxiety disorder, and incomplete data were excluded from the study.

Surgical technique

All operations were performed under general anesthesia. For symptom relief in nasal obstruction, the rhinologist performed endonasal septoplasty, submucosal resection, and inferior turbinoplasty. Nasal valve adjustment and reconstruction were performed using multiple cross-stitch sutures for eligible patients. For two patients with empty nose syndrome, the rhinologist performed inferior turbinate reconstruction using polyethylene, Medpor® (Stryker, Inc., Kalamazoo, Michigan), and autograft. After the rhinologist completed their segment of the surgery, the plastic surgeon (Y-C Hsiao) performed open rhinoplasty, which included septoplasty, osteotomies, humpectomy, and other esthetic enhancements such as dorsal augmentation, alar reduction, and camouflage grafting. At the end of the surgery, the rhinologist checked the airway and applied a nasal tamponade with nasonex-soaked nasopores. A nasal splint was applied before the patient awoke from the anesthesia.

Assessing rhinoplasty outcomes using the questionnaire

Due to the COVID-19 pandemic, arranging rhinomanometry for objective functional results was difficult. The RHINO questionnaire is a validated instrument for assessing the functional and aesthetic outcomes after rhinoplasty (see Supplementary material 1, RHINO questionnaire).[9,10] It is a 10-item questionnaire, with each item scored on a Likert scale from 1 to 5, with high numbers indicating greater satisfaction. The final score is a summation of the item scores multiplied by 2, with the highest possible score being 100 points.[10] The questionnaire was filled out retrospectively at the postoperative clinic visit and covered questions on details before the surgery and 6 months after the operation.

Statistical analysis

The chi-square test and Fisher's exact test were used to compare the outcomes between the plastic surgeon and

combined operation groups, whereas Student's t-test was used to evaluate the differences in operation, admission, and follow-up durations. All statistical analyses were performed using SPSS 26.0 (IBM, Chicago, IL, USA). A p-value of < 0.05 was considered statistically significant.

Results

In total, 99 patients were enrolled in the study, and the demographic data are listed in Table 1. The mean age was 32.58years (range 17–64 years). In the plastic surgeon group, 57.5% (n = 23) of the patients were male, whereas only 33.8% (n = 20) of patients were male in the combined group, indicating a significant difference (p = 0.020). Of the 99 patients, 72.7% (n = 72) were primary rhinoplasty cases, without significant difference between the two groups (72.5% vs. 72.9%, respectively). In the plastic surgeon group, 50.0% (n = 20) of patients had a trauma-related nasal deformity, whereas only 15.3% (n = 9) in the combined group had the condition (p < 0.001). The mean follow-up duration was 373.03 days (range, 180–1623 days). Although the follow-up was longer in the combined group than in the plastic surgeon group (411.64 vs. 316.08 days, respectively), the difference was not significant.

The operation duration was longer in the combined group (229.49 vs. 400.11 min, respectively; p = 0.000) (Table 2). Among the combined group patients, 79.7% were admitted to the ward for operation, compared to only 25.0% in the plastic surgeon group (p = 0.00). The overall admission duration was 3.14 ± 0.7 days. Regarding the operation details, 32 patients (32.3%) underwent dorsal augmentation, 23 (23.2%) underwent humpectomy, 5 (5.1%) underwent alar reduction, and 25 (25.3%) underwent paranasal and/or glabellar and/or radix augmentation. No differences were found between the two groups for the mentioned procedures (Figure 1). Other surgery details, including dorsal augmentation material, nasal bone osteotomy, or tip graft, are described in Supplementary material 2.

The recorded complications included infection, patient dissatisfaction with esthetic outcomes, and no improvement in symptoms postoperatively. The total complication rate was 10.1% (n = 10), involving 6 patients (10.2%) in the combined group and 4 (10.0%) in the plastic surgeon group. Two patients (3.39%) developed an infection in the combined group, while no patients had any in the plastic surgeon group. Three patients (7.5%) in the plastic surgeon group and (3.39%) in the combined group were dissatisfied with the esthetic outcomes. Two patients (3.39%) in the combined group and 1 (2.5%) in the plastic surgeon group showed no improvement in symptoms (Table 3).

The overall response rate to the RHINO questionnaire was 79.8% (n = 79), with 33 responses from the plastic surgeon group and 46 from the combined group. The mean preoperative score was similar between the two groups: 68.30 ± 14.0 in the plastic surgeon group and 63.52 ± 18.55 in the combined group (Table 4). The postoperative scores differed significantly between the two groups (p = 0.032), with 86.18 ± 10.04 in the plastic surgeon group and 90.87 ±

Table 1 Demographic data.

	Plastic surgeon (n = 40)	Combine (n = 59)	Overall (n = 99)	p value
Age, year	32.33 (19–64)	32.75 (17–57)	32.58 (17–64)	0.828
Gender, male	23 (57.5%)	20 (33.8%)	46 (46.5%)	0.020
Operation				0.967
Primary	29 (72.5%)	43 (72.9%)	72 (72.7%)	
Secondary	11 (27.5%)	16 (27.1%)	27 (27.3%)	
Classification				< 0.001
Trauma	20(50.0%)	9 (15.3%)	29 (29.3%)	
Nontraumatic	20 (50.0%)	50 (84.7%)	70 (70.7%)	
Follow-up duration (days)	316.08 (180–643)	411.64 (180–1623)	373.03 (180–1623)	0.057

Demographic data of included patients, 40 patients received operation by a plastic surgeon (Plastic surgeon group, left) and 59 underwent the combined operation (Combine group, right). There was significant difference in gender and cause of crooked nose.

Table 2 Operation details.

	Plastic surgeon (n = 40)	Combine (n = 59)	Overall (n = 99)	p value
Operation duration (min)	229.49 (88–460)	400.11 (194–652)	328.56 (88–652)	0.000
Admission				0.000
Admission before surgery	10 (25.0%)	47 (79.7%)	57 (57.6%)	
Outpatient surgery	30 (75.0%)	12 (20.3%)	42 (42.4%)	
Admission duration (days)	2.80 ± 0.4	3.21 ± 0.7	3.14 ± 0.7	0.087
Additional procedures				
Dorsal augmentation	13 (32.5%)	19 (32.2%)	32 (32.3%)	0.975
Humpectomy	7 (17.5%)	16 (27.1%)	23 (23.2%)	0.266
Paranasal/glabella/radix augmentation	9 (22.5%)	16 (27.1%)	25 (25.3%)	0.604
Alar reduction	1 (2.5%)	4 (6.8%)	5 (5.1%)	0.353

Operation details including operation duration, admitted to the ward or not, and performed additional procedure revealed that operation duration and admitted to the ward or not had significant difference.

Figure 1 Case presentation. A 45-year-old female with crooked nose received the combine operation. (a-d): preoperative frontal/right lateral/right 45°/left 45° view and (e-h): postoperative one year follow frontal/right lateral/right 45°/left 45°/frontal view.

Table 3 Complications.

	Plastic surgeon (n = 40)	Combine (n = 59)	Overall (n = 99)	p value
Total complications	4 (10.0%)	6 (10.2%)	10 (10.1%)	0.244
Infection	0	2 (3.39%)	2 (2.0%)	
Patient unsatisfied with appearance	3 (7.5%)	2 (3.39%)	5 (5.05%)	
Symptom not improved	1(2.5%)	2 (3.39%)	3 (3.0%)	

Total complications showed 10.1%, including infection, patient unsatisfied with appearance, and symptom not improved.

7.69 in the combined group. When functional and esthetic items were assessed separately, the function-related items had lower preoperative scores in the combined than in the plastic surgeon group (36.73 ± 11.14 vs. 30.04 ± 10.84, respectively; p = 0.009). However, no significant difference was found between the two groups in the postoperative score (43.88 ± 6.06 vs. 45.52 ± 5.37; p = 0.217), although the combined group showed a much better average score (7.15 ± 11.11 vs. 15.48 ± 11.81, respectively; p = 0.002) (Table 5). As for esthetic-related items, a lower preoperative score was noted in the plastic surgeon group, although the difference was not significant (31.58 ± 7.74 plastic surgeon group vs. 33.48 ± 10.08 combined group; p = 0.346). Postoperatively, the plastic surgeon group showed an improved score of 10.73 ± 7.38 compared to 11.87 ± 9.57 in the combined group (p = 0.568).

Discussion

Deviated nose correction is one of the most challenging operations for a rhinoplasty surgeon because it involves bone and cartilage correction, as well as nasal valve and turbinate correction while maintaining structural support

Table 4 RHINO questionnaire score.

	Plastic surgeon (n = 33)	Combine (n = 46)	p value
Preoperation score (mean)	68.30 ± 14.0	63.52 ± 18.55	0.053
Postoperation score (mean)	86.18 ± 10.04	90.87 ± 7.69	0.032
Post-pre score	17.88 ± 15.31	27.35 ± 18.97	0.179

RHINO questionnaire score revealed after operation combine group had significant higher score than plastic surgeon group.
Post-pre score: improvement of score amount after operationally, comparing with before operation status.

Table 5 RHINO questionnaire-separate functional and esthetic aspect.

	Plastic surgeon (n = 33)	Combine (n = 46)	p value
Prefunction	36.73 ± 11.14	30.04 ± 10.84	0.009
Postfunction	43.88 ± 6.06	45.52 ± 5.37	0.217
Post-prefunction	7.15 ± 11.11	15.48 ± 11.81	0.002
Pre-esthetic	31.58 ± 7.74	33.48 ± 10.08	0.346
Post-esthetic	42.30 ± 5.64	45.35 ± 3.32	0.004
Post-pre-esthetic	10.73 ± 7.38	11.87 ± 9.57	0.568

Separate function and esthetic items in the RHINO questionnaire noted combine group had gain significant score after operation comparing with plastic surgeon group.
Pre: before the operation, Post: after the operation, Post-pre: improvement of the score after the operation.

and improving esthetic appearance.[2,3,5,11] In undertaking such a complicated situation, the plastic surgeon takes advantage of manipulating nasal soft tissue and the osseocartilaginous framework with a camouflaging onlay graft, whereas the rhinologist approaches the case with a view of the functional anatomy, including the nasal valve, septum, and turbinate.[12] The combined expertise of these two specialists may achieve superior functional restoration through the rhinologist and satisfactory esthetic outcome through the plastic surgeon while lowering the complication rate with the adoption of precise surgical methods.

The study included 99 patients who underwent deviated nose surgical correction through one of the two approaches. The demographic data were similar between the two groups, although more male patients and more trauma-related cases were observed in the plastic surgeon group. The admission rate was much higher in the combined operation group due to the different protocol. The operation duration was also significantly longer in the combined group. However, dividing the surgical dates into two periods, the first 3 years (2017–2019, n = 38) and the last 3 years (2020–2022, n = 16), revealed that the mean operation duration had decreased significantly, from 416 min to 361.38 min, a difference of 54 min (p = 0.006). This may be due to the maturation of interdisciplinary cooperation, no matter the surgeon's teamwork and nursing staff's acclimatization, and shortening unnecessary waiting, preparation, and communication times. The duration of the operation had shortened but there was no difference of RHINO questionnaire score within the combined group over time.

The total complication rate was 10.1%, including 2% from infections, 5% from patient dissatisfaction with esthetic outcome, and 3% of persistent symptoms. No septal perforations, excessive bleeding, or ocular complications, which are possible complications, were observed after rhinoplasty.[13–15] The infection rates were similar to those reported in the literature, and both of the affected patients were treated with oral antibiotic treatment without surgical intervention.[16]

Rhinomanometry is a tool specifically used to evaluate objective dynamic nasal airway resistance.[17] However, due to the COVID-19 pandemic, the examination was difficult to arrange, especially because it required patients to remove their face masks. Instead, the RHINO questionnaire was applied to evaluate subjective functional and aesthetic outcomes. While the preoperative status score was higher in the plastic surgeon group, the postoperative status score was higher in the combined group. Although there was no statistically significant difference, the increase of score after operation was higher in the combined group. (17.88 vs. 27.35 for the plastic surgeon and combined groups, respectively). In function-related questions, a significantly improved score was noted in the combined group, indicating improvements in nasal obstruction symptoms postoperatively. Predictably, the patients in the combined group expected more functional improvements, whereas those in the plastic surgeon group had higher expectations about esthetic outcomes. In addition, there are more traumatic caused nasal deviation male patients in the plastic surgeon group, who may have higher expectation about esthetic outcome then functional outcome. These factors might explain the lower scores in the plastic surgeon group for the esthetic-related questions, although the same plastic surgeon performed the operation in both groups.

The study has certain limitations. The main limitation was its retrospective design and the retrospective manner of completing the questionnaire due to COVID-19 restrictions. In addition, the study enrolled a relatively small number of patients without objective measurement. Further studies are warranted to ensure the objectivity of results, including rhinomanometry and imaging studies as needed. Moreover, there is potentially an issue with selection bias with the nonblinding of participants and surgeons to group allocation when comparing the two treatments. As it was hard to randomize patients into either getting combined surgery or simply having an esthetic surgery, the authors created two separate and self-selecting groups, leading to heterogeneity between the two groups of patients. However, in both groups, patients underwent open rhinoplasty procedures performed by the same surgeon using same standard. Therefore, the bias according to the procedures are little but existing in the patient selection.

Our study demonstrates that a collaborative approach to crooked nose surgical correction can result in better subjective outcomes, especially in esthetic considerations. The operation duration may be longer than the one-surgeon approach, and the learning curves may be longer due to the uncommon collaboration between two teams, not only for the surgeons but also the nursing staff. However, after overcoming such challenges, the surgical team can provide better outcomes for patients.

Ethical approval

The Ethics Committee for Human Research, Linkou Chang Gung Memorial Hospital, Taiwan, approved the study.

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Conflict of interest

All authors declare that they have no conflicts of interest.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.bjps.2024.11.026.

References

1. Akkina SR, Most SP. Treatment of the crooked nose. *Clin Plast Surg* 2022;**49**(1):111–21.
2. Byrd HS, Salomon J, Flood J. Correction of the crooked nose. *Plast Reconstr Surg* 1998;**102**(6):2148–57.
3. Kosins AM, Daniel RK, Nguyen DP. Rhinoplasty: the asymmetric crooked nose-an overview. *Facial Plast Surg* 2016;**32**(4):361–73.
4. Jianfang Z, Lifeng X, Yonghuan Z, et al. Endoscopy-assisted 1-stage correction of the crooked nose airway function and aesthetic morphology. *Ann Plast Surg* 2021;**86**(3S 2):S239–43.
5. Gode S, Benzer M, Uslu M, et al. Outcome of in situ septoplasty and extracorporeal subtotal septal reconstruction in crooked noses: a randomized self-controlled study. *Aesthetic Plast Surg* 2018;**42**(1):234–43.
6. Stepnick D, Guyuron B. Surgical treatment of the crooked nose. *Clin Plast Surg* 2010;**37**(2):313–25.
7. Hsiao YC, Chang CS, Chuang SS, et al. Forty-five degree cutting septoplasty. *Plast Surg* 2016;**24**(3):199–203.
8. Rohrich RJ, Ahmad J. Rhinoplasty. *Plast Reconstr Surg* 2011;**128**(2):49e–73e.
9. Haddady Abianeh S, Moradi Bajestani S, Rahmati J, et al. Evaluation of aesthetic and functional outcomes after open rhinoplasty: a quasi-experimental study by the aid of ROE and RHINO questionnaires. *Aesthetic Plast Surg* 2021;**45**(2):663–9.
10. Lee MK, Most SP. A comprehensive quality-of-life instrument for aesthetic and functional rhinoplasty: the RHINO scale. *Plast Reconstr Surg Glob Open* 2016;**4**(2):e611.
11. Pascali M, Boccieri A, Carinci F, et al. Treatment of the crooked nose: the final steps to perfection. *J Craniofac Surg* 2017;**28**(2):372–8.
12. Rohrich RJ, Krueger JK, Adams Jr. WP, et al. Rationale for submucous resection of hypertrophied inferior turbinates in rhinoplasty: an evolution. *Plast Reconstr Surg* 2001;**108**(2):536–44. discussion 545-536.
13. Cochran CS, Landecker A. Prevention and management of rhinoplasty complications. *Plast Reconstr Surg* 2008;**122**(2):60e–7e.
14. Dabrowska-Bien J, Skarzynski PH, Gwizdalska I, et al. Complications in septoplasty based on a large group of 5639 patients. *Eur Arch Otorhinolaryngol* 2018;**275**(7):1789–94.
15. Wu B, Chen S, Sun K, et al. Complications associated with rhinoplasty: an umbrella review of meta-analyses. *Aesthetic Plast Surg* 2022;**46**(2):805–17.
16. Toriumi DM, Kowalczyk DM, Cristel RT, et al. Evaluation of postoperative infection rates in 3084 rhinoplasty cases using antibiotic soaks and/or irrigations. *Facial Plast Surg Aesthet Med* 2021;**23**(5):368–74.
17. Zhao R, Chen K, Tang Y. Effects of functional rhinoplasty on nasal obstruction: a meta-analysis. *Aesthetic Plast Surg* 2022;**46**(2):873–85.