Original Article

Stability of Nasal Morphology Following Post-Surgical Nasal Stent in Patients with Unilateral Cleft Lip and Palate

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Abstract

Background: Despite advances in cleft treatment, postoperative nasal relapse remains a challenge in patients with unilateral cleft lip and palate (UCLP). Nasal stents are widely used to maintain nasal symmetry; however, the optimal duration of postoperative stenting remains unclear. **Objective:** To compare the stability of nasal morphology one year after three versus six months of postoperative nasal stent use in patients with UCLP. **Materials and methods:** This retrospective cohort study included 12 patients with UCLP (n = 6 per group). Three-dimensional photogrammetric analysis was performed at five time points: immediately after cheiloplasty (T0), at stent termination (T1), and 3 (T2), 6 (T3), and 12 months (T4) after discontinuation. Within-group comparisons were performed using paired t-tests or Wilcoxon signed-rank tests, and between-group comparisons using independent t-tests or Mann–Whitney U-tests. **Results:** Alar base width and nostril width increased, whereas nostril height and lip-columella crease to soft triangle distance decreased in both groups. Columella deviation remained stable throughout the observation period. No significant between-group differences were detected for any measurement, and symmetry ratios remained relatively high throughout the observation period. **Conclusion:** Gradual postoperative changes in nasal morphology were observed. No significant differences were detected between the three- and six-month groups. These findings suggest that extending postoperative nasal stent use beyond three months may provide limited additional benefit. Larger prospective studies are needed to determine the optimal duration of postoperative nasal stenting.

Keywords: Cleft lip and palate, Nasal morphology, Nasal stent, Postoperative stability

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Introduction

Nasal deformity represents one of the most significant aesthetic concerns among patients with unilateral cleft lip and palate (UCLP). Investigations evaluating patient satisfaction with treatment outcomes have demonstrated that nasal appearance constitutes the least satisfactory aspect, followed closely by lip aesthetics.[1,2] Nasal asymmetry arises from aberrant muscle insertion, resulting in a depressed nasal dome, shortened columella, and widened alar base on the affected side.[3-5] To address these anatomical abnormalities, presurgical nasal molding in conjunction with primary lip and nasal surgery is performed to optimize nasal morphology. However, inherent tissue memory and scar contracture following primary lip and nasal repair may precipitate surgical relapse.[6,7]

To preserve nasal symmetry following surgical correction, nasal stents are employed to minimize nasal deformity relapse by externally molding the surrounding alar cartilage and counteracting the forces of scar contracture.[6,8-11] Various nasal stent designs exist, designated by different nomenclature, including "nostril retainer",[12] "nasal splint",[7] and "nostril splint".[13,14] Nevertheless, a standardized protocol for the optimal duration of nasal stent wear has not been established. Recommended durations vary considerably, with suggestions ranging from full-time utilization for 3 to 12 months post-surgery.[7,9,13,15,16]

The present institution recommended full-time post-surgical nasal stent utilization for six months. However, clinical observations revealed that patient tolerance varied over time; certain patients experienced difficulty with stent compliance, while others demonstrated adequate tolerance. Typically, at approximately 7 to 8 months of age, or following approximately three months of utilization, some patients began exhibiting behaviors such as nasal rubbing or stent removal. Consequently, caregivers frequently discontinued stent use earlier than initially recommended, resulting in abbreviated utilization duration.

Although various postoperative nasal stent protocols have been reported, evidence directly comparing different stent durations remains limited. If a shorter postoperative nasal stent wear period yields comparable stability in postoperative nasal morphology, reducing the recommended wear period could lessen the burden on caregivers and improve treatment adherence. It was hypothesized that three months of postoperative nasal stent use would provide nasal morphology stability comparable to that of six months of use. Given the absence of a standardized protocol regarding postoperative nasal stent wear duration, this investigation aimed to evaluate the stability of nasal morphology one year following post-surgical nasal stent discontinuation in patients with unilateral cleft lip and palate by comparing three-month and six-month postoperative nasal stent use.

Materials and methods

This retrospective cohort study received ethical approval from the Khon Kaen University Ethics Committee for Human Research (HE651588).

Three-dimensional photographic records and operative data were retrieved from the database of the Center of Cleft Lip-Cleft Palate and Craniofacial Deformities at Khon Kaen University. This retrospective investigation included 12 patients who underwent primary surgical repair of cleft lip and nasal deformity between 2021 and 2022. All patients received comprehensive treatment at this center. Patient selection was based on the following inclusion criteria: (1) non-syndromic unilateral cleft lip and palate; (2) age at the time of surgery between 3 and 6 months; and (3) surgical intervention performed at Srinagarind Hospital, Khon Kaen University. The exclusion criteria were (1) patients with systemic diseases that may interfere with soft tissue healing, and (2) patients who declined to utilize post-surgical nasal stents. All patients had non-syndromic unilateral complete

clefts of primary and secondary palate and received the same treatment protocol at the cleft center. The protocol consisted of presurgical nasoalveolar molding (NAM), primary cheiloplasty using the modified rotational advancement technique (with or without primary rhinoplasty) between 3 and 6 months of age, followed by the same postoperative nasal stent protocol. Following the surgical procedure, an appropriately sized Nasal Creator Device (Neo Plastomer Co; Ltd; Bangkok, Thailand), a specific nasal stent variant employed at this institution, was applied immediately in the operating room and retained within the patient's nostrils.

Each patient attended a follow-up appointment with a plastic and reconstructive surgeon at two weeks post-surgery to evaluate wound healing and monitor for signs of infection. Following this initial assessment, patients were referred to the Orthodontic Clinic for subsequent follow-up appointments throughout the duration of Nasal Creator Device utilization. During follow-up visits, device retention and size were routinely assessed. The device size was changed when clinically indicated according to nasal growth to ensure an appropriate fit throughout the treatment period. The Nasal Creator Device was available in the following sizes: XS, S, M, L, XL, XXL, EM, and EL. Instructions regarding Nasal Creator Device utilization and maintenance were provided to caregivers in accordance with the institution's standard protocol, which mandated full-time wear for six months. Caregivers were also advised to notify the orthodontist immediately if the patient experienced difficulty tolerating the device. Following discontinuation of Nasal Creator Device utilization, patients were scheduled for follow-up appointments at 3, 6, and 12 months. During each visit, both two-dimensional and three-dimensional photographs were obtained to monitor outcomes and document changes in nasal morphology.

Patient data were stratified into two cohorts based on postoperative nasal stent utilization. Group 1 comprised patients who utilized the Nasal Creator Device for approximately three months prior to discontinuation, while Group 2 included patients who adhered to the institutional protocol and utilized the device for six months. Although the institutional protocol recommended full-time nasal stent use for six months, the actual duration of stent utilization varied among patients and was consistently documented during follow-up visits. Accordingly, patients were grouped retrospectively based on their actual duration of nasal stent use. Patients who discontinued nasal stent use at approximately three months because of reduced tolerance were classified into the three-month group. Patients who were unable to tolerate the nasal stent from the first postoperative month and formally declined its use were classified as non-compliant and were therefore excluded from the analysis. In contrast, patients who demonstrated good compliance and were able to continuously use the nasal stent for approximately five to six months were classified into the six-month group.

Three-dimensional photographs were acquired using the H3 Lumio 3D Face Scanner (LUMIO 3D Co; Ltd; Bangkok, Thailand), with calibration performed in accordance with the manufacturer's guidelines. During image acquisition, each infant was gently supported in an upright position by the caregiver and directed to look forward. Because this was a retrospective study, photographs were obtained by the treating dentists during routine clinical follow-up. The three-dimensional images were subsequently imported into (Dolphin Imaging software; Chatsworth; CA, USA). Before landmark identification, all three-dimensional images were reoriented by aligning the interpupillary line parallel to the horizontal plane. The model was then adjusted to obtain a basilar view in which both nostrils and nasal tip were clearly visible. All measurements were subsequently performed using the same viewing orientation. A set of three-dimensional photographs for each patient was selected from five distinct time points: immediately

Table 1 The description of 14 landmark points

Landmarks	Point	Location
RAl	Right alare	The most infero-lateral point on the right alar contour
LAl	Left alare	The most infero-lateral point on the left alar contour
RUIN	Right upper inner rim of the nostril	The midpoint on the upper inner rim of the nostril on the right side
LUIN	Left upper inner rim of the nostril	The midpoint on the upper inner rim of the nostril on the left side
RLIN	Right lower inner rim of the nostril	The midpoint on the lower inner rim of the nostril on the right side
LLIN	Left lower inner rim of the nostril	The midpoint on the lower inner rim of the nostril on the left side
RMNM	Right medial nostril margin	The most medial nostril margin on the right side
LMNM	Left medial nostril margin	The most medial nostril margin on the left side
RLNM	Right lateral nostril margin	The most lateral nostril margin on the right side
LLNM	Left lateral nostril margin	The most lateral nostril margin on the left side
RSMN	Right superior-medial of the nostril	The most superior-medial point of the right nostril margin
LSMN	Left superior-medial of the nostril	The most superior-medial point of the left nostril margin
RIMN	Right inferior-medial of the nostril	The most inferior-medial point of the right nostril margin
LIMN	Left inferior-medial of the nostril	The most inferior-medial point of the left nostril margin

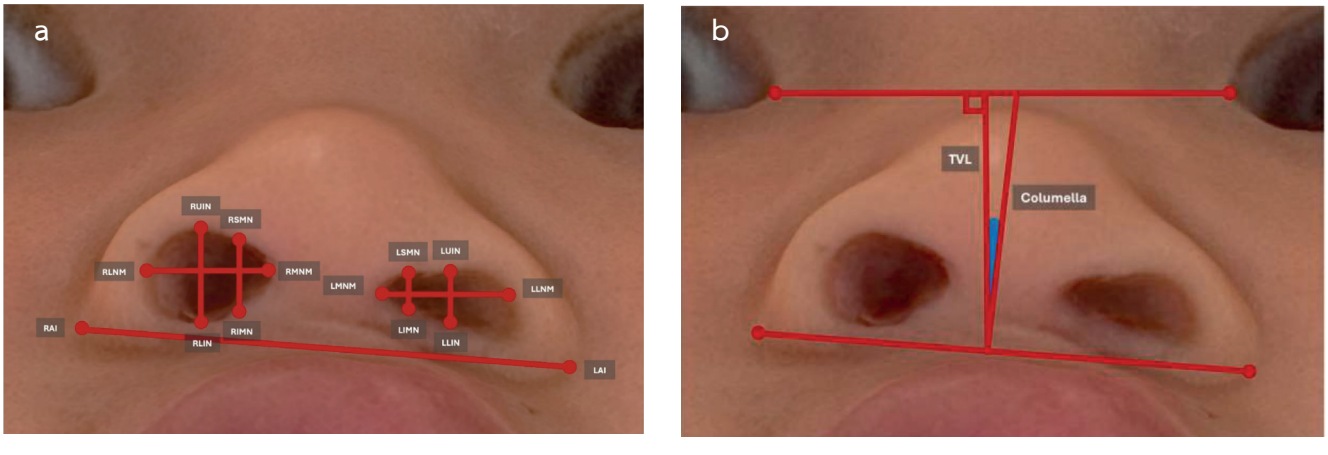


Figure 1 Nasal measurements used to evaluate nasal morphology in basilar view.
(a) Alar base width (RAl-LAl), nostril height (RUIN-RLIN, LUIN-LLIN), nostril width (RMNM-RLNM, LMNM-LLNM), lip-columella crease to soft triangle distance (RSMN-RIMN, LSMN-LIMN). (b) Columella deviation: The angle between the columella and the true vertical line (TVL). The true vertical line is perpendicular to the line formed by connecting the medial canthi.

post-cheiloplasty (T0), upon termination of Nasal Creator Device utilization (regardless of three-month or six-month duration) (T1), three months following device discontinuation (T2), six months following device discontinuation (T3), and one year following device discontinuation (T4). Each photograph was analyzed from the basilar view.

Measurements encompassed four linear dimensions and one angular measurement—alar base width, nostril height, nostril width, lip-columella crease to soft triangle distance, and columella deviation—derived from 14 anatomical landmarks (Table 1). All measurements were performed on three-dimensional surface images, as illustrated in Figure 1.

Definition of measurements

(1) Alar base width: The distance between the most inferolateral points of the alae. (RAl-LAl) (2) Nostril height: The distance from the upper inner rim of the nostril to the lower inner rim of the nostril. (RUIN-RLIN, LUIN-LLIN) (3) Nostril width: The horizontal distance between the most medial nostril margin and the most lateral nostril margin (RMNM-RLNM, LMNM-LLNM) (4) Lip-columella crease to soft triangle distance: The distance between the most superior-medial and the most inferior-medial of the nostril. (RSMN-RIMN, LSMN-LIMN) (5) Columella deviation: The angle between the columella and the true vertical line (TVL). The true vertical line is perpendicular to the line formed by connecting the medial canthi.

All measurements were performed by a single examiner, who was calibrated with an experienced cleft orthodontist before data collection. To assess inter-examiner reliability, 15 three-dimensional images from three randomly selected patients (all five time points per patient) were independently measured by both examiners. To assess intra-examiner reliability, the same 15 images were remeasured by the primary examiner after a one-month interval. Patient identifiers were replaced with study identification numbers during image analysis. Examiner blinding was not performed because the primary examiner was responsible for image preparation, including reorientation by aligning the interpupillary line before landmark identification.

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 28.0.1.1 (IBM Corp; Armonk; NY, USA). Data normality was assessed using the Shapiro–Wilk test. Baseline comparisons between the two groups were performed using the independent t-test. Within-group comparisons between T1 and T4 were performed using the paired t-test for normally distributed data and the Wilcoxon signed-rank test for non-normally distributed data. Between-group comparisons of nasal morphology changes were performed using the independent t-test for normally distributed data and the Mann–Whitney U-test for non-normally distributed data. Statistical significance was set at $P < 0.05$. Intra- and inter-examiner reliability were assessed using intraclass correlation coefficients (ICC).

Nasal symmetry was evaluated using the nostril height ratio, nostril width ratio, and lip-columella crease to soft triangle distance ratio. Each ratio was calculated as the measurement on the cleft side divided by the corresponding measurement on the non-cleft side.

Results

This investigation included 12 patients (7 males and 5 females) with a mean age of 4.50 ± 0.20 months at the time of surgery. Patients were stratified into two cohorts based on the duration of post-surgical Nasal Creator Device utilization. Group 1 (n = 6) utilized the device for three months post-surgery, with a mean age at surgery of 4.70 ± 0.30 months. Group 2 (n = 6) utilized the device for six months post-surgery, with a mean age at surgery of 4.20 ± 0.10 months. Regarding laterality of the condition, nine cases presented with left unilateral cleft lip and palate, while three cases presented with right unilateral cleft lip and palate. Ten patients completed the presurgical nasoalveolar

molding (NAM) protocol before primary cheiloplasty, and primary rhinoplasty was performed in four patients (Table 2). Baseline nasal morphology at T0 was comparable between the three-month and six-month groups, with no statistically significant differences observed for any measurement (Table 3).

Intra- and inter-examiner reliability were high, with ICC values ranging from 0.993 to 0.999.

Table 2 Baseline characteristics of the patients

Measurements	3-month group	6-month group	All patients
Number of patients (n)	6	6	12
Gender (n)			
Female	1	4	5
Male	5	2	7
Age at T0 (Mean ± SD, month)	4.68 ± 0.33	4.23 ± 0.12	4.45 ± 0.19
Side (n)			
Left	3	6	9
Right	3	0	3
Completed presurgical NAM (n)	5	5	10
Primary rhinoplasty (n)	2	2	4

Table 3 Baseline nasal morphology at T0

Measurements	3-month group (Mean ± SD)	6-month group (Mean ± SD)	*P* value
Alar base width (mm)	27.58 ± 2.14	25.95 ± 2.42	0.244
Nostril height (mm)			
Cleft side	4.81 ± 0.88	4.33 ± 1.16	0.434
Non-cleft side	5.72 ± 0.26	5.78 ± 0.35	0.717
Nostril width (mm)			
Cleft side	6.03 ± 0.71	6.08 ± 1.33	0.937
Non-cleft side	6.03 ± 0.71	5.56 ± 0.85	0.310
Lip-columella crease to soft triangle distance (mm)			
Cleft side	3.06 ± 0.56	3.20 ± 0.83	0.751
Non-cleft side	3.12 ± 0.63	3.42 ± 0.26	0.310
Columella deviation (degree)	7.15 ± 2.89	7.25 ± 2.39	0.949

Statistical significance was determined using the independent t-test.

Table 4 Comparison of nasal morphology at T1

Measurements	Mean ± SD		*P* value	Difference between T1 and T4 (Mean ± SD)
	T1	T4		
Alar base width (mm)				
3-month group	29.42 ± 1.94	31.48 ± 1.69	<0.001[a***]	2.07 ± 0.68
6-month group	27.60 ± 1.66	29.63 ± 1.76	0.004[a**]	2.03 ± 0.99
Nostril height (mm)				
Cleft side				
3-month group	4.15 ± 0.44	3.53 ± 0.47	<0.001[a***]	-0.62 ± 0.19
6-month group	3.82 ± 0.62	3.30 ± 0.36	0.21[a*]	-0.52 ± 0.38
Non-cleft side				
3-month group	5.28 ± 0.81	4.80 ± 0.95	0.20[b*]	-0.48 ± 0.31
6-month group	5.63 ± 0.73	5.22 ± 0.28	0.44[b*]	-0.42 ± 0.48
Nostril width (mm)				
Cleft side				
3-month group	7.67 ± 1.47	8.17 ± 1.53	0.005[a**]	0.50 ± 0.26
6-month group	7.07 ± 0.68	7.77 ± 0.35	0.006[a**]	0.70 ± 0.37
Non-cleft side				
3-month group	6.55 ± 0.70	6.73 ± 0.78	0.020[a*]	0.18 ± 0.13
6-month group	5.98 ± 0.65	6.42 ± 0.55	0.017[a*]	0.43 ± 0.30
Lip-columella crease to soft triangle distance (mm)				
Cleft side				
3-month group	2.85 ± 0.45	2.48 ± 0.46	0.004[a**]	-0.37 ± 0.18
6-month group	2.98 ± 0.56	2.58 ± 0.55	0.029[a*]	-0.40 ± 0.32
Non-cleft side				
3-month group	3.00 ± 0.62	2.90 ± 0.57	0.041[a*]	-0.10 ± 0.09
6-month group	3.30 ± 0.25	3.20 ± 0.28	0.011[a]	-0.10 ± 0.13
Columella deviation (degree)				
3-month group	7.45 ± 2.91	7.45 ± 2.81	1.00[a]	0.00 ± 0.33
6-month group	7.62 ± 2.38	7.80 ± 2.45	0.026[a]	0.18 ± 0.36

[a]Statistically significant (Paired t-test, $P < 0.05$.)

[b]Statistically significant (Wilcoxan Signed Rank Test, $P < 0.05$.)

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

Nasal morphology at one year following discontinuation of Nasal Creator Device utilization (T4) demonstrated significant changes from the time of device termination. Specifically, alar base width increased significantly in both cohorts. The three-month cohort exhibited an increase of 2.1 ± 0.7 mm, while the six-month cohort demonstrated an increase of 2.0 ± 1.0 mm.

Nostril height decreased significantly on both the cleft and non-cleft sides. On the cleft side, the three-month cohort demonstrated a reduction of 0.6 ± 0.2 mm, whereas the six-month cohort displayed a decrease of 0.5 ± 0.4 mm. On the non-cleft side, the three-month cohort exhibited a reduction of 0.5 ± 0.3 mm, while the six-month cohort demonstrated a reduction of 0.4 ± 0.5 mm.

Nostril width increased significantly in both cohorts on both the cleft and non-cleft sides. On the cleft side, the three-month cohort demonstrated an increase of 0.5 ± 0.3 mm, while the six-month cohort exhibited an increase of 0.7 ± 0.4 mm. On the non-cleft side, the three-month cohort demonstrated an increase of 0.2 ± 0.1 mm, and the six-month cohort exhibited an increase of 0.4 ± 0.3 mm.

Lip-columella crease to soft triangle distance decreased, particularly on the cleft side. The three-month cohort exhibited a significant reduction of 0.4 ± 0.2 mm on the cleft side, while the non-cleft side demonstrated

Table 5 Comparison of nasal morphology changes between the 3-month group and the 6-month group

Measurements	Differences between T1 and T4			
	3-month group (Mean ± SD)	6-month group (Mean ± SD)	Mean difference (95 % CI)	*P* value
Alar base width (mm)	2.07 ± 0.68	2.03 ± 0.99	0.03 (-1.06, 1.13)	0.947
Nostril height (mm)				
Cleft side	-0.62 ± 0.19	-0.52 ± 0.38	-0.10 (-0.49, 0.29)	0.290
Non-cleft side	-0.48 ± 0.31	-0.42 ± 0.48	-0.07 (-0.59, 0.46)	0.391
Nostril width (mm)				
Cleft side	0.50 ± 0.26	0.70 ± 0.37	-0.20 (-0.61, 0.21)	0.308
Non-cleft side	0.18 ± 0.13	0.43 ± 0.30	-0.25 (-0.57, 0.07)	0.106
Lip-columella crease to soft triangle distance (mm)				
Cleft side	-0.37 ± 0.18	-0.40 ± 0.32	0.03 (-0.30, 0.37)	0.828
Non-cleft side	-0.10 ± 0.09	-0.10 ± 0.13	0.00 (-0.14, 0.14)	1.000
Columella deviation (degree)	0.00 ± 0.33	0.18 ± 0.36	-0.18 (-0.63, 0.26)	0.379

Values are presented as difference between T1 and T4 (mean ± SD). Mean difference represents the between-group difference (3-month group minus 6-month group) with 95 % confidence intervals. T1 = at the cessation of nasal stent use; T4 = one year following the cessation of nasal stents. Statistical significance was determined using the independent t-test ($P < 0.05$).

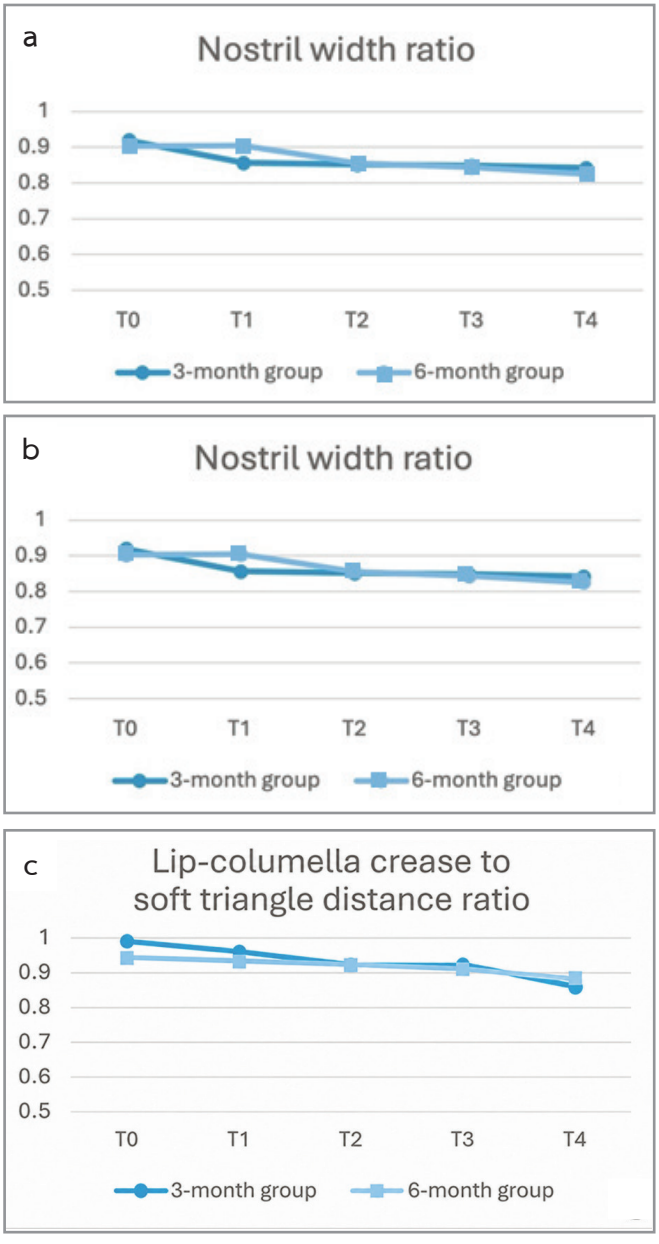


Figure 2 Comparison of nasal symmetry at each time point.
(a) Nostril height ratio.
(b) Nostril width ratio.
(c) Lip-columella crease to soft triangle distance ratio.

a reduction of 0.1 ± 0.1 mm. The six-month cohort revealed significant reductions exclusively on the cleft side, with a reduction of 0.4 ± 0.3 mm.

No significant changes were observed in columella deviation in either cohort (Table 4).

Although significant changes in nasal morphology were observed from T1 to T4, no statistically significant differences in these changes were identified when comparing the two cohorts (Table 5).

Nasal morphology symmetry was quantitatively evaluated using the nostril height ratio, nostril width ratio, and lip-columella crease to soft triangle distance ratio. A gradual decrease in symmetry was observed across all parameters within both study cohorts. Despite this gradual decline, relatively high symmetry ratios were maintained throughout the follow-up period (Figure 2).

Discussion

The institutional protocol for record acquisition incorporated both two-dimensional and three-dimensional (3D) photography. In this investigation, 3D photographs were employed for nasal morphology evaluation owing to their superior accuracy compared with two-dimensional methods. Furthermore, 3D facial scanning enables standardized magnification and precise measurement.

Post-surgical management and challenges

Post-surgical relapse of nasal morphology represents a recognized phenomenon in cleft care. Consequently, craniofacial centers employ diverse pre-surgical, surgical, and post-surgical management protocols to mitigate these undesirable sequelae. Pre-surgical management frequently involves nasoalveolar molding (NAM), which leverages the neonatal estrogen surge to non-surgically enhance nasal morphology.[17,18] Surgical overcorrection represents another technique employed to optimize outcomes. Surgical approaches prioritize minimizing scarring to prevent contracture forces, with surgeon experience being crucial for optimal results.[6,19]

Postoperative management frequently includes nasal stents, which are instrumental in preserving nasal form and function.[9] A common protocol for full-time nasal stent utilization ranges from three to six months.[6,7,12,18,20] Several authors have described suturing nasal stents, augmented with moldable

silicone rubber, to the nasal dorsum for two weeks, in addition to a three- to four-month wear period.[14] At the present institution, the current standard protocol for post-surgical nasal stent utilization is six months, as a previous investigation demonstrated improved nasal morphology following six months of utilization compared with a three-month duration.[21] The timing of device initiation is also crucial. Some centers commence nasal stent application immediately post-surgery,[14,18,20] while others initiate placement one to two weeks following surgery.[10,13] The present institution initiates nasal stent application immediately post-operatively to circumvent the increased difficulty of stent placement due to nostril constriction following surgical intervention.

Practical observations indicate a wide range of patient cooperation. As patients mature, their tolerance for nasal stent utilization decreases, often resulting in premature discontinuation of device usage. The primary reason for non-compliance with the institutional protocol was patients attempting to remove the self-retaining nasal stents. Taping techniques were employed to reinforce stent positioning, with two methods recommended to caregivers. The first technique involved wrapping tape around the bridge of the nasal stents, securing it to the nasal dorsum, and reinforcing it with additional horizontal tape. The second technique involved positioning the nasal stents with an elastic band and securing them to both sides of the cheeks. While some patients demonstrated improved tolerance with taping reinforcement, others remained completely intolerant.

Observed relapse and literature review

Routine follow-up after the termination of nasal stent usage revealed morphological relapse in all patients. Among the observed changes, a reduction in nostril height was noted on both the cleft and non-cleft sides. In the present study, this finding may be explained by postoperative soft-tissue remodeling. Scar maturation within the nasolabial region and reorientation of the orbicularis oris muscle can lead to downward rotation of the columella and nasal tip, thereby reducing the vertical dimension of the nostril bilaterally during the healing process. A previous study suggested that postoperative scar contracture following cleft lip repair may contribute to secondary nasal deformity.[22]

In addition to postoperative tissue remodeling, normal nasal growth may also contribute to changes in nasal morphology over time. A previous study reported that nasal morphology may continue to change during growth following primary cleft repair, and residual asymmetry may persist despite an initially satisfactory surgical outcome.[23] Therefore, long-term postoperative changes are likely influenced by both healing-related remodeling and normal craniofacial growth.

From a clinical perspective, the magnitude of the observed changes should also be considered. Although statistically significant changes were observed in several nasal measurements, the magnitude of these changes was relatively small and nasal symmetry remained within an acceptable range throughout the observation period. Whether these dimensional changes are clinically meaningful requires further investigation in larger prospective studies.

In the present investigation, significant changes in various nasal measurements were observed following the cessation of nasal stent utilization in both cohorts, with only columella deviation remaining stable. The observed widening of alar base width may be attributed to a combination of normal growth and morphological relapse. Furthermore, reductions in vertical dimensions, such as nostril height and lip-columella crease to soft triangle distance, suggest a greater degree of relapse relative to growth in these directions.

During follow-up visits, the considerable burden on caregivers for maintaining nasal stents for extended durations became evident. Adherence to the institutional protocol of full-time nasal stent utilization for six months often posed challenges for caregivers.

Previous studies have demonstrated favorable outcomes with postoperative nasal stenting. Yeow et al.[7] compared two cohorts of three-month-old infants following unilateral complete cleft lip repair with primary rhinoplasty—one cohort received nasal stents for six months, while the other received no stenting (NAM was not utilized). Follow-up assessments at 5 to 8 years of age demonstrated improved nasal appearance, symmetry, alar cartilage position, alar base level, and columella tilt in the nasal stented cohort compared with controls. Similarly, Al-Qatami et al.[12] randomized 50 infants undergoing unilateral cleft lip repair into stenting and non-stenting cohorts. All participants underwent preoperative NAM followed by primary lip repair and rhinoplasty at three months of age, with follow-up occurring three months later during palatoplasty. Most specific nasal measurements and nasal symmetry demonstrated improvement in the nasal stenting cohort. A recent systematic review by Nguyen et al.[9] reported that postoperative nasal stent protocols varied across studies, including differences in stent design, timing of application, and duration of wear. Although favorable outcomes have generally been reported with postoperative nasal stenting, the optimal duration of postoperative nasal stent use remains uncertain. The present study focused on a different aspect of postoperative nasal stenting by comparing different durations of postoperative nasal stent use, whereas these previous studies evaluated the effectiveness of postoperative nasal stenting by comparing stented and non-stented patients.

The present investigation demonstrated relapses of nasal morphology in both cohorts. However, comparison of nasal morphology changes at the one-year follow-up between the two cohorts revealed no statistically significant differences, and nasal morphology symmetry remained within an acceptable range in both cohorts. The present study could not detect a significant advantage of extending postoperative nasal stent use from three to six months, although larger prospective studies are needed to determine the optimal duration of postoperative nasal stenting.

Because of variability in primary rhinoplasty performance based on surgeon preference at the present institution, a reduction in symmetry was noted from T0 (post-cheiloplasty period) to T1 (at the termination of Nasal Creator Device utilization). Primary rhinoplasty may be a contributing factor to achieving nasal symmetry; however, its practice in conjunction with primary cheiloplasty remains a topic of controversy. Given that cleft rhinoplasty is a technique-sensitive procedure, some surgeons refrain from undertaking primary rhinoplasty due to concerns regarding potential growth retardation resulting from early intervention on the nasal structures.[24] Conversely, numerous investigations have reported favorable outcomes following primary rhinoplasty.[25-27] A study by Anderl[28] evaluated patients who underwent simultaneous lip and nose repair and followed them for 15 years, concluding that primary rhinoplasty does not inhibit growth. Regardless of the decision to perform primary rhinoplasty, the judicious utilization of nasal stents should be considered in post-surgical management to maintain nasal shape and mitigate potential future relapse.[9]

Limitations

Owing to the retrospective design of this investigation, completion of presurgical nasoalveolar molding (NAM), the performance of primary rhinoplasty, and the operating surgeon could not be fully standardized and may have influenced the study outcomes. In addition, the absence of randomization and a non-stented control group may have introduced selection bias and limited the ability to distinguish postoperative relapse from normal growth-related changes. Furthermore, the small sample size likely limited the statistical power to detect clinically meaningful differences between the two groups. Future prospective longitudinal studies with larger sample sizes and standardized treatment protocols

are needed to further clarify the relative contributions of postoperative remodeling and normal nasal growth to long-term changes in nasal morphology.

Conclusion

In this investigation, both the three-month and six-month nasal stent groups exhibited mild changes in nasal morphology during the one-year follow-up period after stent discontinuation. No significant differences in nasal morphology changes or nasal symmetry were observed between the two groups, and nasal symmetry ratios remained relatively high throughout the observation period. These findings suggest that extending postoperative nasal stent use beyond three months may provide limited additional benefit. Further prospective studies with larger sample sizes are needed to determine the optimal duration of postoperative nasal stenting.

Author contributions

Nounprang Boonpongsathian: Methodology, Validation, Formal analysis, Investigation, Data curation, Writing-original draft preparation, Visualization; **Buddhathida Wangsrimongkol:** Methodology, Validation, Investigation, Writing-review & editing; **Araya Pisek:** Formal analysis, Writing-review & editing; **Palakorn Surakunprapha:** Investigation, Resources; **Poonsak Pisek:** Conceptualization, Writing-review & editing, Supervision, Project administration.

Ethical statement

This study was approved by the Khon Kaen University Ethics Committee for Human Research (Approval No. HE651588).

Disclosure statement

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AI-assisted writing declaration

The authors used ChatGPT (OpenAI, GPT-5.5) solely for English language editing only, comprising grammar correction, sentence-level clarity, and consistency of academic style. All AI-assisted text was reviewed, verified, and where necessary revised by the authors, who take full responsibility for the accuracy and integrity of the final manuscript.

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