7. Algorithmic Approach to Unilateral Cleft Lip Repair

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SURGICAL GOALS

- Lengthen cleft lip height to vertical height of non-cleft side
- Balance Cupid's Bow
- Reorient and re-establish orbicularis oris
- Establish continuity of white roll
- Establish continuity of red line
- Re-establish philtrum column
- Recreate philtral dimple/tubercle pout
- Primary repair of cleft nose deformity

Key Points:

- Lowest point Cupid's bow
- Peak Cupid's bow noncleft side
- Proposed peak Cupid's bow cleft side
- Midpoint columella
- Base columella noncleft side
- Base columella cleft side
- Insertion alar base into nasal sill cleft side
- Position Cupid's bow lateral lip element (Nordhoff's point)

Nordhoff's point: (Future) peak of Cupid's bow lateral lip element

- Well developed white roll
- Well developed vermillion
- Same horizontal height as peak of Cupid's bow noncleft side
- Distance of alar crease to height of Cupid's bow on noncleft side duplicated on cleft side

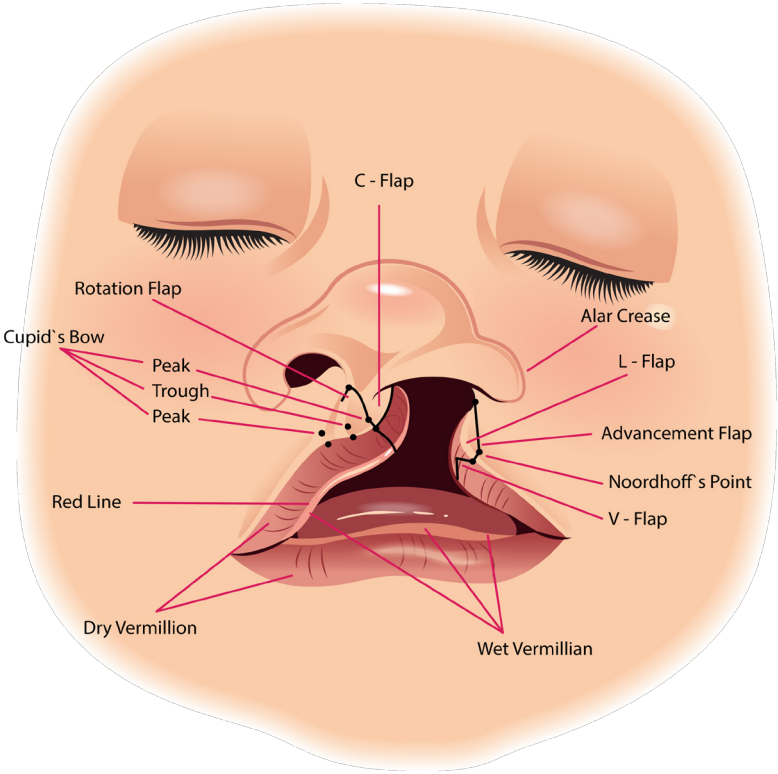

Figure 7-1. Unilateral cleft lip with markings. © 2017 A Campbell, C Restrepo

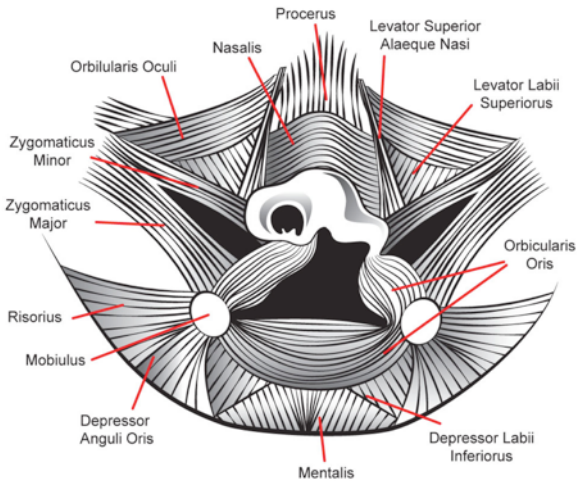

Figure 7-2. The orbicularis oris is discontinuous in unilateral cleft lip, abnormally inserting onto the alar base/ piriform aperature on the cleft side and onto the nasal spine on the noncleft side. © 2017 A Campbell, C Restrepo

CLEFT SEVERITY INDEX

- Cleft lip and palate represent a spectrum of disease ranging from minimal disruptions to major deformities.
- The Cleft Severity Index is a validated evaluation tool based on defined guidelines that evaluate the overall appearance of the deformity, and separates patients into four categories according to the severity of their primary deformity.
- Grade I through Grade 4 cleft lip/nose deformities are defined according to the progressive degree of lip and nose involvement.

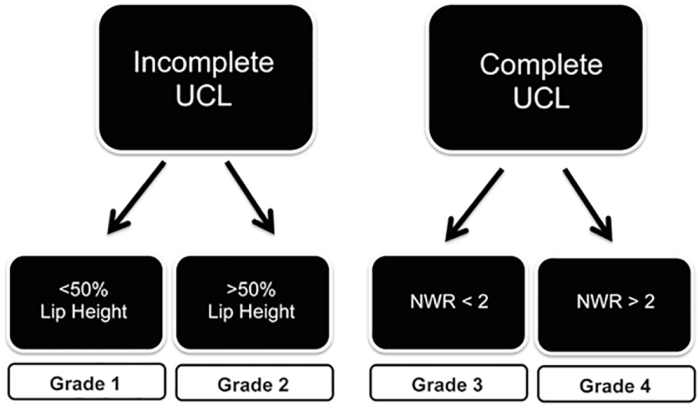

Figure 7-3. Flow chart to grade severity according to the Unilateral Cleft Lip Severity Index. Campbell A, Restrepo C, Despande G, et al. Validation of a Cleft Severity Index of Primary Unilateral Cleft Lip and Nose Deformities for Surgeons and Laypersons. Pending Publication. © 2017 A Campbell, C Restrepo

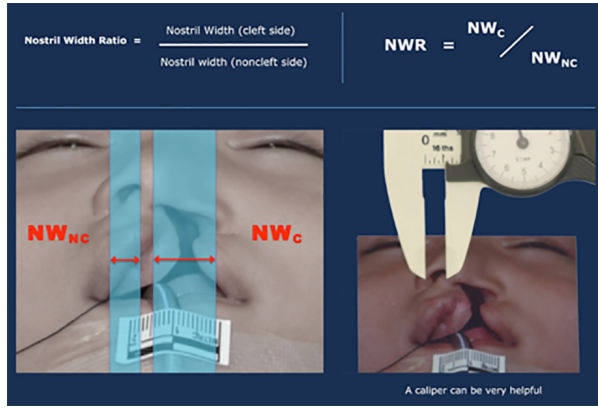

Figure 7-4. Calculation of nostril width ratio. A caliper can be helpful. Campbell A, Restrepo C, Despande G, et al. Validation of a Cleft Severity Index of Primary Unilateral Cleft Lip and Nose Deformities for Surgeons and Laypersons. Pending Publication. © 2017 A Campbell, C Restrepo

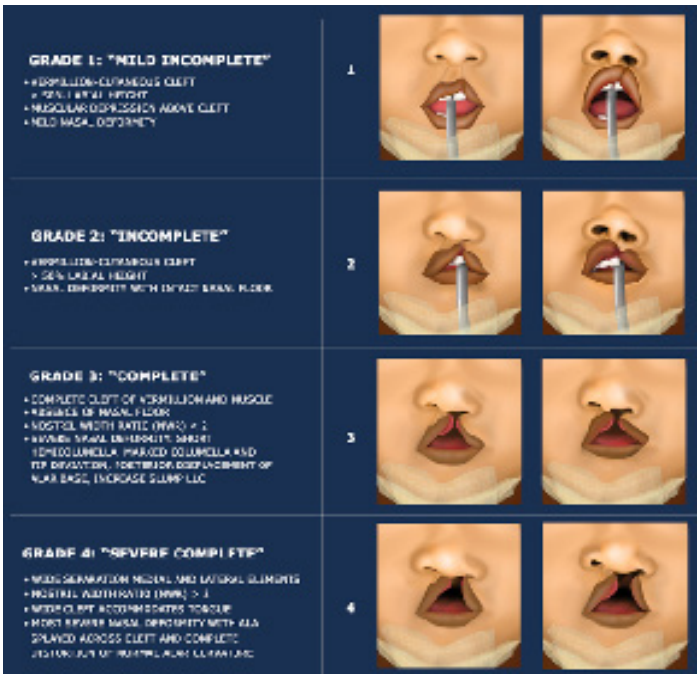

Figure 7-5. Criteria and examples demonstrating each of the four grades of the Cleft Severity Index. Campbell A, Restrepo C, Despande G, et al. Validation of a Cleft Severity Index of Primary Unilateral Cleft Lip and Nose Deformities for Surgeons and Laypersons. Pending Publication. © 2017 A Campbell, C Restrepo.

SURGICAL TECHNIQUE

- The Algorithmic Approach to Unilateral Cleft Lip Repair is based on a rotation advancement (Millard) technique with columellar extension (Mohler) and complete releasing and repositioning of all displaced nasal and lip elements in all three planes of space.
- Advantages:
  - "Free" donor site from columella
  - Scar lies in philtral column
  - Less advancement of lateral flap necessary
  - No transverse component incision
  - Straight line closure of lip

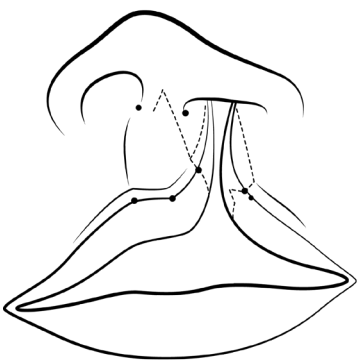

Figure 7-6. Unilateral cleft lip with markings.
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- Flexible for application with all grades of cleft severity
- Patient position
  - End of table, doughnut, shoulder roll, mouth pack
- Preoperative photographs

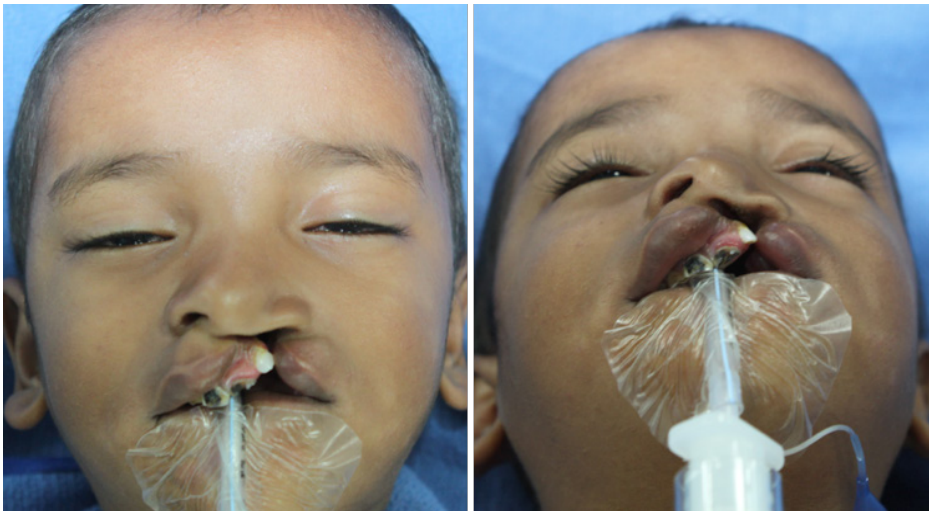


Figure 7-7. Patient with complete left side unilateral cleft lip and palate intubated with oral RAE tube taped in the midline inferiorly. Surgeons should take standardized preoperative anterior-posterior (AP) and inferior (worm's eye) views. © 2017 A Campbell, C Restrepo

MARKING

- Toothpick, methylene blue, 5cc syringe, 27 gauge needle, caliber, alcohol wipes, gauze
- Precise marks with fine points
- Tattoo marks with Methylene blue before infiltration of local anesthetic
- Incisions designed along key points medial and lateral lips

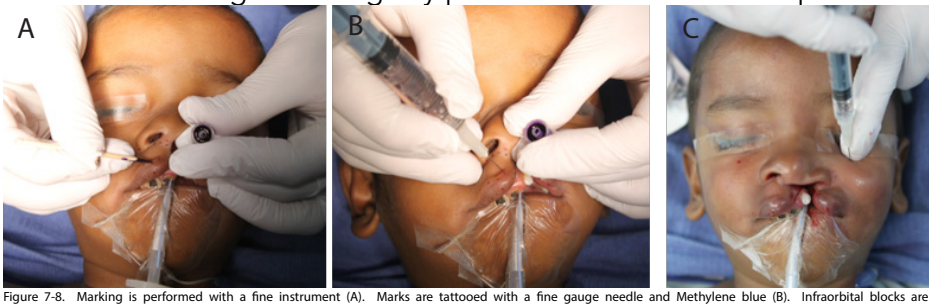


Figure 7-8. Marking is performed with a fine instrument (A). Marks are tattooed with a fine gauge needle and Methylene blue (B). Infraorbital blocks are performed bilaterally (C). © 2017 A Campbell, C Restrepo

Key Points Medial Lip:

- Trough cupid's bow
  - Caudal white roll-vermillion junction
  - Cephalic white roll-cutaneous junction
- Lateral peak cupid's bow
  - Caudal white roll-vermillion junction
  - Cephalic white roll-cutaneous junction
- Medial peak cupid's bow
  - Caudal white roll-vermillion junction
  - Cephalic white roll-cutaneous junction
- Red Line
- Midline base of columella at nasolabial junction
- Lateral base columella triangle at nasolabial junction
- Medial base columella triangle at nasolabial junction
- Peak Mohler triangle in columella (90 degree angle)
- Septum
- Medial footplate LLC noncleft side
- Medial footplate LLC cleft side
- Alar insertion into nasil sill noncleft side

Key Points Lateral Lip:

- Nasofacial groove
- Junction nasal skin (vibrisse) and lip skin
- Alar insertion into nasil sill cleft side
- Peak of Cupid's bow cleft side (Nordhoff's point)
- Peak of proposed philtral column cleft side
- Red Line

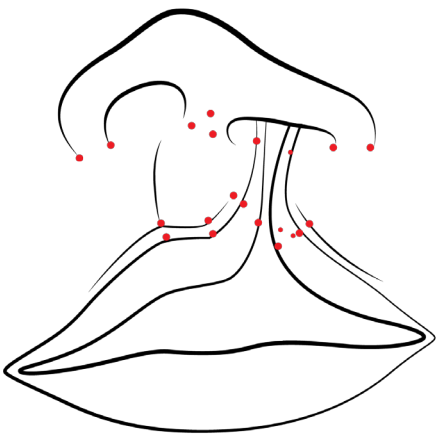


Figure 7-9. Key points of authors' technique of unilateral cleft repair.

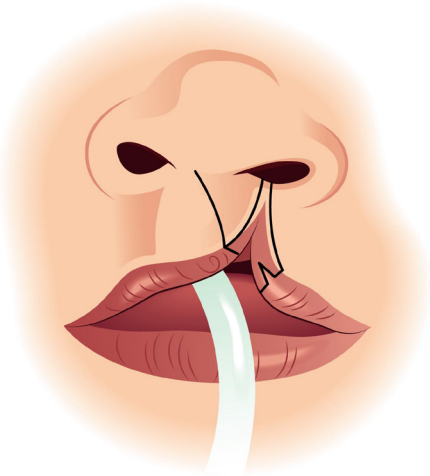


Figure 7-10. Incisions for unilateral cleft repair.

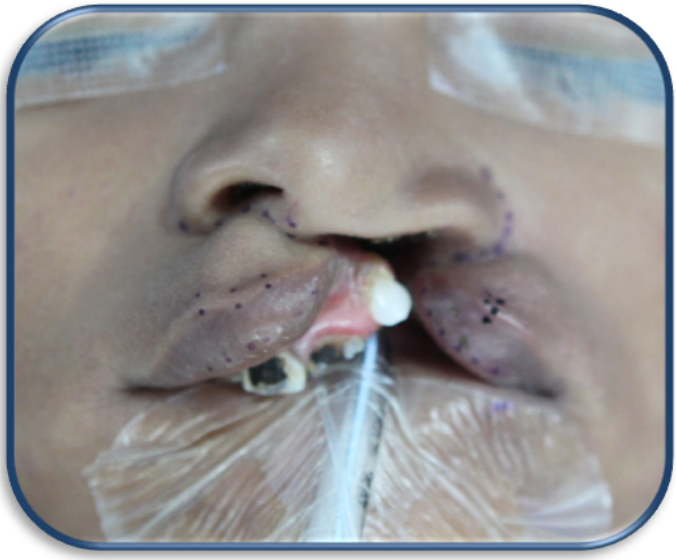


Figure 7-11. Preoperative patient markings for unilateral cleft lip repair.

INFILTRATION

- 0.25% lidocaine, 0.125% marcaine, 1:100,000 epinephrine
- Wide and controlled infiltration of anesthetic to dissection areas medial and lateral lip elements, septum, nose.
- Bilateral infraorbital block.
- Dingman for intraoral injection if vomer flap planned
- After injection, surgeon scrub and patient preparation for ample time for vasoconstriction

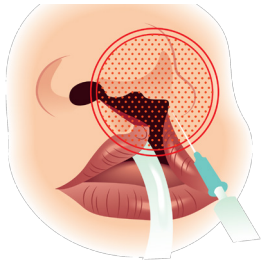


Figure 7-12. Zone of infiltration.

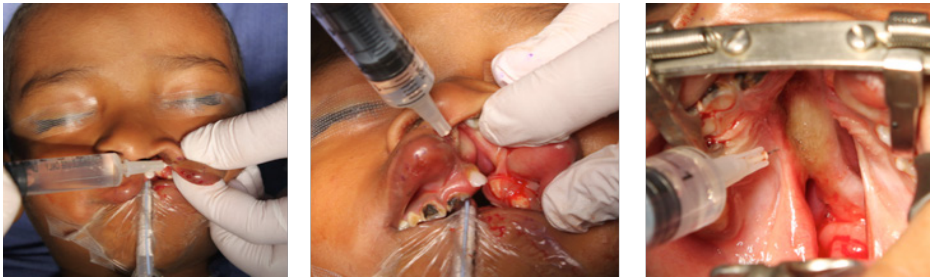


Figure 7-13. Wide and controlled infiltration of local anesthetic to dissection areas of medial and lateral lip elements, septum, nose.

OPERATIVE SEQUENCE

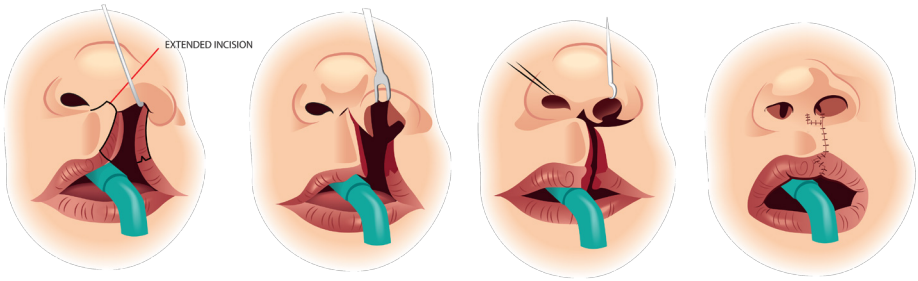
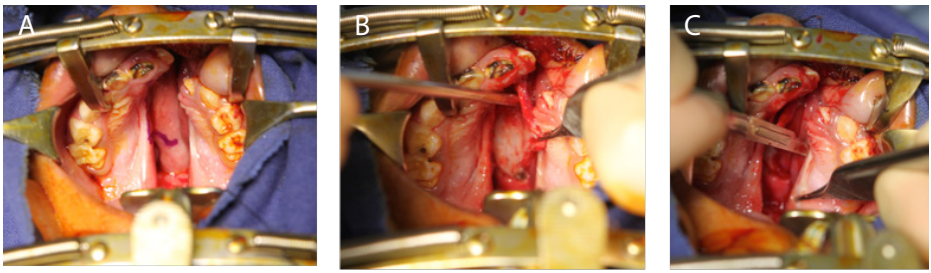


Figure 7-14. Operative summary for unilateral cleft lip repair. © 2017 A Campbell, C Restrepo

Vomer flap

- Indicated by some surgeons for grade 3 and grade 4 UCL repairs.
- Incision at greater segment hard palate oral mucosa margin with vomer. Backcut at posterior aspect of flap and subperiosteal elevation for tension free reflection across cleft to contralateral cleft margin.
- Incision at lesser segment hard palate margin of oral mucosa and nasal mucosa. Subperiosteal elevation of oral mucosa along cleft margin.
- Reflection of vomer flap for insetting beneath raised margin lesser segment and inset with horizontal mattress sutures orienting subperiosteum of vomer flap to subperiosteum of palatal flap.
- Closure anteriorly past alveolus so that complete closure may later be achieved with the septal flap to close the nasal floor and close the potential for an anterior fistula.
- Surgicel may be packed into exposed vomer if is oozing blood and removed at the conclusion of the lip repair.



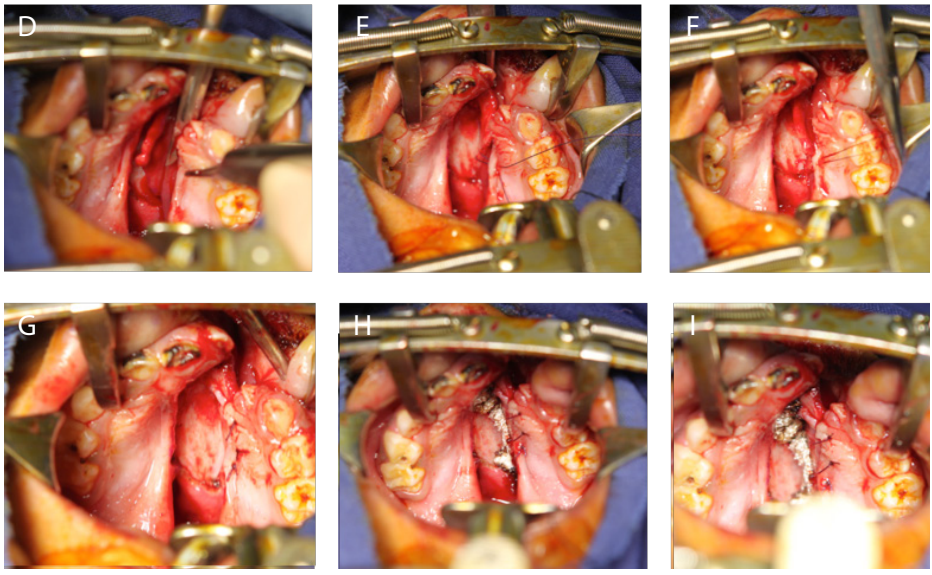


Figure 7-15. Operative sequence for marking (A) and elevation (B) of the vomer flap. Incision at margin of lesser segment (C, D) with horitontal mattress sutures (F) placed to inset the flap under the palatal margin (G). Surgicel is placed on raw surface of vomer to prevent bleeding during the remainder of the case (H, I). © 2017 A Campbell, C Restrepo

Medial Lip Dissection:

- Incisions and dissection medial lip element
  - Release columellar triangle
  - M flap raised to base
  - Release C flap
  - Septal flap raised for nostril floor closure
- Medial Muscle Dissection
  - 1 mm subcutaneous dissection between skin and muscle
  - White roll left intact
  - Submucosal dissection
- Complete release orbicularis from abnormal insertion anterior maxilla
- M flap rotated and sutured into defect for buccal sulcus augmentation
- Subperiosteal release nasal septum from vomerine groove when

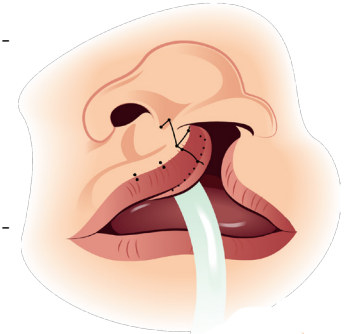


Figure 7-16. Medial lip markings.
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indicated

- Bilateral subperichondrial dissection nasal septum when indicated
- Cleft side septal flap raised for nasal floor closure
- Medial nasal dissection subcutanous over tip and cleft side LLC via medial columeller incision

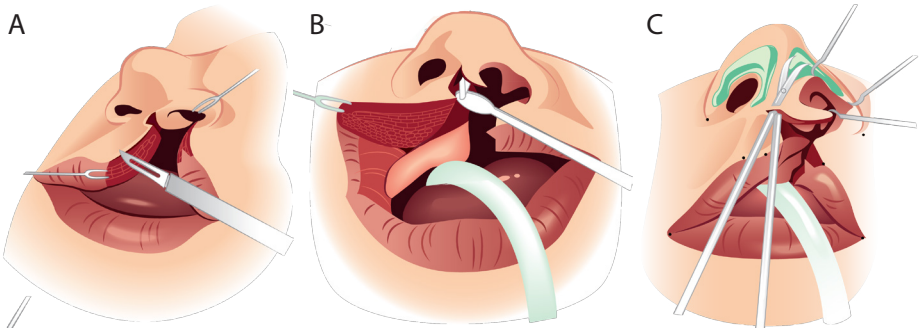

Figure 7-17. Medial lip dissection including 1 mm subcutaneous dissection (A), septal dissection (B), and intranasal dissection (C).

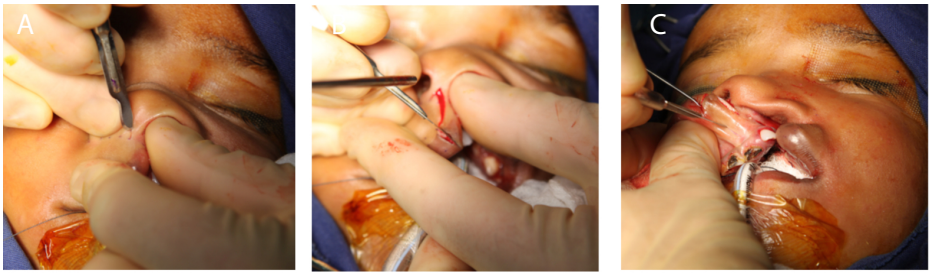

Figure 7-18. Operative sequence medial lip dissection with incision starting in columella (A), continuing down through skin and vermillion border (B), and through mucosa (C) to develop M flap.

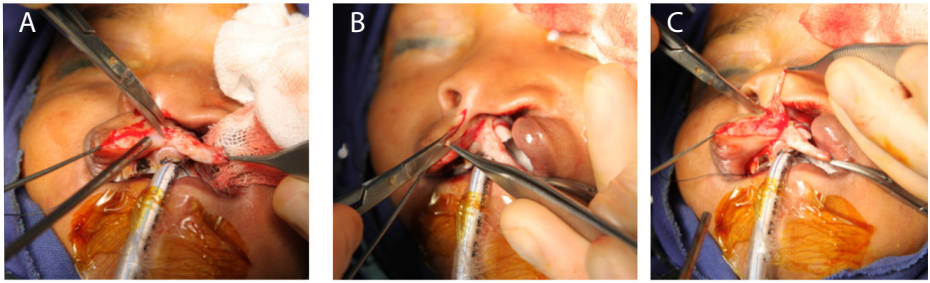

Figure 7-19. Operative sequence with dissection M flap (A), release of C flap (B), release of Mohler triangle from columella (C).

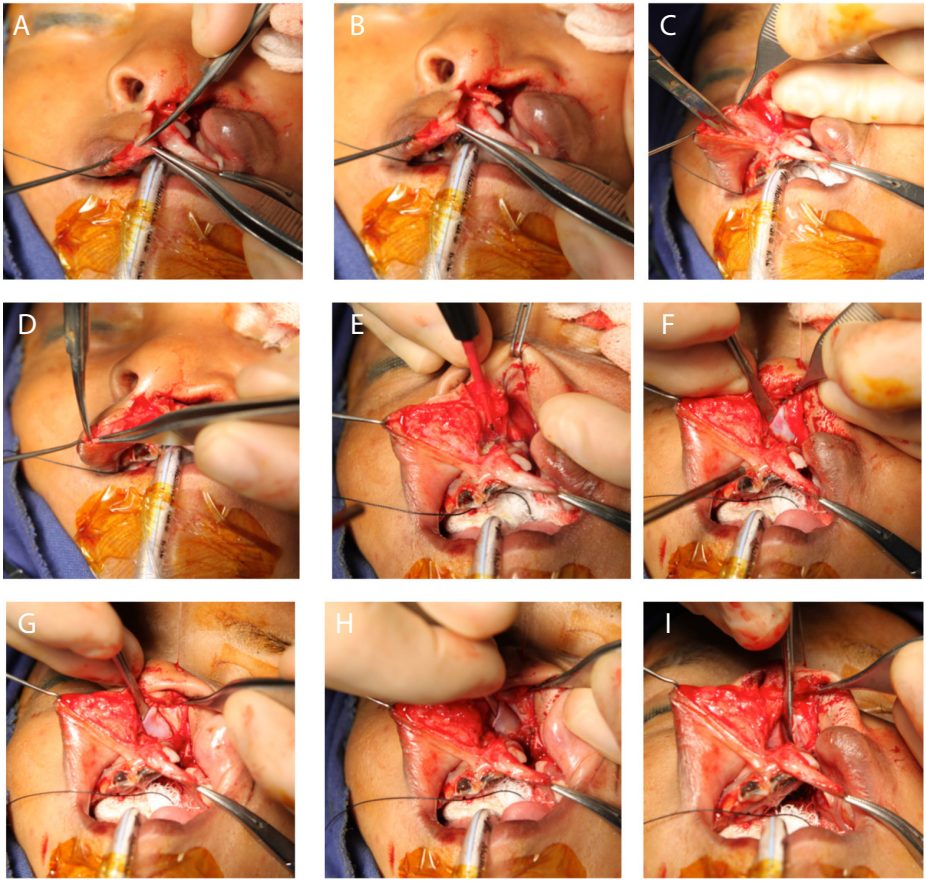

Figure 7-20. Operative sequence with minimal dissection of muscle from skin (A), white roll left intact (B), submuclsal dissection (C), release of muscle margin from vermillion border (D), subperiosteal dissection to expose septum (E), access to subperichondrial plane of septum (F), subperichondrial dissection of septum (G), release of septum from vomerine groove (H), and reflection of septum (I). © 2017 A Campbell, C Restrepo

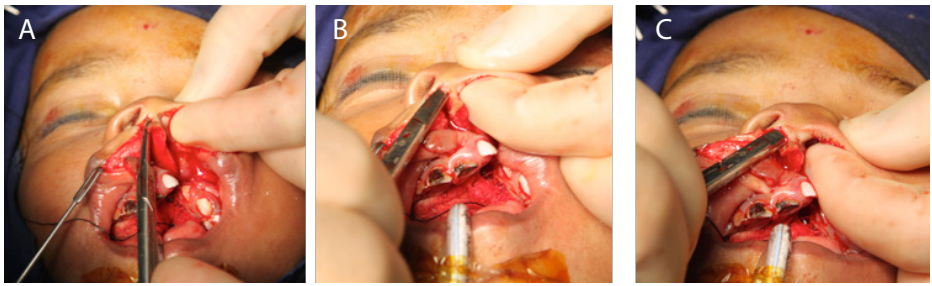

Figure 7-21. Operative sequence of intranasal dissection with scissors entering columellar incision between medial crura (A), dissection subcutanous over tip (B) and cleft side lower lateral cartilage (C). © 2017 A Campbell, C Restrepo

Lateral Lip Dissection:

- Skin Incisions
- Release V flap
- L flap raised to base and amputated
  - Saved in saline for possible graft
- Buccal sulcus incision lateral to release lip and allow advancement
  - Backcut if necessary for added advancement (avoid Stensen duct)
- Subperiosteal dissection for lateral lip advancement and tension free closure
  - Periosteal scoring if necessary for added advancement.
- Lateral Muscle Dissection (1 mm skin-muscle)
  - White roll left intact
  - Submucosal dissection for tension free closure
- Complete release of muscle from abnormal attachment nostril and piriform aperature cleft side.
- Incision extended posterior to piriform aperture
- Piriform aperature released to completely free cleft side alar base.
- Lateral wall flap raised for nostril floor closure

Figure 7-22. Lateral lip markings.
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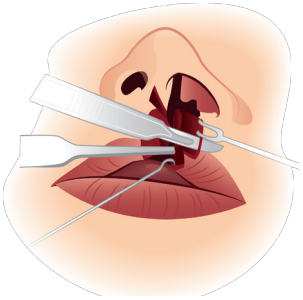

Figure 7-23. Lateral lip dissection including minimal subcutaneous dissection. © 2017 A Campbell, C Restrepo

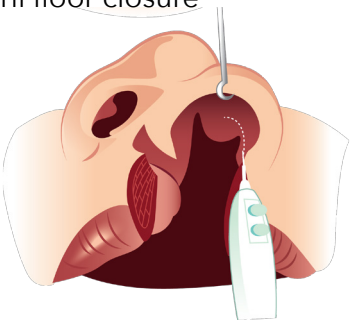

Figure 7-24. Transmucosal release at piriform aperature.
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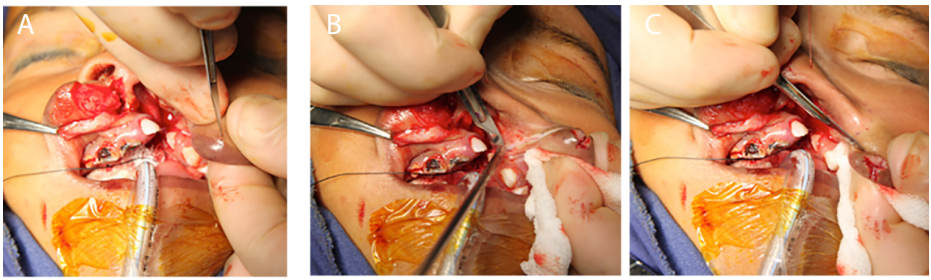

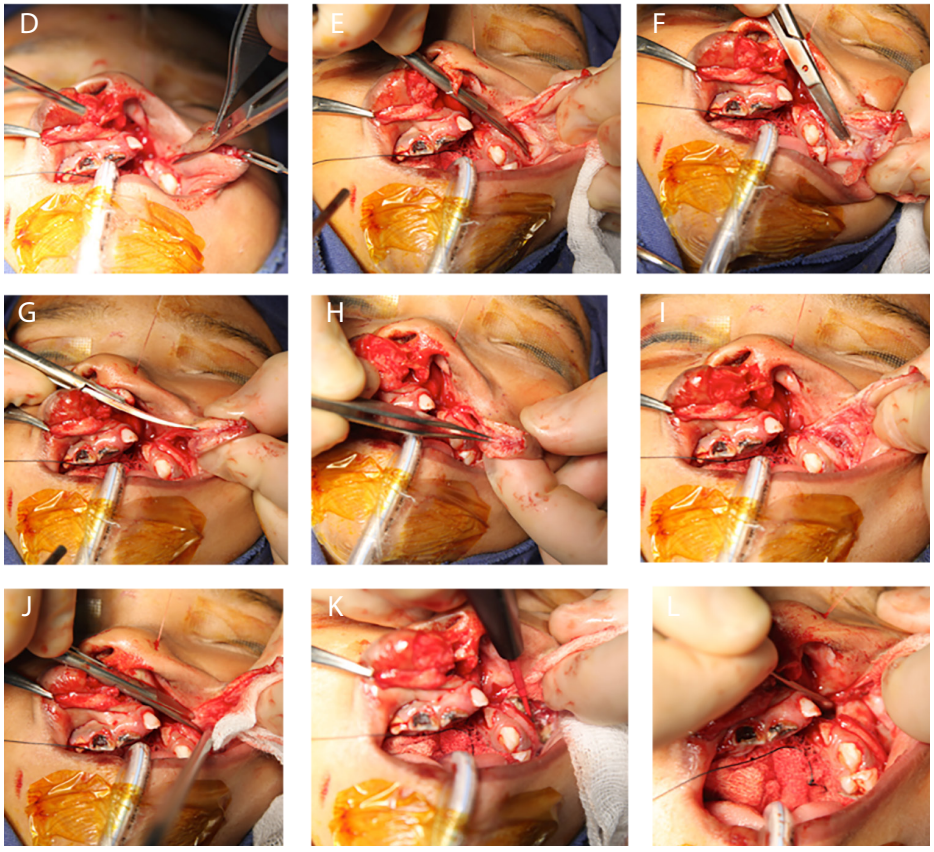

Figure 7-25. Operative sequence of lateral lip dissection. Skin incisions to define flaps at vermillion (A) continuing along cleft margin to piriform aperature (B, C), elevation of L flap (D), buccal sulcus incision (F), submucosal dissection (F), minimal dissection between skin and muscle (G, H), release of abnormal muscular insertions from piriform aperature (I, J), subperiosteal dissection to maxilla (K), and subperiosteal dissection at piriform aperature (L).

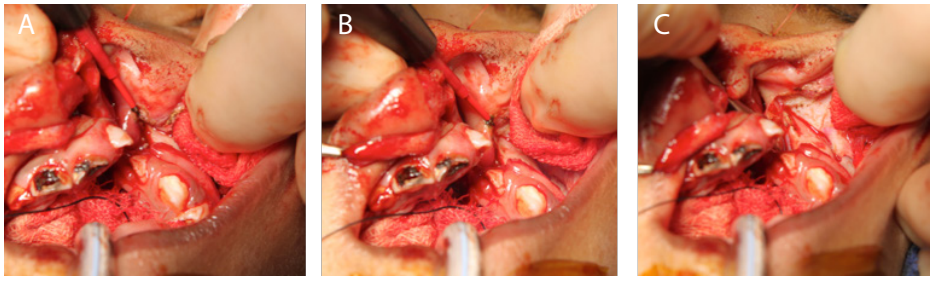

Figure 7-26. Operative sequence with transmucosal release at piriform aperature.

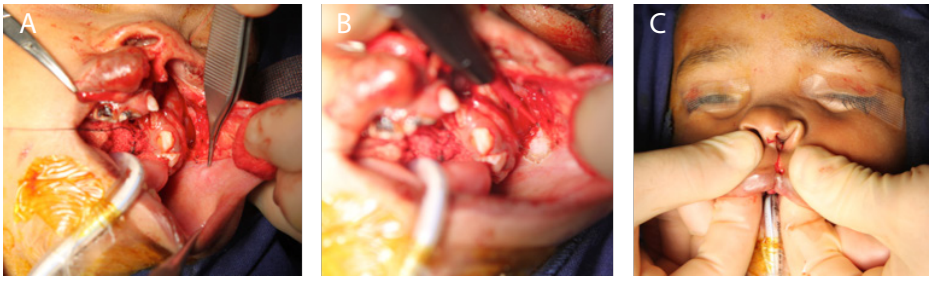

Figure 7-27. Operative sequence demonstrating identification of Stensen's duct (A), backcut of mucosa of buccal sulcus incision (B), and advancement of lateral element for tension free closure (C). © 2017 A Campbell, C Restrepo

Nasal Floor Reconstruction:

Figure 7-28. Nasal floor closure.
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- Cephalic retraction of cleft side nasal ala with hook or suture at soft triangle
- Starting posteriorly, septal flap sutured to lateral well flap transitioning to lateral nasal mucosa
    - Knots tied externally to evert mucosa / skin
- Repair continued anteriorly to complete nasal floor reconstruction to level of nasal sill
- Muscular roll of nasalis muscle released at level of nasal sill, fixate septum in midline, and recreate alar crease.
- Nasal ala inset for symmetry in height, anterior-posterior position, and nasal sill width

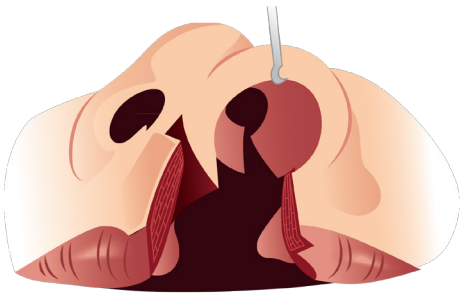

Figure 7-29. Elevation nasal ala at soft triangle for repair.
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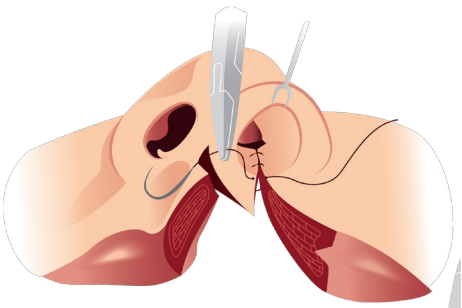

Figure 7-30. Repair of septal flap to lateral nasal wall flap out to level of nasal sill.
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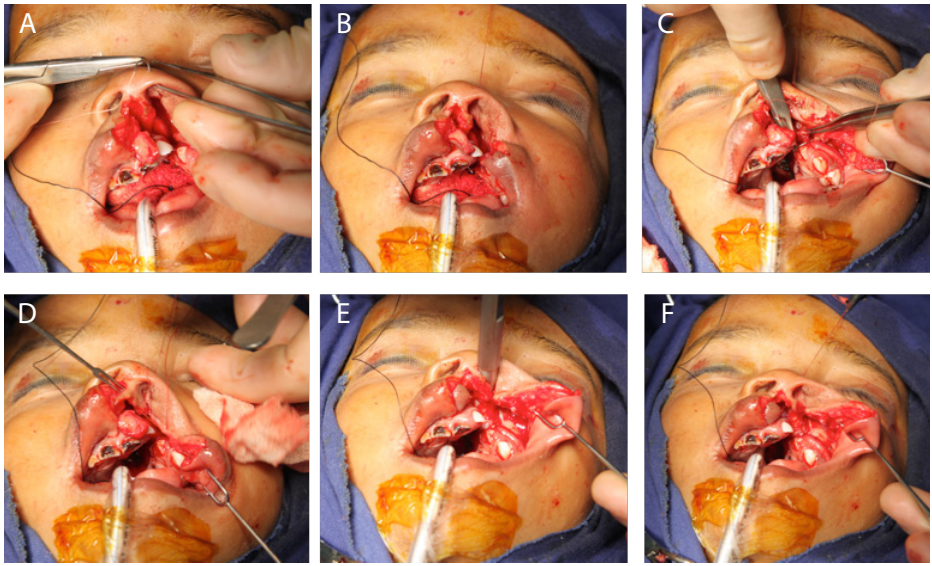

Figure 7-31. Operative sequence with placement of retraction suture in nasal ala at soft triangle (A), retraction of suture for exposure (B), and repair of septal flap to lateral nasal wall flap beginning at most posterior aspect (C) and continuing forward to nasal sill for complete closure of nasal floor (D, E, F). © 2017 A Campbell, C Restrepo

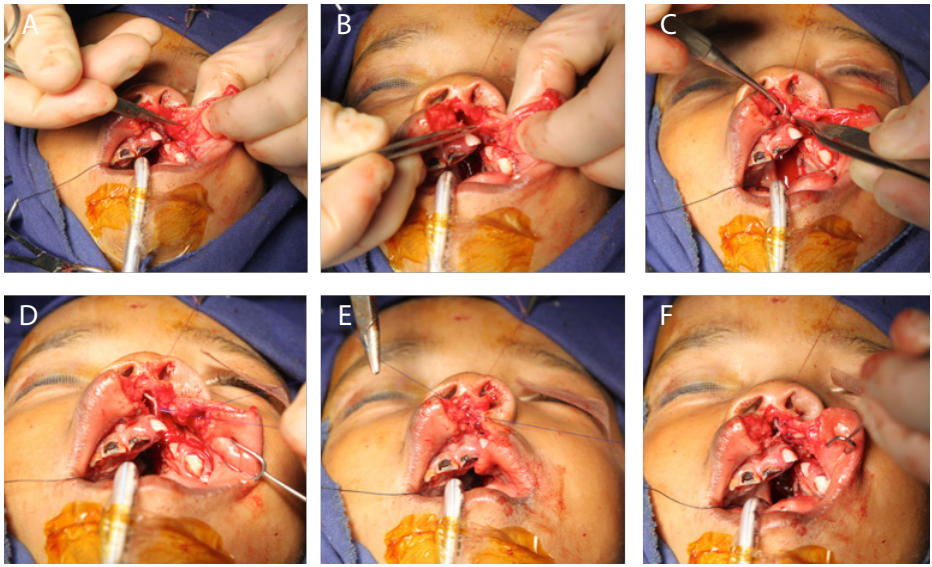

Figure 7-32. Operative sequence with identification muscular roll of nasalis muscle (A), release at level of alar crease (B), and medial reflection of released muscle to suture to nasal septum (C). Muscle flap sutured to nasal septum with permanent mattress sutures to fixate septum in midline, support nasal floor, and recreate alar crease (D, E, F). © 2017 A Campbell, C Restrepo

Labial Mucosa Closure:

- M flap rotated and sutured into defect for medial buccal sulcus augmentation at frenulum
- Lateral buccal mucosa advanced; sulcus closed
- Closure of medial mucosa sutured to lateral mucosa
    - Key suture at redline to determine equal distances medial and lateral mucosal edges

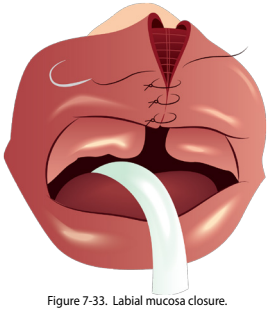

Figure 7-33. Labial mucosa closure.

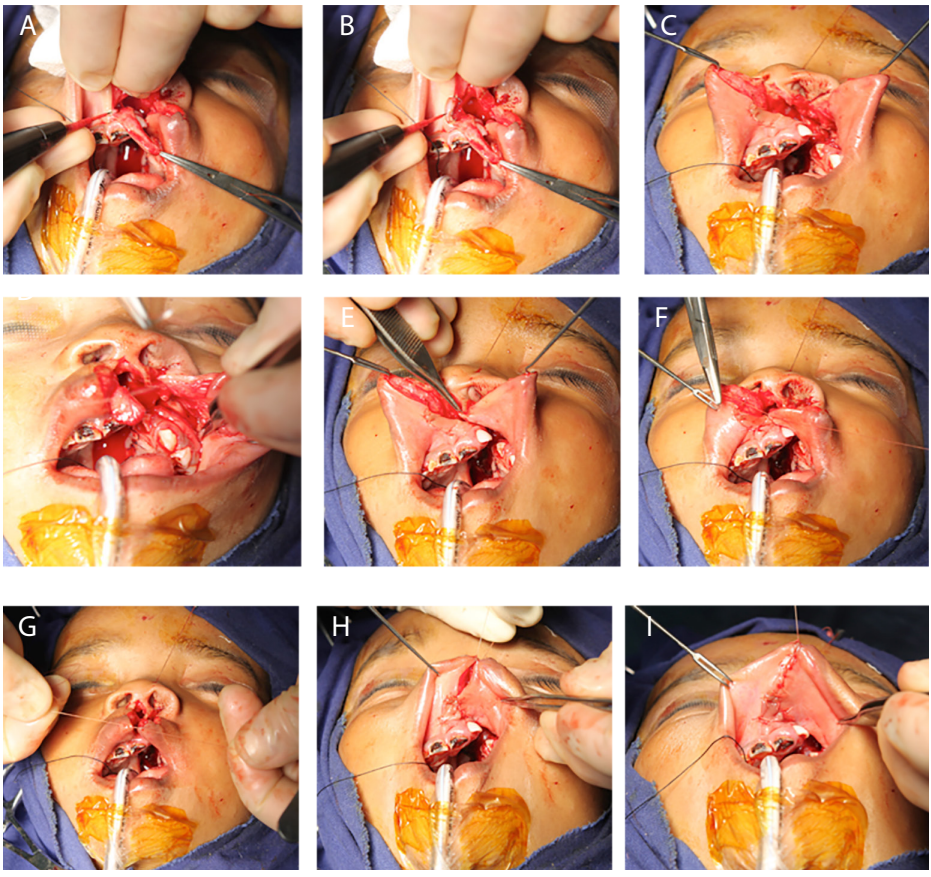

Figure 7-34. Operative sequence closure of mucosa. Backcut at medial buccal sulcus (A) for lengthening (B) and rotation and fixation of M flap into defect to augment sulcus at frenulum (C). Repair lateral buccal sulcus began most posterior region (D) with advancement of labial mucosa medially (E) for buccal sulcus closure to medial element (F). Key suture at red line (G) with complete labial mucosa closure (H,I).

Muscle Reconstruction:

- Prolene horizontal mattress sutures along length of muscle. Repair proceeds from margin up to level of nasal sill.

C Flap:

- Broad C flap advanced cephalically and inset to lengthen hemicolumella and close defect caused by downward rotation of Mohler columellar triangle for medial lip element. C flap trimmed to fit defect and sutured into place.

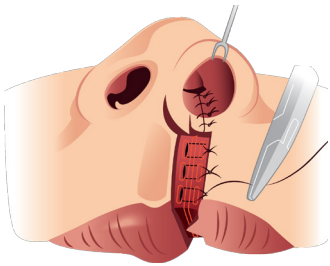

Figure 7-35. Complete muscle closure.

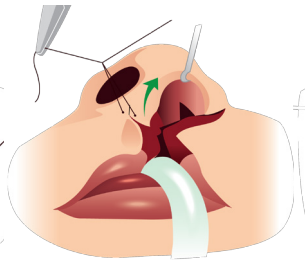

Figure 7-36. Advancement C flap into hemicolumella.

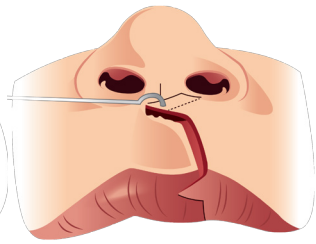

Figure 7-37. Trimming excess C flap to fit defect.

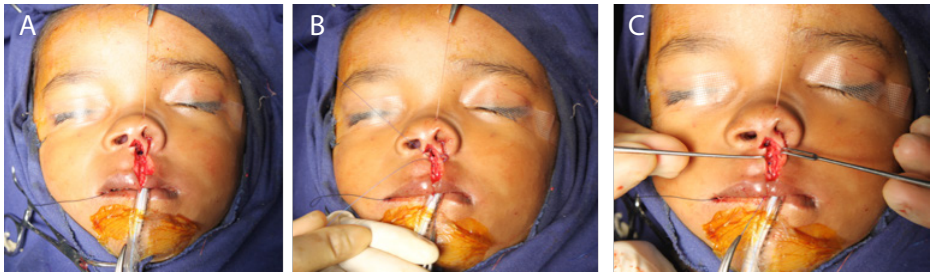

Figure 7-38. Operative sequence demonstrating closure of muscle. Prolene horizontal mattress sutures begin at the vermillion margin of the muscle (A) and continue along the length of muscle (B) up to the level of the nasal sill (C).

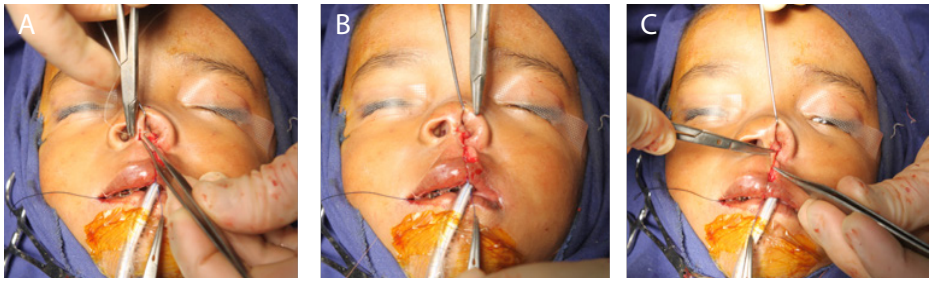

Figure 7-39. Operative sequence demonstrating advancement (A), fixation (B), and trimming of C flap to lengthen the hemicolumella and close the columellar donor site (C).

Skin and Vermillion Closure

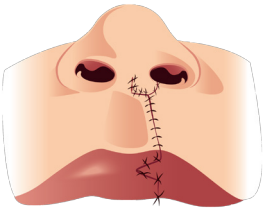

Figure 7-40. Closure skin and vermillion

- Line up superior and inferior edges of white roll
- Inset and trim excess skin
- Check for symmetry, correct lip height
- If lip short, triangular flap lengthening superior border white roll.
- Vermillion closure with inset of V flap, approximation of red line, and trimming of excess vermillion mucosa.

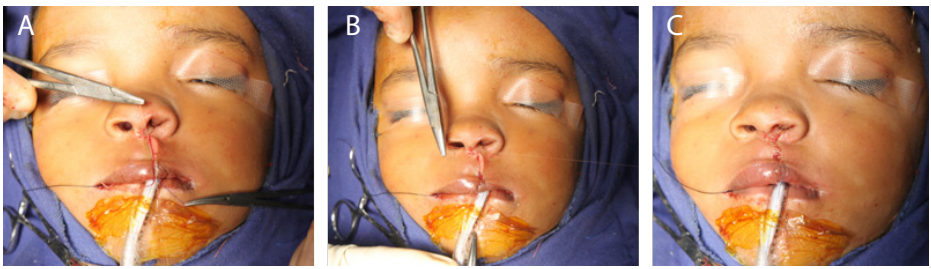

Figure 7-41. Operative sequence demonstrating skin closure with key sutures at white roll (superior and inferior aspect) and superior aspect of closure (A, B). Skin closure for precise approximation (C).

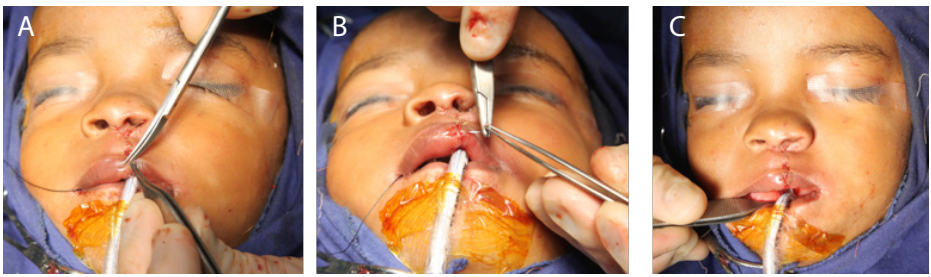

Figure 7-42. Operative sequence demonstrating trimming of excess tissue, vermillion closure with inset of V flap, and approximation of red line.

Nasal Reconstruction Maneuvers:

- Alar suspension sutures to suspend cleft side LLC to contralateral ULC.
- Vestibular web / nasofacial groove sutures to plicate vestibular mucosa and define nasofacial (alar) groove.

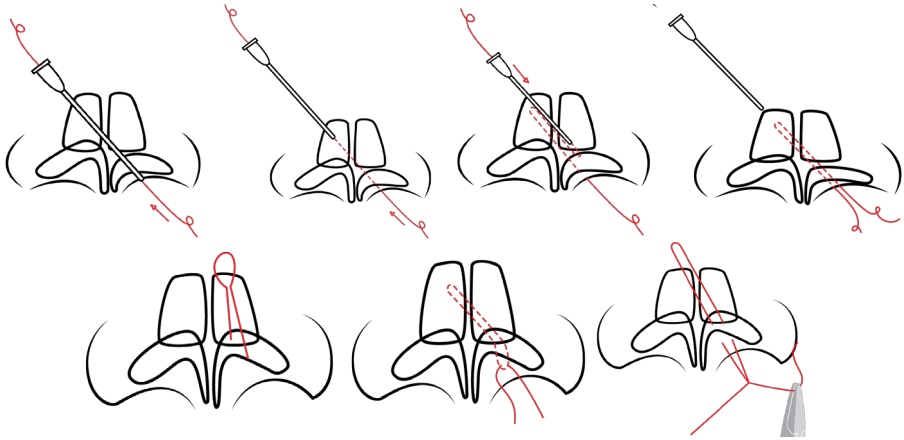

Figure 7-43.. Alar suspension (McComb) sutures placed using 21 gauge needle to pass suture to suspend soft triangle of cleft sided lower lateral cartilage to contralateral upper lateral cartilage, tying know within ala. © 2017 A Campbell, C Restrepo

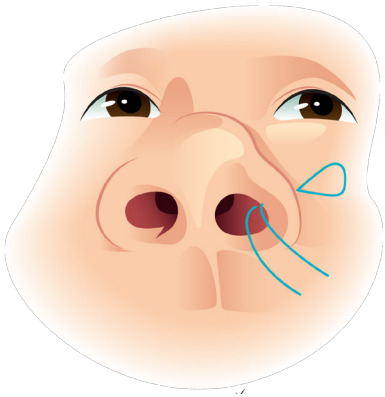

Figure 7-44. Vestibular web / nasofacial groove sutures.
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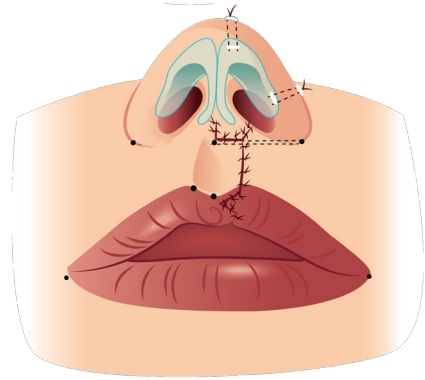

Figure 7-45. Nasal reconstruction sutures.
© 2017 A Campbell, C Restrepo

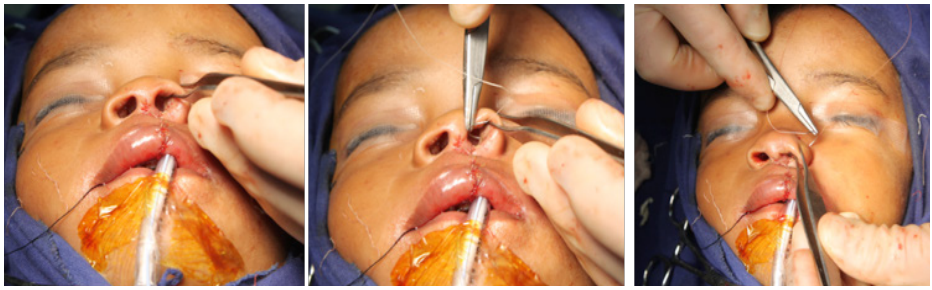

Figure 7-46. Vestibular web / nasofacial groove sutures placed internal-external-internal to plicate vestibular mucosa and to define nasofacial groove. © 2017 A Campbell, C Restrepo

Figure 7-47. Preoperative and postoperative photographs of patient in demonstration. © 2017 A Campbell, C Restrepo

ALGORITHMIC APPROACH TO UNILATERAL CLEFT LIP REPAIR

- Repair of a cleft lip is performed using a spectrum of maneuvers appropriate to the deformity in order to completely release and reposition all displaced nasal and lip elements in all three planes of space.
- Cleft lip grade (1 to 4) according to Cleft Severity Index dictates the surgical strategy and collection of maneuvers necessary for repair.

Cleft Severity	Surgical Maneuvers
Grade 1 **"Mild incomplete"**	**Skin / Muscle / Mucosa Repair** **Nasal Sill Narrowed** **Alar Base Released** **+/- Nasal Dissection and Repair**
Grade 2 **"Incomplete"**	**Skin / Muscle / Mucosa Repair** **Nasal Sill Narrowed** **Alar Base Released** **Nasal Dissection and Repair** **+/- Septal Dissection and Fixation**
Grade 3 **"Complete"**	**Skin / Muscle / Mucosa Repair** **Alar Base Released** **Nasal Dissection and Repair** **Septal Dissection and Fixation** **Nasal Floor Reconstruction** **Lateral Subperiosteal Advancement**

Grade 4 **"Severe Complete"**	**Skin / Muscle / Mucosa Repair** **Alar Base Released** **Nasal Dissection and Repair** **Septal Dissection and Fixation** **Nasal Floor Reconstruction** **Extensive Lateral Subperiosteal Advancement** ○ **Periosteal scoring** ○ **Backcut buccal sulcus**

Table 7-1. Algorithmic approach to unilateral cleft lip repair.

SURGICAL OUTCOMES

Postoperative Complications

- Complication rates are reported in the literature between from 1.7% to 8.2%, and definitions include dehiscence, infection, stitch granuloma, hypertrophic scarring, and notching.
- 3108 consecutive primary cleft lip repairs performed in Guwahati, India were reviewed retrospectively. Patients were aged 3 months to 75 years at the time of surgery, with a median of 7 years.
  - 4.4% had complications with dehiscence (3.0%) and infection (0.8%) being the most common.
  - Visiting surgeon, complete cleft, and bilateral cleft were significantly associated with wound dehiscence.

Type of Complication	*Incidence, n (%)*
Dehiscence	61 (3.0)
Infection	17 (0.8)
Dehiscence and infection	5 (0.2)
Stitch granuloma	5 (0.2)
Philtral flap necrosis and dehiscence	1 (0.05)
Other (pressure necrosis)	1 (0.05)

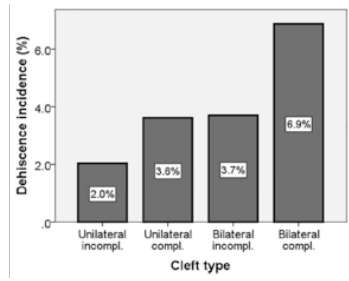

Figure 7-48. Early complications after cleft lip repair (A) and influence of cleft type (B) on dehiscence. Schonmeyr B, Wendby L, Campbell A. Early surgical complications after primary lip repair: a report of 3108 consecutive patients. Cleft Palate Craniofac J. Cleft Palate Craniofac J 2014 Oct 6. Epub 2014 Oct 6.

Aesthetic Outcomes

- The Unilateral Cleft Lip Surgical Outcomes Evaluation (UCL SOE) scale is a validated evaluation tool for use by surgeons and laypersons that measures symmetry of four components of UCL repair and sums these for a total score.

- "Very good" reliability (ICC=0.82) is achieved when the scores of three layperson reviewers are pooled and averaged.
- Combined with the Unilateral Cleft Lip Cleft Severity Scale (UCL CSI), validated in a parallel study, the UCL SOE allows surgeons and laypersons to grade the preoperative severity of the UCL/N deformity and the final aesthetic result after primary surgical repair.
- This has significant implications on the ability to conduct outcomes studies evaluating and comparing various surgeons, centers, techniques, and protocols. These tools have additional value to track patient results through time, and also to monitor surgical development during training and practice.
- The ability to objectively measure unilateral cleft lip surgical outcomes will provide insight into the factors that contribute to differences in outcomes among patients.

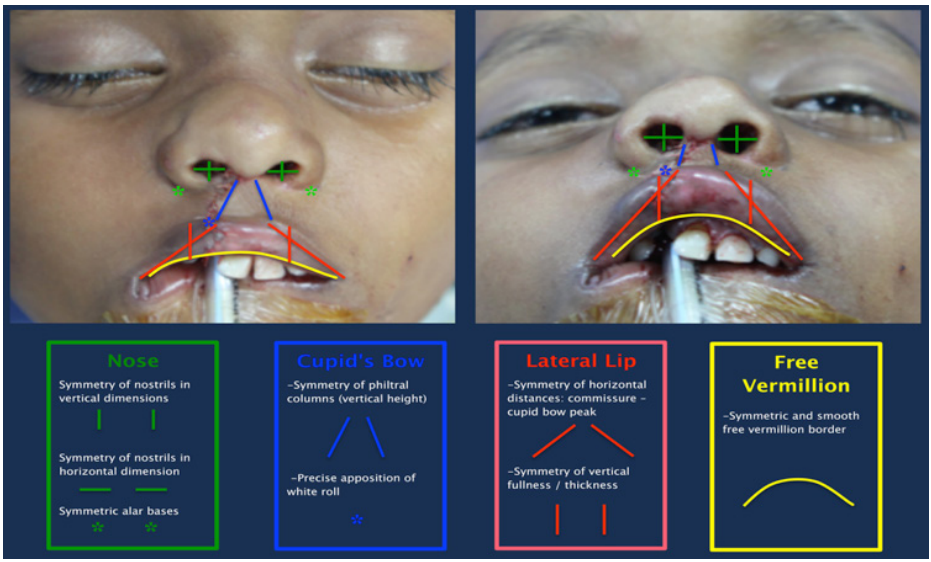

Figure 7-49. The Unilateral Cleft Lip Surgical Outcomes Evaluation (UCL SOE) scale scores symmetry of four individual anthropomorphic components of the cleft repair (Cupid's bow, lateral lip, nose, and free vermillion). Campbell A, Restrepo C, Despande G, et al. Validation of a Surgical Outcomes Evaluation Scale for Unilateral Cleft Lip Repair by Surgeons and Laypersons. PRS Global Open. Pending Publication. © 2017 A Campbell, C Restrepo

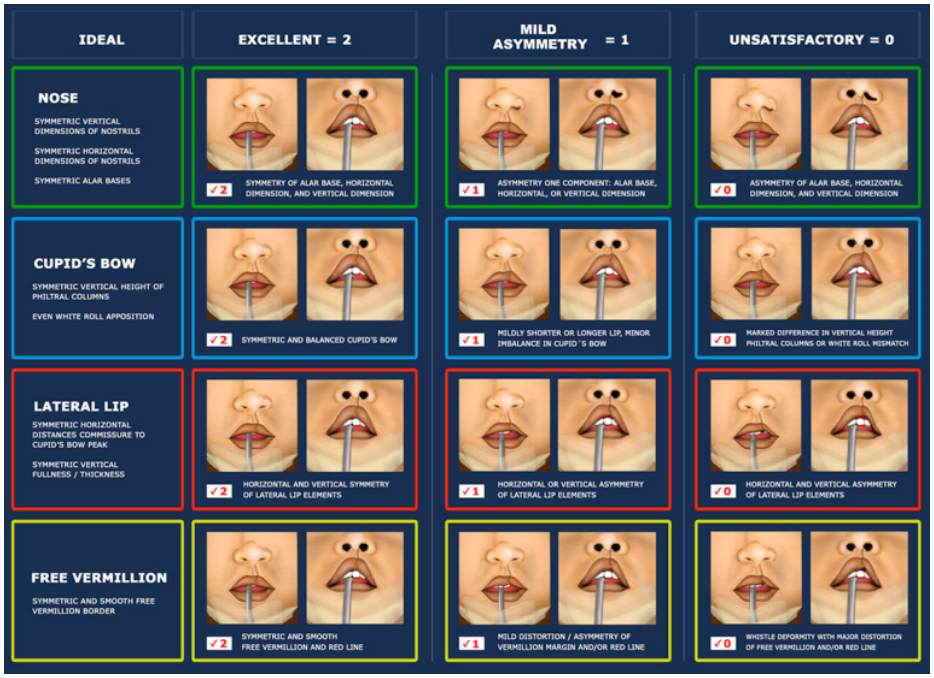

Figure 7-50. Using the UCL SOE, each element (Cupid's bow, lateral lip, nose, and free vermillion) is scored on a three-point scale: 2 (excellent), 1 (mild asymmetry), 0 (unsatisfactory). Campbell A, Restrepo C, Despande G, et al. Validation of a Surgical Outcomes Evaluation Scale for Unilateral Cleft Lip Repair by Surgeons and Laypersons. PRS Global Open. Pending Publication. © 2017 A Campbell, C Restrepo

Figure 7-51. The scores of the four individual scores are then summed for a total score of 0 (lowest) to 8 (highest). Campbell A, Restrepo C, Despande G, et al. Validation of a Surgical Outcomes Evaluation Scale for Unilateral Cleft Lip Repair by Surgeons and Laypersons. Pending Publication.
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KEY READING

1. Cutting C. (2009) The Extended Mohler Unilateral Cleft Lip Repair. In: Losse J, Kirschner R: Comprehensive Cleft Care (pp. 286-298). McGraw-Hill Companies: New York.

2. Salyer K, et al. (2009) Unilateral Cleft Lip / Nose Repair. In: Losse J, Kirschner R: Comprehensive Cleft Care (pp. 299-330). McGraw-Hill Companies: New York.
3. Chen P, Noordhoff S, Kane A. (2012) Repair of Unilateral Cleft Lip. In: Neligan P: Plastic Surgery. 3rd Edition. Rodriguez R, Losse J. Volume 3: Craniofacial, Head and Neck Surgery and Pediatric Plastic Surgery. Elsevir Saunders: Philadelphia.
4. Schonmeyr B, Wendby L, Campbell A. Early surgical complications after primary lip repair: a report of 3108 consecutive patients. Cleft Palate Craniofac J. Cleft Palate Craniofac J 2014 Oct 6. Epub 2014 Oct 6.
5. Campbell A, Restrepo C, Deshpande G, Mongiello S, Tredway C, Wendby L, Schonmeyr B. Validation of a Cleft Severity Index for Grading the Severity of Primary Unilateral Cleft Lip and Nose Deformities by Surgeons and Laypersons. Plastic and Reconstructive Surgery Global Open. 2017, Publication Pending.
6. Campbell A, Restrepo C, Deshpande G, Tredway C, Mongiello S, Patzer R, Wendby L, Schonmeyr B. Validation of a Surgical Outcomes Evaluation Scale for Unilateral Cleft Lip Repair by Surgeons and Laypersons. Plastic and Reconstructive Surgery Global Open. 2017, Publication Pending.