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Analysis of secondary deformities of the lip and nose in children after primary unilateral cheiloplasty

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Abstract. The aim of the study was a comprehensive investigation of the morphological and functional features of secondary deformities of the lip and nose in children after primary unilateral cheiloplasty and the identification of the key structural manifestations. The study was carried out in the Department of Plastic and Reconstructive Microsurgery of the National Children's Specialised Hospital "Okhmatdyt" in Kyiv from 2023 to 2025, within which 57 children with unilateral clefts were examined, with assessment of the parameters of three anatomical zones (upper lip, nose and oral vestibule) in the long-term period after primary cheiloplasty performed in other medical institutions. As a result of the study, it was established that secondary postoperative changes in the nasolabial region were observed in all children (100%), among whom aesthetic deformities were detected in 57.9% and anatomical defects in 42.1%. Moderate forms of severity predominated (47.4%), whereas mild forms accounted for 31.6% and severe forms for 21.0%. The most frequent morphological changes of the upper lip were asymmetry of Cupid's bow (80.7%), cicatricial changes (73.7%) and reduction of philtral height (66.7%), which were combined with impaired mobility in 50.9% of children. In the structure of the nose, asymmetry of the alae (77.2%), deformities of the columella (68.4%) and hypoplasia of the alar cartilage (63.1%) predominated. In the oral vestibule, common findings were reduction of depth (61.4%), scarring of the mucosa (70.2%) and oronasal communications (29.8%). A correlation was found between the severity of cicatricial changes and the reduction in vestibular depth ($r = 0.62$; $p = 0.008$), indicating the systemic nature of the secondary disturbances. The results obtained confirmed that secondary deformities of the nasolabial region after primary cheiloplasty are systemic in nature, with a predominance of aesthetic disturbances of moderate severity. The data can be used by surgeons, orthodontists, and speech therapists for planning reconstructive and rehabilitation interventions in children

Keywords: cleft; cartilage aplasia; palate; oral vestibule; reconstructive interventions; primary operation; asymmetry

Introduction

Congenital clefts of the lip and palate are among the most common developmental defects of the maxillofacial region in children, causing not only cosmetic but also functional disorders. Primary cheilorhinoplasty is the standard treatment for such patients and is aimed at restoring the anatomical integrity of the lip and nose, improving breathing, speech and facial aesthetics. However, even with technically correctly performed intervention, the results of the operation do not always remain stable during facial growth. As the child develops, secondary tissue displacements, asymmetry of the muscles and cartilaginous structures occur, which leads to disturbance of the shape of the nose and of the height and contours of the upper lip. The lack of timely diagnosis and correction of these changes results in a number of problems – persistent deformity of the nasolabial region, difficulty in nasal breathing, articulation disorders, formation of malocclusion and pronounced psychological discomfort. Such consequences significantly reduce the quality of life of patients and require repeat reconstructive operations, which are often more complex and less predictable than the primary intervention.

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The morphological prerequisites for the development of secondary deformities after primary unilateral cheiloplasty are determined by a combination of anatomical, functional and cicatricial factors that disrupt the harmonious development of the nasolabial region during facial growth. In the course of analysing the data of M.I. Dmytrenko *et al.* [1], it was established that persistent morphological changes in the musculo-cartilaginous complex of the upper lip were manifested several years after the operation as a result of incomplete restoration of the orbicularis oris muscle. The authors emphasised that these deformities were exacerbated by cicatricial contractures, which limited tissue mobility and reduced the elasticity. According to the observations of V. Filonenko *et al.* [2], secondary changes formed as a result of imbalance between the soft-tissue segments and uncoordinated regeneration after primary suturing. The researchers stressed that uneven distribution of tissue tension caused volume deficiency and depression in the central part of the lip. The results obtained by R.J. Alimdjanovich & T.N.K. Ugli [3] showed that asymmetric forms of deformity with hypoplasia of the lateral nasal wing and residual cicatricial changes predominated, reflecting the combined influence of the operative technique and individual features of healing. In addition, as demonstrated by N. Uchino *et al.* [4], primary postoperative symmetry was gradually disrupted with age due to uneven development of bony and soft tissues, and the severity of secondary deformities had a clear correlation with the age of the patients, which confirms the need for long-term morphological follow-up.

Diagnosis and morphometric characteristics of secondary deformities of the nasolabial region are crucial for determining the degree of disturbance, predicting the results of reconstructive interventions and choosing the optimal treatment strategy. As noted by M.Y. Oliinyk *et al.* [5], orthopaedic monitoring and systematic anthropometric control after primary repair made it possible to identify the initial signs of deformities at early stages of growth. The authors proved that regular registration of anthropometric parameters facilitated timely adjustment of orthopaedic appliances and prevented the formation of pronounced asymmetries. In the study by S.T. Shokirov *et al.* [6], an analysis of facial anthropometric indices in children after the main stages of surgical treatment was carried out, which made it possible to trace the dynamics of changes in the structure of the lip and nose. The researchers established a pattern of asymmetry development that increased with age due to uneven tissue growth. The use of modern technologies in the study by M.C. Neves [7] enabled quantitative assessment of lip and nasal parameters using stereophotogrammetry. The scientist demonstrated that this method provided high accuracy in determining deformities and allowed objective criteria for the classification to be formulated. In turn, S. Schmutz *et al.* [8] used 3D analysis for a comprehensive assessment of the shape of the nasolabial complex, which made it possible to compare individual variations of deformities with an average three-dimensional template. It was shown that this technique provides a standardised assessment of the results of reconstructive interventions and can be used to plan secondary corrections.

Surgical and multidisciplinary correction of secondary deformities of the lip and nose is aimed at the simultaneous restoration of anatomical integrity, functional capacity and aesthetic harmony of the nasolabial complex, which requires a combination of microsurgical, orthodontic, speech-therapy and psychosocial approaches. According to the results of the study by Y. Kovach *et al.* [9], experience was presented in the use of microvascular free tissue flaps in children with secondary defects after clefts, which made it possible to restore the volume and projection of the midface. The researchers demonstrated that this strategy provided not only closure of complex defects but also improvement of soft palate function and conditions for further rehabilitation. In the study by Y. Chen *et al.* [10], a new algorithm for revision correction of unilateral secondary deformities of the lip and nose was developed, combining reconstruction of soft tissues and structural rhinoplasty. The authors proved that comprehensive restoration of the supporting elements of the nose and redistribution of tissue tension in the upper lip ensured improved profile symmetry and nasal breathing and reduced the risk of further recurrence of deformities.

Previous studies mainly focused on the description of individual clinical cases and technical aspects of surgical correction; however, the structural mechanisms of formation of secondary deformities and the morphometric characteristics in children after primary unilateral cheiloplasty remained insufficiently studied. The aim of this work was to carry out a comprehensive morphometric and clinical analysis of secondary morphological changes in the nasolabial region in children after primary unilateral cheiloplasty in order to determine the frequency, structure and functional significance. To achieve this aim, it was planned to perform the following tasks: to determine the frequency, type, and degree of severity of secondary postoperative deformities; to establish the relationships between morphological changes of the lip, nose and oral vestibule and functional disorders.

Materials and Methods

The study had a retrospective-prospective clinical design and was carried out at the Department of Plastic and Reconstructive Microsurgery and the Consultative and Diagnostic Outpatient Clinic of the State Non-Commercial Enterprise "National Children's Specialised Hospital "Okhmatdyt" of the Ministry of Health of Ukraine" (Kyiv) [11]. In the period from from 2023 to 2025, children with secondary deformities of the upper lip and nose after surgical treatment of congenital clefts presented to the institution. This time interval was chosen because it provided a sufficient number of observations for a representative analysis and covered clinical cases that were homogeneous in terms of treatment techniques. During this period, a clinical analysis of the cases was carried out in

order to assess the morphological features and severity of postoperative changes. The patients underwent planned examination and treatment at the Department of Dentistry within the state programme of medical care for children with congenital facial clefts, which ensured a comprehensive multidisciplinary approach to rehabilitation. The study complied with the ethical principles laid down in the WMA Declaration of Helsinki [12]. Before the start of the study, written informed consent was obtained from the parents or legal representatives of all participants. Personal data were fully anonymised, and the work had an observational character and did not involve any additional medical intervention. The study protocol was approved by the Ethics Committee of the clinic, as confirmed by decision No. EK-24/117 of 31.08.2023. Generative artificial intelligence tools were not used at any stage of this study, including study design, data collection, data analysis, interpretation of results, or manuscript preparation.

In the study, 57 children with a diagnosis of unilateral complete cleft of the upper lip, alveolar process, and hard and soft palate were examined. Among these children were 23 boys and 34 girls aged from 4 to 6 years, which corresponded to the pre-school period, when the formation of functional and psycho-emotional reactions related to the aesthetic appearance of the face intensified. All patients had previously undergone primary surgical treatment: lip repair was performed at the age of 4 months to 1 year, and hard and soft palate repair at the age of 1-1.5 years. The mean postoperative period at the time of examination was 3.5 years after the primary cheiloplasty. From the medical records it was established that the primary operations had been performed using the classical Millard and Tennison-Randall techniques. In 9 children, both techniques were applied sequentially at different stages of treatment. These cases were included in the overall descriptive analysis of secondary deformities but were excluded from direct intergroup comparisons between single-technique cohorts. The Millard technique involved rotation of the medial segment of the lip with simultaneous advancement of the lateral flap to form a natural Cupid's bow. The Tennison-Randall technique was based on excision of a triangular flap, which provided precise approximation of the cleft margins and preservation of symmetry of the upper lip. The sample included children with complete unilateral clefts of the upper lip and palate, with existing morphological manifestations of secondary deformities of the lip or nose after primary cheiloplasty, in a stable somatic condition, and with complete clinical and photographic documentation required for morphometric analysis. Children with bilateral, atypical or incomplete cleft forms; with congenital syndromes accompanied by craniofacial anomalies; with severe somatic or neurological disorders that made correct examination impossible; with incomplete documentation; as well as those who had undergone non-standardised or out-of-protocol reconstructive procedures that could distort the morphological assessment of secondary deformities were not included.

Assessment of the nasolabial complex was carried out taking into account three anatomical components: nasal structures, the upper lip and the oral vestibule. The examination was performed by a maxillofacial surgeon together with an orthodontist under standard clinic conditions in daylight. Each patient was examined in a sitting position, with the head fixed in order to ensure symmetry of photographic documentation. Photography was performed according to a standardised protocol: with a digital camera at a focal length of 50 mm and a distance of approximately 1.0-1.2 m from the patient's face, under frontal lighting without shadows. Images were obtained in three main projections – frontal, right, and left lateral – as well as in an additional three-quarter projection to assess profile asymmetries. To assess the internal nasal structures and identify partial aplasia of the lateral crus, flattening of the alar cartilage, deformities of the nasal floor and residual oronasal communications, anterior rhinoscopy was additionally performed using a Killian nasal speculum and a cold frontal reflector. Clinical assessment was carried out according to morphometric criteria (Table 1).

Table 1. Criteria for clinical assessment of secondary nasolabial deformities

Assessment group	Assessment parameter	Description of the criterion	Score (0-3)	Deformity severity stratification
Upper lip	Symmetry of Cupid's bow	Preservation or disturbance of symmetry between the unaffected and operated sides	0 – symmetrical 1 – slight asymmetry 2 – moderate asymmetry 3 – pronounced disturbance	0 – normal 1-2 – mild/moderate 3 – severe
	Philtral columns	Equality of the height and direction of the philtral columns	0 – normal 1 – slight difference 2 – moderate 3 – significant asymmetry	0 – normal 1-2 – moderate 3 – severe
	Volume of the vermilion border	Hypo- or hypertrophy of the vermilion border	0 – symmetrical 1 – moderate difference 2 – pronounced 3 – deformity >50%	0 – normal 1-2 – mild/moderate 3 – severe
	Lip mobility	Amplitude of movements, participation in mouth closure	0 – full 1 – slight limitation 2 – moderate 3 – absence of mobility	0 – normal 1-2 – functional impairment 3 – severe

Continued Table 1

Assessment group	Assessment parameter	Description of the criterion	Score (0-3)	Deformity severity stratification
Upper lip	Cicatricial changes	Presence of retractions, contractures, excessive scars	0 – absent 1 – moderate 2 – pronounced 3 – marked with contracture	0 – normal 1-2 – moderate 3 – severe
Nose	Symmetry of the nasal wings	Equality of height, shape, and volume of the wings	0 – symmetrical 1 – moderate difference 2 – asymmetry up to 3 mm 3 – marked deformity	0 – normal 1-2 – moderate 3 – severe
	Position of the columella	Position, height, deviation from the midline	0 – centred 1 – deviation up to 1 mm 2 – 1-3 mm 3 – >3 mm	0 – normal 1-2 – mild/moderate 3 – severe
	Alar cartilage	Deformation or aplasia of the cartilaginous structure	0 – preserved 1 – slight deformity 2 – partial aplasia 3 – marked distortion	0 – normal 1-2 – structural disorders 3 – severe
	Nasal floor	Widening or narrowing, retraction of the nasal floor	0 – normal 1 – slight deviation 2 – pronounced 3 – communication with the oral cavity	0 – normal 1-2 – moderate 3 – severe
Vestibule of the oral cavity	Depth of the vestibule	Reduction or absence of the anterior vestibule	0 – normal 1 – reduction up to 2 mm 2 – 2-4 mm 3 – absence	0 – normal 1-2 – moderate 3 – severe
	Presence of oronasal connections	Fistulas between the nose and mouth	0 – absent 1 – microscopic 2 – single 3 – multiple	0 – normal 1-2 – moderate 3 – severe
	Condition of the mucous membrane	Scarring, hypertrophy, atrophy	0 – normal mucosa 1 – slight changes 2 – atrophy/hypertrophy 3 – coarse scarring	0 – normal 1-2 – moderate 3 – severe

Source: compiled by the author

The total scores were used to determine the severity of secondary deformities within the three anatomical zones – the upper lip, nose and oral vestibule. The maximum value of the integral index was 36 points. Severity stratification of deformities was carried out according to the accepted three-level scale: 0-12 points – mild deformities, characterised by minimal aesthetic or functional changes; 13-24 points – moderate deformities, which combined aesthetic disturbances with partial structural changes; 25-36 points – severe deformities, accompanied by pronounced asymmetry, structural defects or functional limitations of the nasolabial complex.

For systematisation of the clinical manifestations, the secondary deformities were divided into two main groups. Aesthetic deformities were characterised by disturbance of anthropometric proportions without loss of anatomical structures. These included reduction in the height of the philtral column on the cleft side, atrophic or hypertrophic tissue changes, retraction or excessive stretching of the skin, which led to distortion of the lip contours, while the muscle layer and mucosa remained restored. Anatomical defects, in contrast, included disruption of the integrity or absence of individual elements of the nasolabial region – the upper oral vestibule, fixation of the orbicularis oris muscle, as well as the formation of oronasal fistulae.

Statistical analysis was performed using SPSS Statistics version 26.0 (IBM Corp., USA). Descriptive statistics included absolute and relative frequencies (n, %) for categorical variables and mean values with standard deviations (mean ± SD) for quantitative variables. The normality of continuous data distributions was assessed using the Shapiro-Wilk test. As severity scores of secondary deformities did not follow a normal distribution ($p < 0.05$), non-parametric statistical methods were applied (Spearman's rank correlation coefficient for assessment of associations between severity-related variables). Associations between categorical variables, including type of deformity, severity category, sex, cleft laterality, and primary surgical technique, were analysed using Fisher's exact test. Statistical significance was defined as $p < 0.05$.

Results

Frequency and distribution of secondary deformities. In the course of the analysis, it was established that secondary postoperative changes in the nasolabial region were observed in 100% of cases (n = 57), although the severity

and character varied considerably. According to the results of a comprehensive assessment of secondary deformities based on morphological criteria, it was found that aesthetic disturbances (asymmetry, cicatricial changes, distortion of the lip contour or nasal shape) were detected in 33 children (57.9%), whereas anatomical defects (absence or deformation of structures, oronasal communications, cartilage aplasia, vestibular defects) were present in 24 children (42.1%). These results indicated a predominance of aesthetic changes, which mostly formed due to slight displacement of tissues and scarring after the primary surgical intervention. To assess the structure of secondary changes and the relationship with biological factors (sex, side of lesion), stratification of cases by type of deformity and severity was carried out. The obtained data were summarised in Table 2.

Table 2. Distribution of secondary deformities by type, sex, and side of lesion

Indicator	Total number (n=57)	Boys (n = 23)	Girls (n = 34)	Right-sided cleft (n = 31)	Left-sided cleft (n = 26)
Aesthetic deformities	33(57.9%)	11(47.8%)	22(64.7%)	18(58.1%)	15(57.7%)
Anatomical defects	24(42.1%)	12(52.2%)	12(35.3%)	13(41.9%)	11(42.3%)
Mild form (0-12 points)	18(31.6%)	8(34.8%)	10(29.4%)	9(29.0%)	9(34.6%)
Moderate form (13-24 points)	27(47.4%)	10(43.5%)	17(50.0%)	15(48.4%)	12(46.2%)
Severe form (25-36 points)	12(21.0%)	5(21.7%)	7(20.6%)	7(22.6%)	5(19.2%)

Note: comparisons between groups according to sex and cleft laterality were performed using Fisher's exact test. No statistically significant differences were found in the distribution of deformity types or severity categories between groups ($p > 0.05$)
Source: compiled by the author

The quantitative indicators obtained showed that aesthetic changes accounted for a greater proportion of secondary deformities compared with anatomical defects. However, comparative analysis did not reveal statistically significant differences in the distribution of deformity types or severity categories according to sex or cleft laterality ($p > 0.05$). The proportion of aesthetic deformities (57.9%) indicates that in most cases surgical reconstruction ensured anatomical integrity of the tissues but did not allow achievement of complete morphological symmetry. This situation is typical for the postoperative period in preschool children, when asymmetric growth of soft tissues and elements of cicatricial deformation begin to appear. In the group of anatomical defects (42.1%), combined disturbances were descriptively more frequent, including defects of the oral vestibule, partial absence of the nasal floor, or residual fistulae. These findings characterised the clinical spectrum of secondary postoperative deformities observed in the study population and emphasised the heterogeneity of their morphological presentation. Clinically, such children often required additional functional rehabilitation, including speech therapy and orthodontic treatment. Comparison by sex revealed numerical tendencies: anatomical defects were numerically more frequent in boys (52.2%), whereas aesthetic deformities were more commonly observed in girls (64.7%); these differences remained within the limits of random variation. Analysis by side of lesion demonstrated a comparable distribution of secondary deformities between right-sided (58.1%) and left-sided (57.7%) clefts, indicating no apparent influence of laterality on the frequency of postoperative changes.

In terms of severity, deformities of moderate degree accounted for the largest proportion of cases (47.4%), while mild forms represented 31.6% and severe forms 21.0%. This distribution reflects a descriptive pattern rather than a statistically tested difference between severity categories. In most cases, the primary operation ensured satisfactory anatomical restoration but did not guarantee complete symmetry or functional coherence of the nasolabial complex. The predominance of a moderate level of severity is clinically favourable, as such changes are generally amenable to correction through secondary reconstructive interventions or orthodontic treatment. Among children with severe deformities (n = 12), combined defects of the lip and nose with total scores above 25 were more frequently observed descriptively, often accompanied by pronounced cicatricial contractures and retractions. These observations characterised the clinical features of the severe subgroup and were not subjected to separate statistical comparison. Such cases represented a risk group for the formation of persistent cosmetic defects affecting appearance, articulation and nasal breathing. Thus, a qualitative analysis of the obtained data confirmed that the structure of secondary postoperative deformities was of a mixed nature, with aesthetic forms constituting a larger proportion and a tendency towards a moderate level of severity. These findings described overall patterns within the study sample rather than statistically significant group differences. This indicated that primary cheiloplasty generally provided anatomical restoration of the lip and nose but required further rehabilitation and, in some cases, revision surgery to eliminate residual asymmetry and cicatricial changes. To clarify the distribution of deformity severity within individual anatomical zones, a comparative analysis of average severity scores was performed, the results of which are shown in Figure 1.

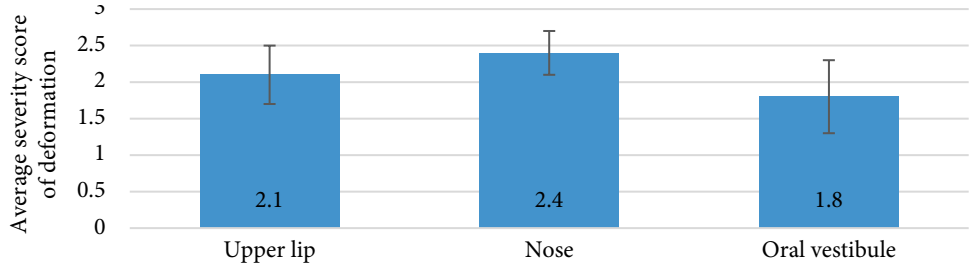

Figure 1. Mean severity scores of secondary deformities by anatomical region
Source: compiled by the author

Analysis of the total scores for the three anatomical regions (upper lip, nose, oral vestibule) showed that the highest mean severity score was observed in the nasal structures (2.4 ± 0.3), followed by the upper lip (2.1 ± 0.4) and the oral vestibule (1.8 ± 0.5). These values indicate a numerical gradient of severity across anatomical regions; however, no formal statistical comparison between regions was performed. This distribution can be explained by the complexity of three-dimensional nasal reconstruction during primary cheilorhinoplasty and the limited predictability of growth-related changes in cartilaginous structures. In most children with severe deformities, combined changes of the lip and nose were observed, and in cases of pronounced scarring these were accompanied by functional disorders such as incomplete lip closure, impaired nasal breathing and reduced mimetic activity.

Thus, the results of the comprehensive analysis showed that secondary deformities after primary unilateral cheilorhinoplasty were predominantly of moderate severity, with aesthetic changes prevailing over anatomical ones. This reflected the effectiveness of the primary restoration of tissue integrity but incomplete compensation of nasolabial symmetry. The most vulnerable areas remained the alar cartilages of the nose and the central part of the upper lip, where residual asymmetries and scar retractions formed, which could subsequently cause functional disorders. The results obtained underlined the need for early morphometric monitoring and planning of staged reconstructive interventions to ensure a stable functional and aesthetic outcome.

Morphological characteristics of secondary changes in the upper lip. The analysis showed that, after primary unilateral cheilorhinoplasty, most children retained secondary morphological changes of varying severity, caused both by technical features of the primary intervention and by asymmetric tissue growth during development. The assessment was performed according to five key morphological criteria: symmetry of the Cupid's bow, philtral columns, volume of the vermilion border, lip mobility and scar changes. The summarised results were presented in Table 3.

Table 3. Morphological changes of the upper lip after cheilorhinoplasty

Assessment parameter	Detection frequency, n (%)	Mean score ± SD	Nature of the predominant changes
Symmetry of the Cupid's bow	46(80.7%)	2.3 ± 0.4	Moderate arch asymmetry on the cleft side.
Philtral columns	38(66.7%)	2.1 ± 0.3	Reduced height or displacement of the column on the operated side.
Vermilion border volume	31(54.4%)	1.9 ± 0.4	Hypo- or hypertrophy, more often flattening.
Lip mobility	29(50.9%)	2.0 ± 0.5	Partial restriction on mouth closure.
Scar changes	42(73.7%)	2.2 ± 0.5	Retraction or hypertrophy in the postoperative scar zone.

Note: SD – standard deviation, characterising the variation in severity scores of morphological changes within the sample
Source: compiled by the author

Analysis of the results showed that in most cases the morphological changes of the upper lip were of moderate severity, combining aesthetic disproportions with minimal functional limitations. The most frequent manifestation was asymmetry of the Cupid's bow – in 80.7% of children. It appeared as a shift of the mid-point of the bow towards the former cleft, creating a visual shortening of the lip and disruption of its contour line. This defect was interpreted as a typical postoperative feature associated with asymmetric tissue tension and slight displacement of the cutaneous-muscular segments during primary repair. Disturbances in philtral column height were observed in 66.7% of cases and were characterised by a decrease in height or a change in the direction of the column on the operated side. This type of deformity affected the visual proportionality of the mid-face, and its formation was descriptively associated with the technique of triangular flap formation according to Tennison-Randall, which is characterised by increased local tissue tension. Scar changes represented the second most frequent group (73.7%) and often combined with impaired lip mobility. The mean score of 2.2 ± 0.5 indicated that most scars were moderately expressed, with retraction of the cutaneous-mucosal junction or formation of linear contractures. Such changes not only reduced aesthetic

attractiveness, but in some patients (about 15%) also caused functional complications – incomplete mouth closure and difficulties during articulation.

Changes in the volume of the vermilion border were observed in more than half of the children (54.4%) and were predominantly mild. Hypoplasia of the lip on the cleft side was more common than hypertrophy, which was explained by uneven filling of the musculo-cutaneous layer and residual scar retraction. Despite moderate manifestations, this defect created an impression of asymmetry of the lower third of the face, especially when smiling. Decreased lip mobility was observed in 50.9% of patients. The mean score of 2.0 ± 0.5 confirmed that, in most cases, this was partial limitation associated with scar changes in the region of the orbicularis oris muscle. Such disorders had not only an aesthetic but also a functional character, as the disorders affected articulation, swallowing and facial expression.

Comparison by type of primary operation revealed descriptive differences in the morphological patterns of secondary upper-lip changes. Residual asymmetries of the Cupid's bow were numerically more frequent in children treated using the Millard technique (59.1%), whereas hypertrophic scar changes were more commonly observed after the Tennison-Randall procedure (55.2%). These differences reflect clinical distribution patterns and were not subjected to formal statistical testing; therefore, they should not be interpreted as statistically significant. The overall cumulative index of morphological changes of the upper lip was 10.5 ± 1.8 points, corresponding to a moderate severity level. Most children had a combination of two or three types of defect, mainly asymmetry of the Cupid's bow, scar changes and reduced philtral height. These parameters had the greatest impact on the aesthetic perception of the face.

Thus, the study results indicated that, after primary cheilorhinoplasty in children, moderate aesthetic deformities predominated, caused by morphological disproportions rather than structural defects. The most vulnerable areas remained the central part of the upper lip and the Cupid's bow region, where residual asymmetries and scar retractions formed, which could subsequently cause functional limitations. This underlined the need for early morphometric monitoring, the use of gentle techniques for revision cheiloplasty and an interdisciplinary approach to restoring symmetry and mobility of the upper lip.

Characteristics of secondary nasal deformities. After primary cheilorhinoplasty, the nasal region is the most vulnerable part of the nasolabial complex, as it contains cartilaginous, muscular and cutaneous structures that change actively during a child's growth. Even with technically correct primary surgery, maintaining complete nasal symmetry is a challenging task, which explains the high frequency of secondary defects. To quantify the frequency and severity of secondary morphological changes in the nasal structures after primary cheilorhinoplasty, a detailed assessment was carried out according to four key parameters – symmetry of the nasal alae, position of the columella, condition of the alar cartilage and shape of the nasal floor. The summarised results were presented in Table 4.

Table 4. Morphological characteristics of secondary nasal changes in children after cheilorhinoplasty

Assessment parameter	Detection frequency, n (%)	Mean score ± SD	Nature of the predominant changes
Symmetry of the nasal alae	44(77.2%)	2.4 ± 0.3	Moderate or pronounced asymmetry of the alae, drooping of the operated side.
Position of the columella	39(68.4%)	2.2 ± 0.4	Deviation from the midline, shortening, or rotation.
Alar cartilage	36(63.1%)	2.5 ± 0.3	Partial aplasia or deformity of the lateral crus.
Nasal floor	28(49.1%)	1.9 ± 0.5	Narrowing or retraction of the nasal floor, sometimes fistulas.

Source: compiled by the author

The results obtained showed that 77.2% of children after primary cheilorhinoplasty retained nasal deformities of varying severity, most often asymmetry of the alae. In most cases, this manifested as drooping of the ala on the cleft side, creating a visual widening of the nostril. This deformity was mainly aesthetic, but in some patients, it led to partial narrowing of the nasal passage. The mean score of 2.4 ± 0.3 indicated a predominance of moderate severity, which is usually amenable to correction during secondary reconstruction. Deformities of the columella were recorded in 68.4% of cases. Deviation from the midline and shortening of the structure produced a visual effect of nasal asymmetry, particularly in frontal projection. These features were interpreted as postoperative morphological changes associated with uneven tissue adaptation and healing processes rather than as isolated structural defects. More pronounced columellar deviation was typically accompanied by deformation of the nasal ala and rotation of the nasal tip, which contributed to an increase in profile asymmetry.

Particular attention should be paid to the condition of the alar cartilages, which were altered in 63.1% of children, with a mean score of 2.5 ± 0.3 – the highest among all parameters. In most cases, partial aplasia or flattening of the lateral crus was observed, leading to nostril asymmetry. This observation reflects the relative vulnerability of the cartilaginous framework during early reconstructive stages. Deformities of the alar cartilage were often accompanied by inadequate projection of the nasal tip, which complicated breathing by reducing the lumen of the nasal passages. The nasal floor was altered in 49.1% of patients, mainly in the form of retraction of the nasal base or narrowing. Such changes limited aeration of the nasal

cavity and were accompanied by recurrent episodes of difficult breathing. In some children, residual fistulas were observed, which formed as a result of incomplete closure of the mucosal-muscular layers during the primary intervention. Comparative analysis showed that in most patients the deformities had a combined character: in 41.7% of cases a combination of alar asymmetry and columellar deviation was identified, while in 22.8% complex defects included disturbances in all four parameters. This tendency pointed to the morphological interdependence of the nasal structures, where even slight deviation of one element led to cascade changes in adjacent zones.

A statistically significant correlation was found between the severity of upper-lip scar changes and nasal deformities ($r = 0.68$; $p = 0.003$), indicating a shared morphogenetic mechanism related to scar tissue contraction. This process influenced the position of the columella and the configuration of the nasal alae, suggesting that the condition of lip scars may serve as a clinical indicator of secondary nasal changes. When nasal deformities were analysed according to the type of primary operation, children who underwent Millard repair numerically lower mean nasal deformity scores (2.1 ± 0.4) compared with those treated using the Tennison-Randall technique (2.4 ± 0.3). This comparison was descriptive and was not subjected to formal statistical testing, reflecting differences related to technical characteristics of the procedures, including greater mobilisation of the nasal alae in the Millard technique and more limited correction of nasal structures in the Tennison-Randall approach.

Thus, the study results showed that the nasal region remained the most problematic area after primary cheilorhinoplasty. The most frequent findings were alar asymmetry, columellar deformities and hypoplasia of the alar cartilage, which caused both aesthetic and functional disturbances. The combination of nasal defects with lip scarring indicated a single morphogenetic mechanism that required a comprehensive treatment approach. To improve reconstructive outcomes, it is necessary to take into account the biomechanics of cartilage growth and ensure symmetrical formation of the nasal supporting structures. The optimal option is to use combined techniques that integrate the principles of Millard repair with local columellar correction and reinforcement of the alar cartilage using autografts. Such an approach will minimise the risk of secondary deformities and improve both aesthetic and functional outcomes in the long term.

Disturbances of the anatomy of the oral vestibule and the clinical significance. The results of the analysis of morphological changes in the oral vestibule showed that this area often remained a source of residual anatomical and functional disorders after primary cheilorhinoplasty. To assess the degree of such changes, a detailed study of three parameters was carried out – vestibular depth, presence of oronasal communications and condition of the mucosa, the results of which were presented in Table 5.

Table 5. Morphological changes of the oral vestibule in children after primary cheilorhinoplasty

Assessment parameter	Detection frequency, n (%)	Mean score ± SD	Nature of the predominant changes
Vestibular depth	35(61.4%)	2.1 ± 0.4	Reduced depth of the anterior vestibule, restriction of lip mobility.
Oronasal communications	17(29.8%)	2.3 ± 0.5	Presence of residual fistulas in the anterior part of the alveolar process.
Condition of the mucosa	40(70.2%)	2.0 ± 0.4	Scarring, atrophic areas, hypertrophy in the postoperative suture zone.

Source: compiled by the author

The results obtained showed that the most frequent disturbance was insufficient depth of the oral vestibule – in 61.4% of cases. This defect was found both on the cleft side and partly on the opposite side due to asymmetry of attachment of the orbicularis oris muscle. Reduced depth led to restriction of upper-lip mobility, especially when smiling or articulating sounds requiring lip elevation. Children with this type of defect often complained of muscle fatigue when speaking and mild hypersalivation. In some cases, retraction of the mucosa in the postoperative scar area was observed, which indicated insufficient tissue mobilisation during the primary operation or excessive tension during wound closure. Oronasal communications were identified in almost one-third of patients (29.8%). These communications were most often localised in the anterior part of the hard palate and alveolar process and clinically reflected incomplete fusion of the mucosal-muscular layer. The presence of such communications had important functional significance – it disrupted the separation between the oral and nasal cavities, complicating sound formation and normal nasal breathing. During clinical examination, these children often showed air leakage through the nose when articulating or swallowing, indicating incomplete sealing of the oral cavity. In addition, these defects may be a chronic source of infection, promoting the development of rhinitis or inflammatory processes of the mucosa.

With regard to the condition of the mucosa, pathological changes were recorded in 70.2% of patients. The most common were scar changes (hypertrophic or retracted scars), which impaired mucosal elasticity, limited tissue mobility and led to formation of local depressions. In some cases, atrophic areas of mucosa in the postoperative scar zone were observed, formed due to disturbed microcirculation in the postoperative period. Such changes complicated repeated reconstructive interventions, as the changes reduced the possibility of adequate tissue mobilisation

without the risk of new scar formation. Comprehensive analysis showed that vestibular depth and mucosal status were functionally linked: correlation analysis revealed a moderate direct relationship between reduced vestibular depth and the severity score for mucosal changes ($r = 0.62$; $p = 0.008$). In children with pronounced reduction in vestibular depth (scores 2-3), scar-related mucosal contractures were more common, supporting the role of musculo-fascial tension in the development of secondary deformities. In such cases, the upper lip demonstrated a reduced range of motion, and tension during smiling promoted scar thinning and retraction of the vermilion border, contributing to secondary aesthetic asymmetry.

A descriptive co-occurrence was noted between oral-vestibular defects, particularly residual oronasal communications, and nasal asymmetry (columellar deviation and alar asymmetry), indicating morphological interdependence of nasolabial structures. From a clinical perspective, anatomical defects of the oral vestibule had pronounced functional significance. Insufficient vestibular depth or scar shortening of the anterior vestibule resulted in restricted upper-lip mobility and impaired lip closure, creating prerequisites for articulation disorders, particularly during the production of labial consonants (p, b, m), as well as for disturbed nasal breathing. In cases with more severe vestibular involvement (vestibular depth scores ≥3), incomplete lip closure at rest was observed, accompanied by compensatory chin elevation and increased activity of the lower-lip muscles. Prolonged muscular imbalance of this type contributed to secondary deformities of the lower facial region and disruption of profile harmony.

The results obtained showed that even minor morphological defects of the oral vestibule could have a substantial functional impact and therefore required early correction. Restoration of normal vestibular depth and mucosal elasticity should be regarded as a key stage in the comprehensive rehabilitation of children after cheilorhinoplasty. The optimal direction of correction is considered to be a combination of soft-tissue plasties with subsequent speech therapy and orthodontic support, which allows not only elimination of local anatomical defects but also restoration of the functional balance of the nasolabial complex. In summary, disturbances of the anatomy of the oral vestibule have a systemic character and are closely related to the severity of secondary changes in adjacent structures – the lip and nose. Timely diagnosis makes it possible not only to assess the extent of postoperative complications, but also to anticipate the potential need for revision interventions and prolonged rehabilitation.

Discussion

The study results showed that secondary postoperative deformities were observed in all children after primary unilateral cheilorhinoplasty, were predominantly of moderate severity and had a combined character. The most frequent changes were asymmetry of the nasal alae, displacement of the Cupid's bow, reduction in philtrum height and scar retractions in the central zone of the lip. The highest severity scores were recorded in the nasal structures, especially in the region of the alar cartilages. Disturbances of the anatomy of the oral vestibule were combined with restricted lip mobility and functional disorders of articulation and nasal breathing.

Secondary changes in the nasolabial region were identified in all children; in 57.9% aesthetic deformities prevailed, and in 42.1% anatomical defects with combined involvement of the lip, nose, and vestibule were present. In terms of severity, moderate forms dominated (47.4%), whereas severe deformities were recorded in 21.0% of cases, which indicated preservation of structural integrity with incomplete compensation of symmetry. A similar pattern was demonstrated in the study by C.A. Yao & J.B. Mulliken [13], where it was established that most patients required revision procedures during the first twenty years after primary correction. The authors linked this trend to the progressive influence of facial skeletal growth on reconstructed tissues, which explained the occurrence of residual deformities even after a technically sound operation. According to the classification presented by U.S. Hamdan *et al.* [14], secondary defects were regarded as a predictable stage of morphological adaptation after cheilorhinoplasty. In that work, it was emphasised that even with complete anatomical reconstruction, functional and aesthetic symmetry could be disrupted over time due to natural growth processes.

The dependence of the frequency of postoperative deformities on variants of the surgical protocol was shown in the work of P. Corthouts *et al.* [15], where the influence of different techniques on the growth of the midface was analysed. It was proved that the position of the flaps and the degree of tissue tension were key factors in the formation of residual asymmetries, which was consistent with the patterns identified. In the study by I. Roohani *et al.* [16] it was noted that early cheiloplasty improved the overall perception of appearance but was accompanied by an increase in the incidence of minor aesthetic defects. This effect was explained by the peculiarities of tissue healing in infants and incomplete prediction of growth processes, which corresponded to the obtained indicators of moderate forms of deformity. The importance of even slight morphological deviations was confirmed in the work of G. Bohneberger & N.M. Ernica [17], where the significant impact on the quality of life of children was established. The authors stressed that asymmetry in the lip and nose region affected not only appearance but also patients' social confidence. According to the meta-analysis by E.K. Branson *et al.* [18], the presence of facial asymmetry after cheilorhinoplasty was associated with an increased risk of psychological and social difficulties in childhood. The study showed that even moderate residual defects generated long-term emotional discomfort, which confirmed the clinical significance of the identified changes as a complex medico-psychosocial problem.

In the sample, the most frequent disorders of the upper lip were asymmetry of the Cupid's bow (80.7%), scar changes (73.7%) and reduction in philtrum height (66.7%), predominantly of moderate severity. The cumulative index of

morphological changes corresponded to a moderate severity level; most children had a combination of two or three defects. Persistence of asymmetry after reconstruction was confirmed in the study by Z.A. Khan *et al.* [19], where, even with the modified Delaire technique, significant differences between the operated and intact sides remained. It was established that the asymmetry was caused not only by surgical factors but also by asynchronous growth of the soft tissues in the philtral region. Difficulties in restoring stable upper-lip projection were described by M. Schwaiger *et al.* [20]. The researchers noted that complete symmetry after revision procedures was an exceptional phenomenon. The presence of residual asymmetries was regarded as an inevitable result of postoperative tissue remodelling. The influence of cheiloplasty technique on the formation of residual defects was shown by K.S. Abdullateef *et al.* [21], where the Millard method was more often accompanied by asymmetries, whereas the Tennison-Randall technique produced pronounced scar changes. Differences in flap tension and incision direction determined the morphological structure of the postoperative scar. A synthesis of techniques carried out by M. Zaidov [22] confirmed that excessive tissue tension in the suture zone increased the risk of forming retracted or hypertrophic scars. This pattern reflected the pathogenetic basis of the high frequency of scar contractures in cohorts after primary repair. The importance of the soft-tissue framework for lip stability and mobility was highlighted by A.I. Shaikh *et al.* [23], where it was noted that even anatomically correct reconstruction without an adequate muscular layer led to loss of functional range of motion. It was determined that the quality of restoration of the orbicularis oris muscle was the key factor in preventing postoperative deformities.

Within the structure of secondary changes, the nasal region proved to be the most problematic: asymmetry of the nasal alae was observed in 77.2% of children, deformities of the columella in 68.4%, and disturbances of the alar cartilages in 63.1%, with the cartilaginous framework showing the highest severity scores. The combination of these defects formed a typical picture of a "low" asymmetrical nose with functional limitation of nasal breathing. The need for structural reinforcement of the supporting framework in secondary reconstruction was substantiated by H. Yue *et al.* [24], who proved that the use of cartilage grafts ensured stability and long-lasting correction outcomes. It was demonstrated that deficiency of supporting elements was the main cause of recurrent deformities after primary cheilorhinoplasty. The effectiveness of open rhinoplasty with autologous cartilage was confirmed by B.C. Cho *et al.* [25], who showed the possibility of simultaneous restoration of nasal form and function. In the authors' study, it was emphasised that reconstruction of the cartilaginous structure directly influenced the patency of the nasal passages. The advisability of using septal cartilage to restore the columella and nostril symmetry was confirmed by H.L. Nguyen *et al.* [26]. The study demonstrated a reduction in residual columellar deviation and improvement in nasal aeration. The use of costal cartilage to correct asymmetry was described by Z. Zhang *et al.* [27], where increased reconstruction stability and a reduced risk of recurrence of deformity were noted. Both approaches reflected patterns similar to those observed in the present study, particularly the high frequency of hypoplasia of the alar cartilages. The functional effect of secondary rhinoplasty was summarised in the systematic review by J. Yuan & Y. An [28], which showed that elimination of morphological defects was accompanied by a significant improvement in nasal breathing. It was emphasised that reconstruction should be considered not only as an aesthetic, but also as a functional procedure.

In the present study, insufficient depth of the oral vestibule was found in 61.4% of children, pathological mucosal changes in 70.2%, and oronasal communications in 29.8%, which were accompanied by restricted lip mobility and impaired articulation. A moderate direct association between reduction in vestibular depth and severity of scar changes was established ($r = 0.62$; $p = 0.008$), as well as an association of oronasal fistulas with nasal deformities, indicating the systemic nature of involvement of the nasolabial complex. In the scoping review by M.S. Yusof & H.M. Ibrahim [29] it was demonstrated that residual oronasal and oropharyngeal disorders were associated with a marked reduction in quality of life in younger children. It was emphasised that even minimal functional defects of the mucosa or vestibule resulted in difficulties with speech, swallowing and social adaptation. The study by N.H. Nguyen *et al.* [30] showed that successful psychosocial rehabilitation of patients with clefts required a comprehensive multidisciplinary approach including speech therapy, orthodontic and psychological support. It was indicated that precisely such comprehensive rehabilitation minimised the consequences of vestibular scar contractures.

According to the data of S.M. Sarrami *et al.* [31], timely revision surgery for secondary deformities had to be based on an assessment of the functional potential of the mucosal-muscular layer, since its inadequate restoration determined the persistence of fistulas. The authors emphasised the importance of using soft-tissue plasties to prevent recurrent disruption of vestibular sealing. Similarly, V.L. Gille *et al.* [32] drew attention to the role of postoperative tissue stabilisation and the use of retainers in maintaining the restored anatomy after primary and revision procedures, which was consistent with the need to prevent repeated scarring of the mucosa. The dependence of local deformities on age-related anthropometric factors was shown by M.F. Arpacı *et al.* [33], where it was established that asymmetric development of facial structures intensified morphofunctional disorders of the vestibule. The study proved that even minor displacements of tissues in early childhood led to persistent anatomical defects, which fully corresponded to the identified tendency towards the formation of scar contractures in younger children.

Summarising the results, it was established that secondary morphological changes after primary unilateral cheilorhinoplasty involved all components of the nasolabial

complex and had a systemic character. The data obtained were consistent with the results of other studies confirming the interrelation between deformities of the lip, nose and vestibule, as well as the influence of surgical technique on long-term facial symmetry. The consistency of the results indicated common pathogenetic mechanisms and the need for a comprehensive approach to correction and rehabilitation of patients after cheilorhinoplasty.

Conclusions

Secondary postoperative changes in the nasolabial region were identified in 100% of children, which confirmed the regularity after primary unilateral cheilorhinoplasty. Aesthetic deformities accounted for 57.9%, anatomical defects for 42.1%, and the predominance of moderate forms (47.4%) indicated overall effective restoration of anatomical integrity while retaining residual asymmetry. Severe deformities with combined involvement of the lip and nose were recorded in 21.0% of children, which was explained by insufficient tissue mobilisation and disturbed functional integration of the orbicularis oris muscle. The absence of significant differences between right-sided (58.1%) and left-sided (57.7%) clefts indicated that the decisive factor in the formation of secondary defects was not the side of involvement but the quality of the primary reconstruction.

Within the structure of morphological changes of the upper lip, asymmetry of the Cupid's bow (80.7%), scar changes (73.7%) and reduction in philtrum height (66.7%) were most frequently detected, whereas the mean total severity score amounted to 10.5 ± 1.8 points, corresponding to a moderate level. Changes in the volume of the vermilion border (54.4%) and reduced lip mobility (50.9%) indicated a combination of aesthetic and functional components of the deformity. The highest mean severity scores were recorded for scar changes (2.2 ± 0.5) and asymmetry of the Cupid's bow (2.3 ± 0.4), which was explained by tissue tension in the suture zone and uneven reconstruction of the muscular layer. The identified dependence between operative technique and the nature of defects (Millard – asymmetry, Tennison-Randall – hypertrophic scars) highlighted the importance of choosing the surgical approach for the prevention of postoperative contractures.

The most frequent disorders were asymmetry of the nasal alae (77.2%), deviation of the columella (68.4%) and deformity of the alar cartilages (63.1%), which were accompanied by a mean severity score of 2.4 ± 0.3. The high frequency of combined defects (41.7%) indicated morphological interdependence of the nasal structures. The established correlation between the severity of upper-lip scarring and nasal deformities ($r = 0.68$; $p = 0.003$) confirmed a common mechanism of scar-induced tissue contraction. The highest severity scores were recorded for the alar cartilage (2.5 ± 0.3), which explained the instability of the cartilaginous framework under growth conditions. The obtained results indicated the need for structural reinforcement of the supporting nasal elements during primary and revision reconstructions to prevent secondary asymmetries.

Insufficient depth of the oral vestibule was found in 61.4% of children, scar changes of the mucosa in 70.2%, and oronasal communications in 29.8%, which pointed to a frequent combination of local anatomical defects with functional disorders. The moderate direct correlation between vestibular depth and severity of scarring ($r = 0.62$; $p = 0.008$) confirmed the role of musculo-fascial tension in the formation of secondary contractures. In children with pronounced reduction in depth (>2.5 points), difficulties with full lip closure and nasal breathing were observed, which indicated the functional nature of the deformities. It was revealed that vestibular defects had systemic significance, affecting articulation, breathing and aesthetics, and therefore should be a mandatory target of comprehensive rehabilitation after cheilorhinoplasty. The data obtained emphasised the need for a multidisciplinary approach to follow-up of such patients, involving a surgeon, orthodontist, speech therapist and otolaryngologist in order to achieve a complete functional and aesthetic outcome. Recommendations for further research included expanding the age range of the sample and introducing dynamic monitoring of long-term outcomes to clarify the influence of growth and surgical factors on the formation of secondary deformities.

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Conflict of Interest

None.

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Аналіз вторинних деформацій губи та носа у дітей після первинної однобічної хейлоринопластики

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Анотація. Метою дослідження було комплексне вивчення морфологічних і функціональних особливостей вторинних деформацій губи й носа у дітей після первинної однобічної хейлоринопластики та визначення їхніх ключових структурних проявів. Дослідження проведено у відділенні пластично-реконструктивної мікрохірургії Національної дитячої спеціалізованої лікарні «Охматдит» у Києві з 2023 по 2025 рік, у межах якого обстежено 57 дітей з однобічними розщілинами із оцінкою параметрів трьох анатомічних зон (верхньої губи, носа та присінка порожнини рота) у віддаленому періоді після первинної хейлоринопластики, проведеної в інших медичних закладах. У результаті дослідження встановлено, що вторинні післяопераційні зміни назо-лабіальної ділянки спостерігалися у всіх дітей (100 %), серед яких естетичні деформації виявлено у 57,9 %, а анатомічні дефекти – у 42,1 %. Переважали помірні форми тяжкості (47,4 %), тоді як легкі становили 31,6 %, а тяжкі – 21,0 %. Найчастішими морфологічними змінами верхньої губи були асиметрія дуги Купідона (80,7 %), рубцеві зміни (73,7 %) та зниження висоти фільтрума (66,7 %), що поєднувалися з порушенням рухливості у 50,9 % дітей. У структурі носа переважали асиметрія крил (77,2 %), деформації колумели (68,4 %) і гіпоплазія крилоподібного хряща (63,1 %). У присінку порожнини рота частими були зменшення глибини (61,4 %), рубцювання слизової оболонки (70,2 %) та ороназальні сполучення (29,8 %). Виявлено кореляцію між вираженістю рубцевих змін і зменшенням глибини присінка (r=0,62; p=0,008), що вказує на системний характер вторинних порушень. Отримані результати підтвердили, що вторинні деформації назо-лабіальної ділянки після первинної хейлоринопластики мають системний характер із переважанням естетичних порушень помірного ступеня. Дані можуть бути використані хірургами, ортодонтами й логопедами для планування реконструктивних та реабілітаційних втручань у дітей

Ключові слова: розщілина; аплазія хряща; піднебіння; присінок порожнини рота; реконструктивні втручання; первинна операція; асиметрія