

Cephalometric Evaluation of Upper Lip Symmetry after Functional Unilateral Cleft Lip Repair with the Kernahan and Bauer Technique and Primary Cleft Rhinoplasty

Alex Margulis MD, Ehud Alperson* and Allan Billig MD

Department of Plastic Surgery, Hadassah University Medical Center (Ein Kerem Campus), Jerusalem, Israel

ABSTRACT: **Background:** Cleft lip repair with the Millard technique has undergone many modifications throughout the years, yet analysis of the successes of these various methods is still lacking.

Objectives: To make a quantitative evaluation of the outcomes obtained after unilateral cleft lip surgical repair using the Kernahan and Bauer technique with primary rhinoplasty.

Methods: Five anatomical parameters for evaluating upper lip and nostril symmetry were compared between the cleft and the normal side at least 1 year post-surgery in 23 children who underwent unilateral cleft lip repair with this particular technique.

Results: Surgical success (defined as a 10% or less deviation between the cleft and contralateral side) was achieved for four of the five parameters: distance between oral commissure and peak of Cupid's bow, nasal sill width, distance between peak and lowest point of Cupid's bow, and vertical distance between the highest point of the philtral column and lowest point of the upper lip. Surgical success was not achieved for the last parameter: length of philtral column.

Conclusions: Unilateral cleft lip repair using the Kernahan and Bauer technique with primary cleft rhinoplasty is mostly successful when aiming to achieve symmetry between the cleft and the normal side of the upper lip. Success was elusive in achieving symmetry between the philtral columns despite an overall average difference of only 1.2 mm.

IMAJ 2014; 16: 693–696

KEY WORDS: cleft lip, cephalometry, rhinoplasty, philtral column, Cupid's bow

Surgeons have been repairing cleft lip deformities for 2000 years since it was first attempted during the Qin Dynasty in China. Today, unilateral cleft lip is one of the most common congenital craniofacial anomalies treated by plastic surgeons, and its incidence in the general population worldwide is approximately 0.5 per 1000 births [1,2]. The etiology is multifactorial,

and this condition may be accompanied by other syndromic malformations. Long-term sequelae of cleft lip malformation may include difficulty in oral continence, speech disability, and other psychological effects stemming from a negative self-image. Therefore, ideal treatment involves a multidisciplinary approach incorporating dentists, audiologists, orthodontists, speech therapists, psychologists, plastic surgeons, and others. Ultimate treatment necessitates surgical intervention, which is commonly performed at age 3 months.

Surgical techniques for unilateral cleft lip repair are varied, and there is no one prevailing method or standard. Originally, straight-line closure techniques were prevalent, yet with time Mirault [3] advocated incorporation of local upper and lower lip flaps to close the deficit via advancement of tissue from one side of the cleft to the other. Numerous flap designs exist for cleft lip closure, among them the lateral quadrilateral flap by Le Mesurier [4], and the lateral triangular flap by Tennison [5]. Despite the range of variation, the most commonly applied base technique worldwide today is the medial rotation and lateral advancement flap technique originally introduced by Millard [6] in 1955. What the Millard technique offered and others failed to provide was preservation of Cupid's bow and the philtral dimple. With time, primary nasal reconstruction addressing nasal tip asymmetry at the time of cleft lip repair became widely accepted [7], simplifying the definitive secondary rhinoplasty often necessary in these patients during adolescence. Since its introduction more than 50 years ago, there have been many modifications of the Millard technique, and partiality of one over the other remains a personal surgical preference rather than a statistically proven champion.

The purpose of this study was to evaluate the lip and nasal symmetry in children with unilateral cleft lip treated with the functional unilateral cleft lip repair by Kernahan and Bauer [8] combined with primary cleft rhinoplasty.

PATIENTS AND METHODS

In this retrospective cohort study, each subject served as his or her own control, i.e., the repaired cleft and nostril was compared with its non-deformed counterpart. The study

*Medical student at Hebrew University-Hadassah Medical School

Figure 1. Diagram of cephalometric parameters of the upper lip: A) the distance between the oral commissure and the peak of Cupid's bow on each side, B) the length of the philtral columns, C) the width of the nasal sills, D) the distance from the peak of Cupid's bow on each side to the lowest point on Cupid's bow, and E) the vertical distance between the superior point of the philtral column (directly below the columella) and the inferior border of the upper lip



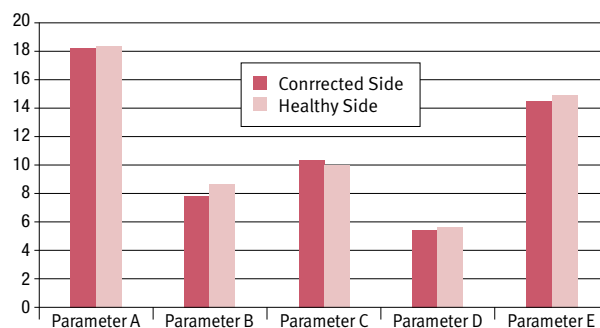
Figure 2. Intraoperative photograph of left unilateral and complete cleft lip deformity [A], and postoperative photograph of same patient [B] after cleft lip repair via the Kernahan and Bauer technique with primary cleft rhinoplasty



group consisted of 23 patients, both male and female, born with non-syndromic unilateral and complete cleft lip deformity. Whether or not nasolabial molding was performed on our subjects was not recorded. All patients were operated on at age 3 months by the senior author during the years 2003 and 2008. Measurements of the cleft and non-cleft sides were conducted approximately 1 year after surgical repair. All measurements were carried out with the same digital caliper and by the senior author for each measurement parameter and not extrapolated from accompanying photographs. Patient consent was obtained from each subject after the study was approved by the Hadassah Medical Center Helsinki Committee.

The anatomical landmarks and distances between them that were measured were: A) the distance between the oral commissure and the peak of Cupid's bow on each side, B)

Figure 3. Average distances of the healthy and corrected sides for each parameter



the length of the philtral columns, C) width of the nasal sills, D) the distance from the peak of Cupid's bow on each side to the lowest point on Cupid's bow, and E) the vertical distance between the superior point of the philtral column (directly below the columella) and the inferior border of the upper lip [Figure 1].

The authors acknowledged surgical success when each average parameter variation between healthy and corrected side was no larger than 10%. Differences between corrected and healthy sides were evaluated using the Wilcoxon signed rank test. We describe the absolute differences using the mean (with standard deviation), median (with interquartile range), and minimum and maximum values. We used the frequency table to describe the percentage of patients with less than 5%, 10% and 15% differences between the healthy and corrected sides. All the data were organized within an Excel (Microsoft 2008) spreadsheet, and subsequently analyzed using SPSS statistics version 21. $P < 0.05$ was defined as statistically significant.

RESULTS

The bidirectional variation of lengths (in millimeters) between the corrected and the healthy side after functional repair of unilateral cleft lip using the Kernahan and Bauer technique with primary rhinoplasty is shown in Figure 2, presented in Table 1, and summarized in Figure 3. Surgical success (defined as a 10% or less bidirectional deviation between the sides) was obtained for parameter A (distance between each oral commissure to the peak of Cupid's bow on the relevant side), parameter C (nasal sill width), parameter D (distance between peak of Cupid's bow on each side to the lowest point of Cupid's bow), and parameter E (vertical distance between the superior point of the philtral column and the inferior border of the upper lip). The results of the surgical technique chosen were not successful (more than 10% difference between healthy and corrected sides) when comparing the philtral column length (parameter B) between the corrected and healthy side, despite an average absolute difference of only 1.2 mm.

After statistical analysis for the majority of parameters (A–E), it was found that the *P* value for the average difference between healthy and corrected sides was more than 0.05, thus supporting our null hypothesis that there is no real difference between sides. However, when the Wilcoxon signed rank test was applied, parameter B showed a *P* value of less than 0.05, thus supporting a statistically significant difference between the healthy and corrected sides of the philtral columns.

DISCUSSION

Despite the various techniques available for unilateral cleft lip repair, no one method provides flawless results and each method of correction comes with its own set of inherent disadvantages. Many studies have attempted to compare the efficacy of one method over another [9-19], but lack of standardization has proven an obstacle for obtaining conclusive results. This study aims to objectively evaluate the symmetry of results of complete unilateral cleft lip repair using the Kernahan and Bauer technique with primary rhinoplasty. This aim was achieved by measuring various parameters of the upper lip and nose and making comparisons between the corrected and healthy sides.

Kernahan and Bauer emphasized the need for a functional orbicularis muscle reconstruction in 1983 [7,8]. Following accurate and anatomical muscle repair, skin closure is carried out, typically employing one Z-plasty at the nostril floor and a second Z-plasty approximately 1 mm above the mucocutaneous junction. The goal of these cutaneous Z-plasties is to obtain the needed length of the cleft side philtral column and subsequent symmetry between both halves of the upper lip. As stated, additional primary rhinoplasty to this cleft lip repair technique further enhances the appearance of the commonly associated nasal alar deformity, and this is achieved by dissection of the lower lateral alar cartilage on the cleft side, followed by application of the Tajima suture on the cleft side. The importance of primary rhinoplasty during cleft lip repair is to narrow the width and reintroduce the normal flare of the cleft-side nostril, and thus achieve symmetry not only between both sides of the upper lip but between the nostrils as well [1,13]. Briefly, the surgical technique involves presurgical marking of anatomical landmarks on the upper lip and nostril, lifting the L-flap, separating the orbicularis muscle from the overlying skin and underlying oral mucosa, undermining the skin from of the lower lateral cartilage and nasal tip of the cleft side, placement of Tajima sutures within the cleft side nostril, and suturing the oral mucosa, the orbicularis muscle, and finally the overlying skin with an upper Z plasty around the nasal sill and a lower Z-plasty at the vermilion border [7,8].

For any cleft lip repair technique aiming to achieve maximal aesthetic results, it must prioritize the quality and symmetry of Cupid’s bow, the philtral columns with a well-aligned white roll, a philtral dimple, slight pout of the vermilion tubercle, and

Table 1. Quantitative data collected from all the patients in this study

Patient	Parameter									
	A	A'	B	B'	C	C'	D	D'	E	E'
1	19	20	7	7	11	10.5	5	5	17	18
2	22	22	9	9	9	10	4	4	15	19
3	19	18	9	11	12	12	5	5	17	16
4	18	19	15	17	15	13	7	7	17	16
5	16	17	9	10	9	8	5	5	12	11
6	20	20	8	10.5	13	13	7	8.5	18	18
7	22	19	8	10	10	9.5	7	7	16	15
8	20	20	8	9	14	13.5	5	7	16	16
9	16	16	5	6	12	11	5	5.5	16	16.5
10	18	19	7	8	11	9	5	6	14	14
11	18	18	6	10	9	9	6	6	12	13
12	18	19	3	4	9	9	4	4	13	15
13	19	19	10	10	8	8	5	5	13	15
14	12	12	6	8	10	9	4	4	13	13
15	23	23	10	11	10	9	6	6	14	15
16	19	20	7	7	11	11	5	6	15	15
17	17	17	7	9	10	11	7	7	14	15
18	15	16	6	7	11	10	5	5	14	13.5
19	21	22	10	7	10	10	7	7	14	15
20	18.5	19	9	9	11	12	6	6	14	15
21	20	20	9	10	6.5	7	4	4	10	10
22	20	20	6	6	10	10	5	4	15	14
23	22	22	9	10	11	11	6	7	26	26
Mean difference (SD)	0.54 (0.72)		1.24 (1.06)		0.61 (0.62)		0.35 (0.59)		0.87 (0.91)	
Median (IQR)	0 (0-1)		1 (0-2)		0.5 (0-1)		0 (0-1)		1 (0-1)	
Min, Max	0, 3		0, 4		0, 2		0, 2		0, 4	
Average % difference	1%		11%		3%		5%		2%	
Wilcoxon signed rank test <i>P</i> value	0.130		0.003		0.115		0.071		0.154	
% of subjects with less than 15%, 10%, and 5% difference	98.7%, 95.7%, 82.6%		60.9%, 43.5%, 30.4%		95.7%, 78.3%, 52.2%		78.3%, 74.0%, 73.9%		95.7%, 87%, 39.2%	
% of patients with no difference	52.2		26.09		39.13		69.57		30.43	

For each parameter category, the prime symbol designates the healthy side

symmetry of the nostrils and nasal sills. Furthermore, it should minimize the apparent scar at the base of the columella.

In the study presented here, unilateral complete cleft lip repair using the Kernahan and Bauer technique with primary rhinoplasty [7,8] was evaluated by measuring the differences of various parameters between the corrected and healthy sides of the face. In other words, the healthy side of the face served as the control “group” to which the corrected side was compared. Five parameters of the upper lip and nose were chosen for measurement, namely the distance between the oral commissure and the peak of Cupid’s bow on each side (A), length of

the philtral columns (B), width of the nasal sills (C), distance between the peak of Cupid's bow on each side to the lowest point on Cupid's bow (D), and vertical distance between the superior point of the philtral column (directly below the columella) and the inferior border of the upper lip (E).

Of the 23 patients evaluated approximately 1 year post-surgery, it was found that four of the five parameters showed minimal differences between the healthy and corrected sides (average difference of 10% or less), while one parameter failed to sustain a difference of 10% or less (namely, parameter B: the length of the philtral columns). When comparing corrected and healthy sides for this particular parameter, the average difference between the sides was approximately 11%, which was not satisfactory given the decided-upon threshold. Furthermore, when applying the Wilcoxon signed rank test, parameter B had a *P* value less than 0.05 and thus reflected a statistically significant difference between the healthy and corrected sides of the philtral columns.

CONCLUSIONS

Despite the many surgical techniques available for unilateral cleft lip repair, the predominance of one method over the other is commonly due to surgical preference rather than proven superiority. This study aims to provide insight into the predominantly successful results obtained when applying the technique of Kernahan and Bauer with primary rhinoplasty. Five anatomical parameters were chosen and average differences between healthy and corrected sides for each parameter were measured. Four of the five parameters exhibited "surgical success" (difference of $\leq 10\%$ between healthy and corrected sides), while one parameter failed to remain within this 10% range. Despite the need for a larger study group in order to achieve better statistical and conclusive results, the surgical technique described here is largely successful in achieving overall symmetry of the upper lip and nostril regions.

Correspondence

Dr. A. Billig

Dept. of Plastic Surgery, Hadassah University Medical Center, P.O. Box 12112, Jerusalem 91120, Israel

Fax: (972-2) 641-8868

email: abillig@gmail.com

References

- Flores RL, Sailon AM, Cutting CB. A novel cleft rhinoplasty procedure combining an open rhinoplasty with the Dibbell and Tajima techniques: a 10-year review. *Plast Reconstr Surg* 2009; 124 (6): 2041-7.
- Silberstein E, Silberstein T, Elhanan E, Bar-Droma E, Bogdanov-Berezovsky A, Rosenberg L. Epidemiology of cleft lip and palate among Jews and Bedouins in the Negev. *IMAJ* 2012; 14: 378-81.
- Mirault G. Deux lettres sur l'operation du bec-delièvre. *J Chir* 1844; 2: 257.
- Le Mesurier AB. A method of cutting and suturing the lip in the treatment of complete unilateral clefts. *Plast Reconstr Surg* 1949; 4: 1-12.
- Tennison CW. The repair of unilateral cleft lip by the stencil method. *Plast Reconstr Surg* 1952; 9: 115-20.
- Millard RC. *Cleft Craft*. Vol. 1.3. Boston: Little Brown, 1976.
- Kernahan DA, Bauer BS, Harris GD. Experience with the Tajima procedure in primary and secondary repair in unilateral cleft lip nasal deformity. *Plast Reconstr Surg* 1980; 66: 46-53.
- Kernahan DA, Bauer BS. Functional cleft lip repair: a sequential layered closure with orbicular muscle realignment. *Plast Reconstr Surg* 1983; 72: 459-67.
- Mercado A, Russell K, Hathaway R, et al. The Americleft study: an inter-center study of treatment outcomes for patients with unilateral cleft lip and palate. Part 4. Nasolabial Aesthetics. *Cleft Palate Craniofac J* 2011; 48 (3): 259-64.
- Chang CS, Por YC, Liou EJ, Chang CJ, Chen PK, Noordhoff MS. Long-term comparison of four techniques for obtaining nasal symmetry in unilateral complete cleft lip patients: a single surgeon's experience. *Plast Reconstr Surg* 2010; 126 (4): 1276-84.
- Reddy GS, Webb RM, Reddy RR, Reddy LV, Thomas P, Markus AF. Choice of incision for primary repair of unilateral complete cleft lip: a comparative study of outcomes in 796 patients. *Plast Reconstr Surg* 2008; 121 (3): 932-40.
- Koh KS, Kim EK. Management of unilateral cleft lip nose deformity, with retracted ala of the noncleft side. *Plast Reconstr Surg* 2006; 118 (3): 723-9.
- J Barillas I, Dec W, Warren SM, Cutting CB, Grayson BH. Nasoalveolar molding improves long-term nasal symmetry in complete unilateral cleft lip-cleft palate patients. *Plast Reconstr Surg* 2009; 123 (3): 1002-6.
- Heller M, Schmidt M, Mueller C, Thorwarth M, Schultze-Mosgau S. Clinical-anthropometric and aesthetic analysis of nose and lip in unilateral cleft lip and palate patients. *Cleft Palate Craniofac J* 2011; 48 (4): 388-93.
- Pigott RW, Pigott BB. Quantitative measurement of symmetry from photographs following surgery for unilateral cleft lip and palate. *Cleft Palate Craniofac J* 2010; 47 (4): 363-7.
- Bilwatsch S, Kramer M, Haeusler G, et al. Nasolabial symmetry following Tennison-Randall lip repair: a three-dimensional approach in 10-year-old patients with unilateral clefts of lip, alveolus and palate. *J Craniomaxillofac Surg* 2006; 34 (5): 253-62.
- Reddy SG, Reddy RR, Bronkhorst EM, Prasad R, Kuijpers Jagtman AM, Bergé S. Comparison of three incisions to repair complete unilateral cleft lip. *Plast Reconstr Surg* 2010; 125 (4): 1208-16.
- Byrd HS, Salomon J. Primary correction of the unilateral cleft nasal deformity. *Plast Reconstr Surg* 2000; 106: 1276-86.
- Rottgers SA, Jiang S. Repositioning of the lower lateral cartilage in primary cleft nasoplasty: utilization of a modified Tajima technique. *Ann Plast Surg* 2010; 64 (5): 691-5.