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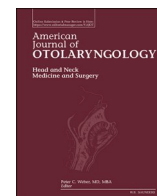
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The unilateral cleft lip repair

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ABSTRACT

Objective: To determine if there is a benefit of 2-stage cleft lip repair in regard to improving facial symmetry and facilitating definitive lip, nose, and palate repair.

Study design: Retrospective chart review of patients born with complete, unilateral cleft lip deformity that underwent a two-stage repair described as a stage 1 straight line repair and a stage 2 modified Millard repair, for which a complete set of records, and peri-operative and post-operative photos were available. All cases were performed by a single surgeon.

Setting: Tertiary care center craniofacial team.

Methods: Measurements were taken from intraoperative, perioperative, and postoperative images of patients before and after each stage. Ratios were then created comparing the affected size to the unaffected side, and these were averaged between observers.

Results: A 19% increase in the width of area of the presumptive C flap was obtained between the unrepaired and the post-stage I images. The nostril width of the cleft side was 1.2× the width of the unaffected side, demonstrating a 140% decrease in nostril width at the completion of stage II. The cleft side nostril width was maintained slightly larger than the noncleft side as desired. Symmetry of the upper lip length was achieved, as the length of the cleft side lateral lip after stage II was 92% of the unaffected side.

Conclusion: We believe this study provides evidence for our observations that a two-stage repair can be performed with functionally and aesthetically pleasing outcomes as an alternative to presurgical nasolabial molding.

1. Introduction

Repair of the unilateral cleft lip is a controversial topic which continues to evolve. The goal of unilateral cleft lip repair is to create a functional and cosmetically acceptable lip and nose, with the lowest reasonable cost and burden to the families of these patients.

Presurgical naso alveolar molding (PNAM) is a development in cleft care that allows for shaping and contouring of the lip and nose for easier closure and delay in the timing of surgery. Advocates of PNAM also claim better results than with traditional single stage cleft repair. However, PNAM is time intensive, expensive and requires frequent visits to clinic for adjustments, which is often less feasible depending on patient demographics.

In 2007, we described our institution's two stage unilateral repair technique as an alternative to PNAM [1]. Briefly, we perform our first stage full-thickness, 3-layer straight line procedure at 4–6 weeks of age

usually with a tip rhinoplasty. As the child grows, the alveolar segments are brought closer together by orbicularis oris function. At 6 months of age, a modified Millard repair procedure is performed. We reported the advantages of the two-stage procedure to be increase in length of the cleft-side philtral ridge and widening of the tissue used for the C-flap after the first stage. These changes reduce the amount of A-flap rotation required to obtain adequate cleft side philtral ridge length. The changes also permit C-flap closure of the rotation defect during the second stage instead of B-flap advancement, avoiding a lateral sill incision extending into the lateral ala. This eliminates lateral scarring and with tip rhinoplasty creates a wider cleft side nostril. Additionally, the lip scar follows the philtral ridge up close to the nasal sill rather than tracking diagonally across the mid philtrum making it more linear and cosmetically acceptable. We also noted increased symmetry of the cleft side lateral lip from philtrum to lateral commissure, and overall increase in the cleft side nostril width. We present a single surgeon case series of 23 children

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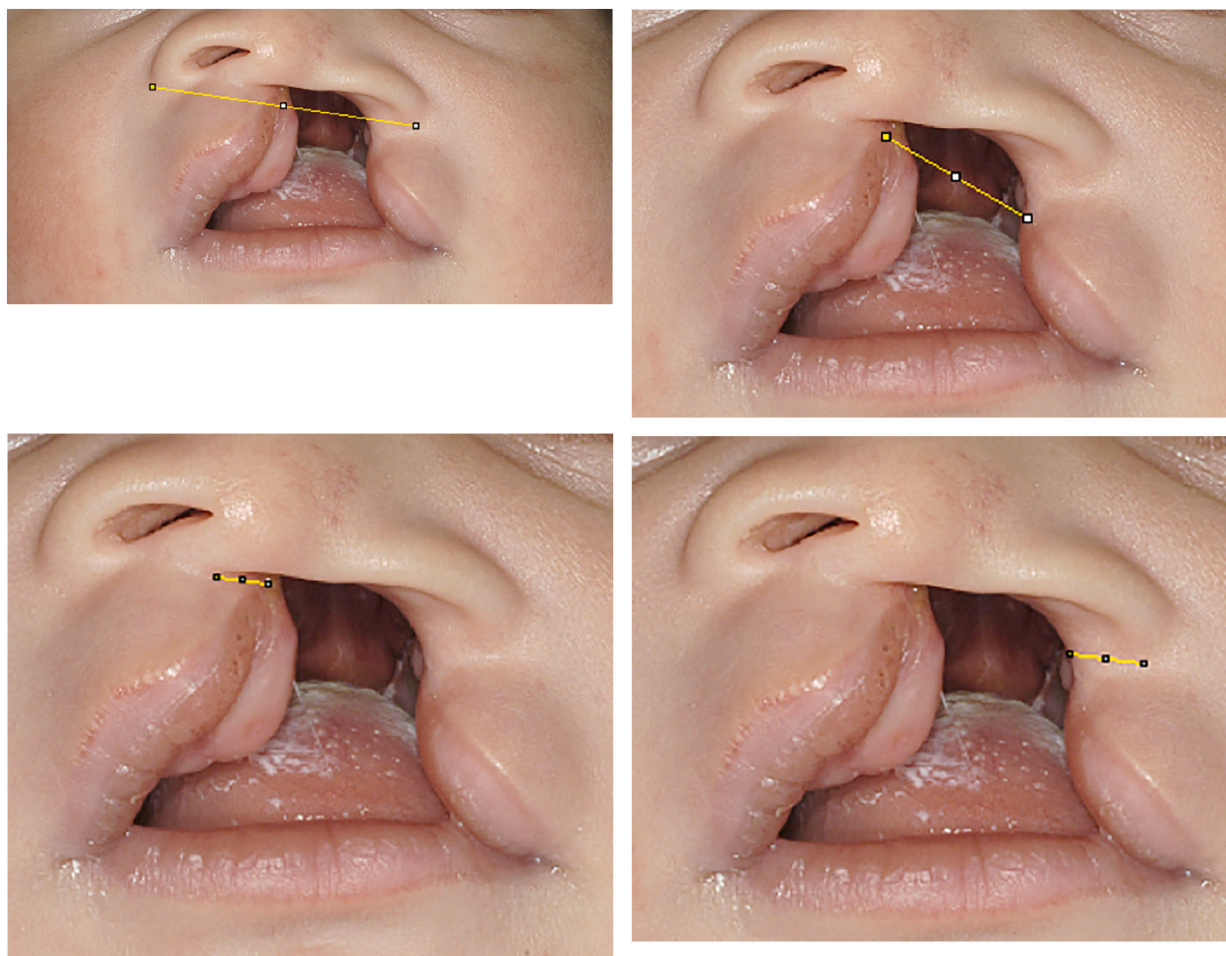


Fig. 1. 1.1. Example, unrepaired stage, alar base. 1.2. Unrepaired stage, cleft margin to cleft margin. 1.3 Unrepaired stage, cleft margin to columella. 1.4 Unrepaired stage, cleft margin to lateral alar rim.

who underwent the two-stage protocol from the years 2001–2014 as a proof of concept.

2. Methods

This retrospective chart review was approved by the SUNY Upstate Medical University Institutional Review Board for exemption from complete review. Collected data included patient demographics, information from the medical records of an academic multidisciplinary Cleft and Craniofacial Center at Upstate Medical University's medical records peri-operative clinic photos. Patient identifying information was protected and patients were identified by their unique medical record number.

Inclusion criteria for this study included patients born with complete, unilateral cleft lip deformity that underwent a two-stage repair by a single surgeon for which a complete set of records, and peri-operative and post-operative photos were available. Exclusion criteria included bilateral cleft lip, incomplete cleft and completion of only a single stage repair.

Our dataset consists of patients who underwent a two-stage repair described as a stage 1 straight line repair and a stage 2 modified Millard repair [1]. Measurements were taken from intraoperative, perioperative, and postoperative images of patients before and after each stage. Anatomical measurements comparing the patient's images throughout their operative course were performed by two separate investigators using Image J software, and averaged to reduce observer bias. Image J measured distances in images while accounting for image pixel

differences. Ratios were then created comparing the affected size to the unaffected side, and these were averaged between observers. Examples can be seen in Fig. 1.

Anatomic measurements for the unrepaired stage include philtral column height, cleft margin to lateral commissure, Cupid's bow high point to lateral commissure, cleft margin distance, distance between cupid's bow peaks, nostril width, cleft margin to lateral alar rim, cleft margin to columella and alar base.

Measurements for the post-stage 1 and post-stage 2 include philtral column height, cupid's bow peak to lateral commissure, distance between cupid's bow peaks, nostril width, cleft scar to lateral alar rim, cleft scar to columella and alar base.

The non-cleft side was used to serve as an internal control to assess progression between the repairs after each stage. Ratios were created using these measurements and averaged across all subjects allowing for analysis.

3. Results

3.1. Patient Demographics

We analyzed 28 patients undergoing a 2-stage procedure at our institution between January 1, 2001 and December 31, 2014. 65% were male, 35% female. All were non-syndromic. 74% were associated with a cleft palate. Left and right sided clefts were distributed nearly evenly. 65% of patients utilized Medicaid for insurance.

3.2. Data Analysis

The length of the philtral height, and the area to become the C-flap in the stage II procedure was measured for all patients pre-operatively and after stage I. Pre-operatively, the length of the cleft margin to columella was used as a proxy for future C-flap width. After stage I and prior to stage II, the C-flap width was considered to be the measurement between the stage I straight line scar and the cleft side of the columella. A 19% increase in the width of area of the presumptive C flap was obtained between the unrepaired and the post-stage I images. The length of the C-flap was estimated using philtral height measurements.

The philtral height of the cleft was 47% of non-affected side prior to any surgical intervention. We found a 22% increase in the philtral height of the cleft side between the unrepaired and post-stage I images. Furthermore, after stage II there appeared to be an additional 24% increase in philtral height length, with a total of a 46% gain in cleft side philtral height after undergoing a two-stage procedure.

The nostril width of the cleft side prior to repair was $2.65\times$ the length of the unaffected side. After undergoing a stage I repair, the cleft side nostril width was $1.4\times$ larger than the unaffected side. After a stage II repair, the nostril width of the cleft side was $1.2\times$ the width of the unaffected side, demonstrating a 140% decrease in nostril width at the completion of stage II.

The length of the upper lip of the cleft side was $1.35\times$ unaffected side length in unrepaired patients, using the cleft margin to lateral commissure of the cleft side compared to the cupid's bow high point to lateral commissure of the unaffected side. After undergoing stage I repair, the length of the cleft side lateral lip was $1.1\times$ the unaffected side. The length of the cleft side lateral lip after stage II was 92% of the unaffected side.

4. Discussion

We have attempted to objectively analyze our surgical outcomes over a thirteen-year period using analysis of pre- and post-operative photographs in our unilateral cleft lip patients. In our 2007 publication, we made several qualitative observations that are now supported by the data in this study. We had observed in our patients undergoing the two stage procedures, the first stage had allowed for muscle pull and overall growth of the cleft side philtral ridge, which we have now demonstrated with our finding of increased area of tissue to become the

C-flap and increased symmetry of the philtral heights. Furthermore, we demonstrated our improvement in the overall appearances of the cleft lip stigmata, including maintaining good cleft side nostril width and improved lateral lip symmetry.

There are several weaknesses of the study. The sample size is small, in part due to the need for availability of a full set of pre- and post-operative photos throughout the child's operative history. Additionally, because the photos were taken in a variety of settings with different cameras at different distances, we were not able to compare absolute measurements of the structures being studied. Rather we performed relative measurements creating ratios comparing the changes in the parameters we chose.

We believe this study provides evidence for our observations that a two-stage repair can be performed with functionally and aesthetically pleasing outcomes as an alternative to PNAM. We advocate for the use of a two-stage procedure to improve outcomes when presurgical nasoalveolar molding is unavailable or undesirable.

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CRediT authorship contribution statement

Jeewanjot S. Grewal, MD: Study design, data collection, data analysis, manuscript writing, editing, and correspondence.

Susan C. Yanik, MD: Study design, data collection, data analysis, manuscript writing and editing.

Alexis M. Strohl-Bryan, MD: Study design, data collection, data analysis, manuscript writing and editing.

Sherard A. Tatum, MD: Study design, manuscript writing and editing.

Declaration of competing interest

None.

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