

10. Cleft Palate Repair: Two Flap Technique

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BACKGROUND

A cleft palate has tremendous aesthetic and functional implications for patients in their social interactions, particularly on their ability to communicate effectively and on their facial appearance. The treatment plan focuses on two areas: speech development and facial growth. Speech development is paramount in the appropriate management of cleft palate. Many surgical techniques and modifications have been advocated to improve functional outcome and aesthetic results. The most controversial issues in the management of cleft palate are the procedures and the effects of surgery on facial growth.

RELEVANT ANATOMY

- Hard palate is a symmetric structure divided into the primary and secondary palate based on its embryonic origin.
- Primary palate (anterior to incisive foramen) - premaxilla, alveolus, lip.
- Secondary palate (posterior to incisive foramen) - paired maxilla, palatine bones, pterygoid plates.
- Six muscles have attachment to the palate: levator veli palatini, superior pharyngeal constrictor, musculus uvulae, palatopharyngeus, palatoglossus and tensor veli palatini.
- Levator veli palatini pulls the velum superiorly and posteriorly to appose the velum against the posterior pharyngeal wall.
- Superior pharyngeal constrictor causes medial movement of the pharyngeal wall, aiding in formation of the competent sphincter.
- Musculus uvulae muscle acts by increasing the bulk of the velum

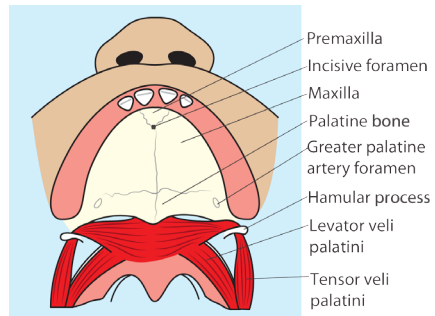


Figure 10-1. Palate anatomy.
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during muscular contraction.

- Palatopharyngeus displaces the palate downwards and medially.
- Palatoglossus is mainly a palatal depressor that plays a role in the production of phonemes with nasal coupling by allowing controlled airflow into the nasal chamber.

Key Point: Three muscles that appear to have the greatest contribution to the velopharyngeal function are the levator veli palatine, superior pharyngeal constrictor, and musculus uvulae.

- Tensor veli palatini originates partially on the cartilaginous border of the auditory tubes and the tendon hooks around the hamulus of the pterygoid plate to insert along the posterior border of the hard palate. The muscle functions to improve the ventilation and drainage of the auditory tube
- Severity of bony palate cleft varies from simple notching of the hard palate to complete clefting of the alveolus.
- Pathology in the muscles and soft tissues has the greatest impact on functional result.
- Sling of the levator veli palatini is interrupted with the insertion of the muscle onto the back of the hard palate. Thus, in patients with cleft palate, the effectiveness of the velar pull against the posterior pharyngeal wall is impaired.
- The palatoglossus and palatopharyngeus also insert abnormally onto the back of the hard palate, contributing to the overall shortened length of the palate
- **Submucous cleft palate occurs** when the palate appears to be structurally intact, but there are bony and/or muscular abnormalities underlying the skin's surface.

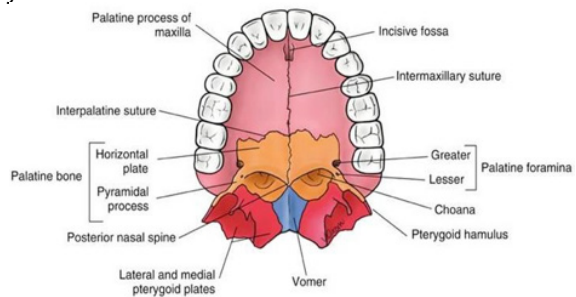


Figure 10-2. Hard palate anatomy. © 2017 A Campbell, C Restrepo

- Diagnostic signs: bifid uvula, notching of the posterior border of the hard palate, and muscular diastasis of the soft palate with intact mucosal layer.

- o Majority asymptomatic; 15% develop velopharyngeal insufficiency.

Veau Classification	
CLASS	SITE INVOLVED
I	Soft palate
II	Soft palate and hard palate
III	Soft palate and hard palate and unilateral cleft of primary palate
IV	Soft palate and hard palate and bilateral cleft of primary palate

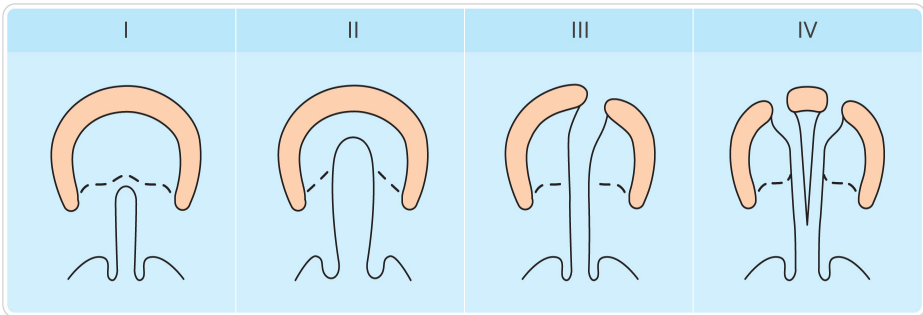


Figure 10-3. Veau classification of cleft palate. © 2017 A Campbell, C Restrepo

CLINICAL FINDINGS

- Airway Problems - Infant with Pierre Robin sequence or other conditions in which the cleft palate is observed in association with a micrognathia or retrognathic mandible may be particularly prone to upper airway obstruction.
- Feeding Difficulty - Communication between the oral and nasal chamber impairs the normal sucking and swallowing mechanism of the cleft infants. Food particles can reflux into the nasal chamber. Breastfeeding often not successful unless milk production is abundant.
- Speech Abnormalities - Intrinsic to the anatomic derangement of cleft palate. The velopharyngeal mechanism is essential in production of nonnasal sounds and is a modulator of the airflow in the production of other phonemes that require nasal coupling. The manipulation of the velopharyngeal mechanism, if not success-

fully learned during early speech development, can permanently impair normal speech.

- Middle Ear Disease - Disturbance in anatomy associated with cleft palate affects the function of the eustachian tube orifices because the abnormal insertion of the tensor veli palatini that prevents satisfactory emptying of the middle ear. Recurrent ear infections have been implicated in the hearing loss of patients with cleft palate that may worsen the speech. The repositioning of the muscles levator and the tensor veli palatini improves function of these muscles, improves ventilation of the middle ear, decreases serous otitis and decreases the incidence of hearing abnormality. Palate repair alone does not usually completely correct this dysfunction and additional therapy frequently includes placement of ear tubes as necessary.
- Facial Growth Abnormalities - Multiple studies have demonstrated that the cleft palate maxilla has some intrinsic deficiency of growth potential. This growth potential is further impaired by surgical repair. Any surgical intervention performed prior to completion of full facial growth can have deleterious effects on maxillary growth. The formation of scar and scar contracture in the areas of denuded palatal bones are blamed for restriction of maxillary expansion. The growth disturbance is usually prognathic appearance and discrepant occlusion relationship between the maxilla and the mandible. Disagreement exists as to the appropriate timing of surgery to minimize the harmful effects on facial growth and on what type of surgical intervention is most responsible for growth impairment.
- Associated Deformities - Up to 29% of patients with cleft palate may have other anomalies. These may be more commonly associated with isolated cleft palate than with CL/P. High among the associated anomalies are those affecting the facial region (21%), followed by the ocular (17%), central nervous (15%), gastrointestinal (3%), and urogenital (2%) systems.²

PRESURGICAL ORTHOPEDICS

- Guide the cleft segments into approximation
- Manipulation of neonatal arch prior to surgical intervention

- Mold nasal deformities

SURGICAL GOALS

- Separate the oral and nasal cavities to normalize feeding and decrease regurgitation and nasal irritation.
- Reposition soft palate musculature to anatomically recreate a functional velum for development of normal speech.
- Minimize restriction of growth of the maxilla (sagittal and transverse).
- Improve eustachian tube function and for normal hearing.

TWO-FLAP PALATOPLASTY WITH INTRAVELAR VELOPLASTY

- Original description by Bardach (1967) with modifications over time.
- Two mucoperiosteal flaps based posteriorly on the greater palatine neurovascular bundle.
- Excellent mobilization for tension free closure of widest clefts.
- Intravelar veloplasty (IVV) involves repositioning of muscle with direct coaptation for anatomic reconstruction of levator sling.
- Adequate mobility with appropriate resting muscle tension
- Palatal lengthening through “velar stretch” of mucosa with IVV under tension
- Midline dorsal convexity conforms to the dorsal surface of the pharyngeal wall.
- Closure always includes an oral and nasal layer.
- Offsetting incisions minimizes risk of fistula

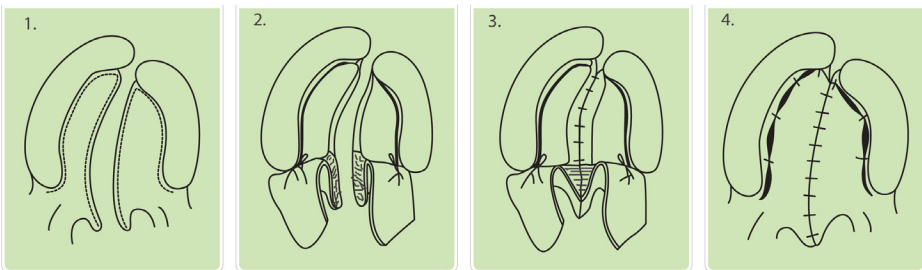


Figure 10-4. Two Flap Palatoplasty. Markings for flap design (A); Elevation of bilateral oral and nasal mucoperiosteal flaps with preservation of the greater palatine arteries (B); Repair of nasal mucoperiosteal flaps with repositioning, and repair of the levator veli palatini muscle - intravelar veloplasty (C);

Tension free closure of the oral mucoperiosteal flaps (D). © 2017 A Campbell, C Restrepo

TECHNIQUE

- Patient position: Head at end of table on doughnut; ET tube taped down midline lower lip; Neck extension, shoulder roll (palate facing ceiling).
- Throat pack (silk suture tag) to prevent aspiration.
- Local anesthesia (0.5% Lidocaine with 1:100,000 Epinephrine) injected into all areas dissection - subperiosteal hard palate, soft palate, retromolar, vomer.

Key Tip: Calculate maximum dosage prior to injection and confirm with anesthesiologist. For above mixture (0.5% Lidocaine with 1:100,000 epinephrine) a conservative maximum dosage (5mg epinephrine per kg) is the volume in cc equivalent to the weight in kg (eg. 6cc for 6 kg patient).

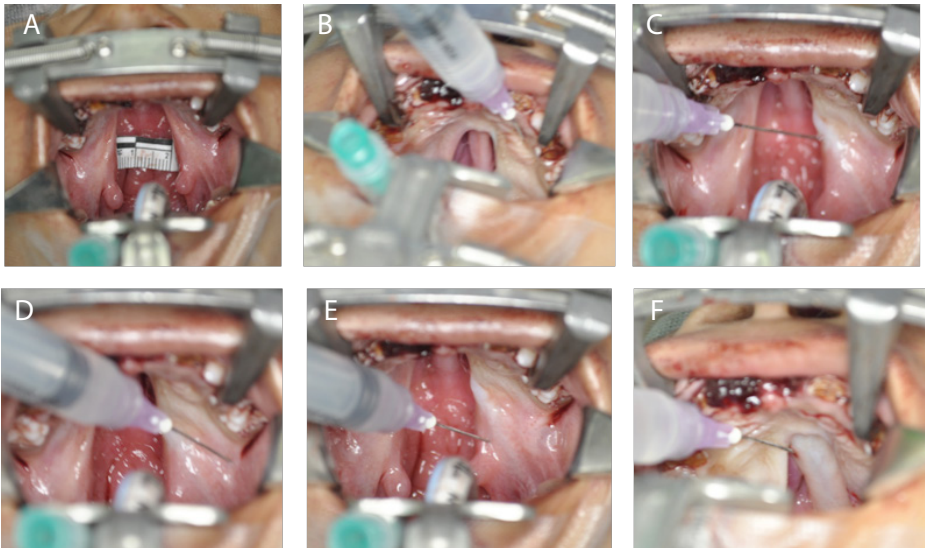


Figure 10-5. Patient with Dingman in position with bilateral cleft palate (Veau IV), 18mm wide at the posterior nasal spine (A). Infiltration local anesthesia into subperiosteal plane beneath palate flaps (B), cleft margin (C), retromolar region (D), soft palate (E), and vomer (F). © 2017 A Campbell, C Restrepo

- Palpate the hook of pterygoid hamulus and make small incisions just lateral and posterior to the hamulus on both sides.
- Sweep dissector anterior-posterior to enter the space between the laterally positioned tensor veli palatini and medially position-

ned palatal musculature (levator veli palatine, palatoglossus, and palatopharyngeus).

- Velar muscles are swept medially and dissected free from hamulus and posterior lateral portion of hard palate.

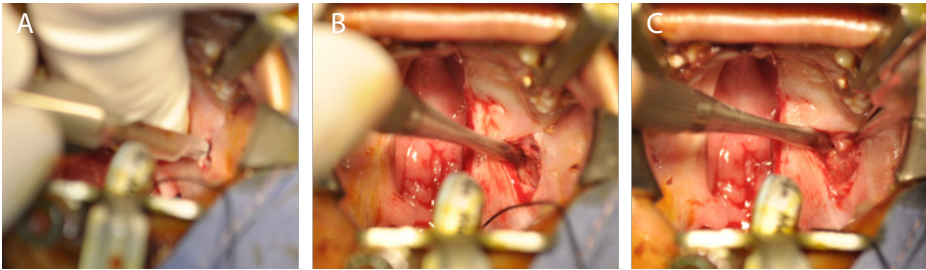


Figure 10-6. Retromolar incision lateral to hamulus (A) with exposure of the hamulus (B) and release of lateral abnormal insertions to hamulus and lateral posterior hard palate (C). © 2017 A Campbell, C Restrepo

Key Tip: Dissection around the hamulus, along the medial pterygoid plate, and in the space of Ernst should be performed carefully to avoid damage to the ascending palatine artery, ascending pharyngeal, and recurrent pharyngeal arteries. These vessels can be quite large in older children and adults and can cause bleeding that is difficult to visualize and control if avulsed during traumatic dissection.

- Lateral incision of hard palate performed along alveolar ridge.
- Medial incision along cleft margin of hard and soft palate.
- 30% of medial uvula mucosa excised leaving ample tissue for reconstruction.
- Elevation mucoperiosteal flaps from bony palate with periosteal elevator, starting at anterior region and proceeding to posterior in subperiosteal plane.

Key Tip:

- Delicate tissue handling is essential to avoid tissue trauma and suture line breakdown.
- Do not directly grasp mucosal edges.
- Maneuver the flaps by grasping the muscle and internal surfaces.
- Cautery is minimized and applied with precision using a pointed tip.

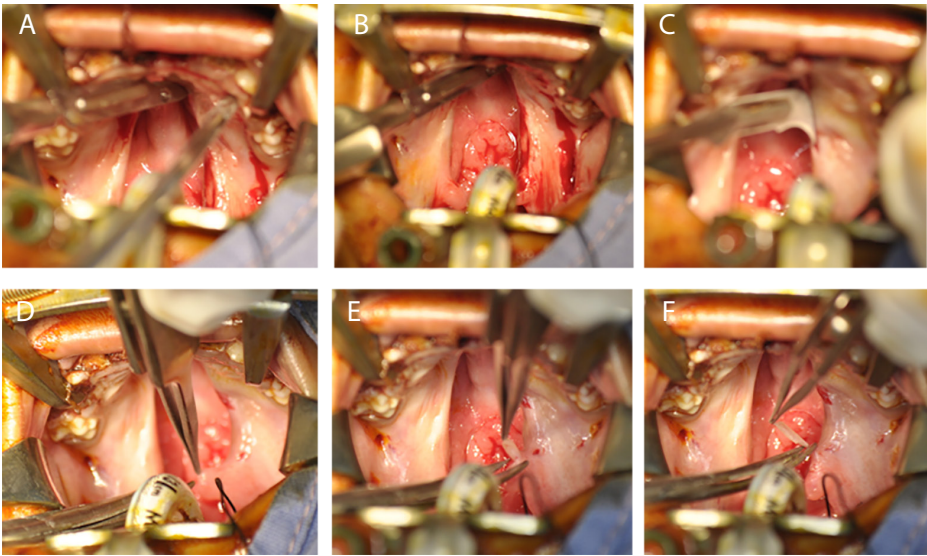
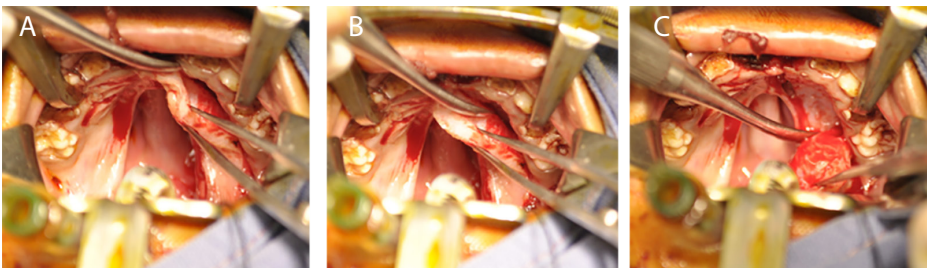


Figure 10-7. Lateral incision of hard palate performed along alveolar ridge (A,B) and medial incision performed along cleft margin of hard and soft palate (C). The medial 30% of uvula mucosa amputated (D,E,F). © 2017 A Campbell, C Restrepo

- Greater palantine vessels are identified and followed back to the greater palantine foramen. Fibers at posterior spine divided.
- After elevation of the mucoperiosteal flaps, both flaps are skeletonized on the greater palatine arteries, with division of oral fibers from the tensor veli palatine that extend toward the oral mucosa posterior to the pedicles.
- Do not divide the tensor muscle and do not intentionally fracture the hamulus.



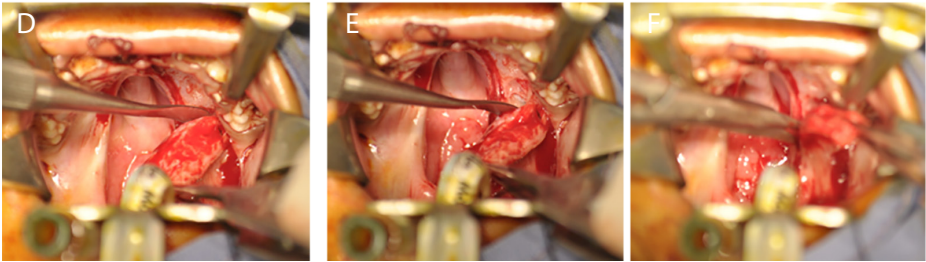


Figure 10-8. Subperiosteal elevation mucoperiosteal flap using periosteal elevator and delicate handling of flap with forceps (A,B). Greater palatine vessels identified and followed to the foramen (C-F). © 2017 A Campbell, C Restrepo

- Mobilization of the mucoperiosteal flap is improved by dissecting the neurovascular bundle from the mucoperiosteal flap, with incisions lateral y medial to the pedicle and then it applied firm but gentle traction to pull it out of the greater palatine foramen. This improves the medial mobility of the flaps.
- Additional flap mobilization can be achieved through division of periosteum on either side of the pedicle. This is achieved with two parallel incisions on either side of the greater palatine vessel, allowing release from the adherent and restrictive periosteum and impressive mobilization for medial advancement without tension even in the widest of clefts.

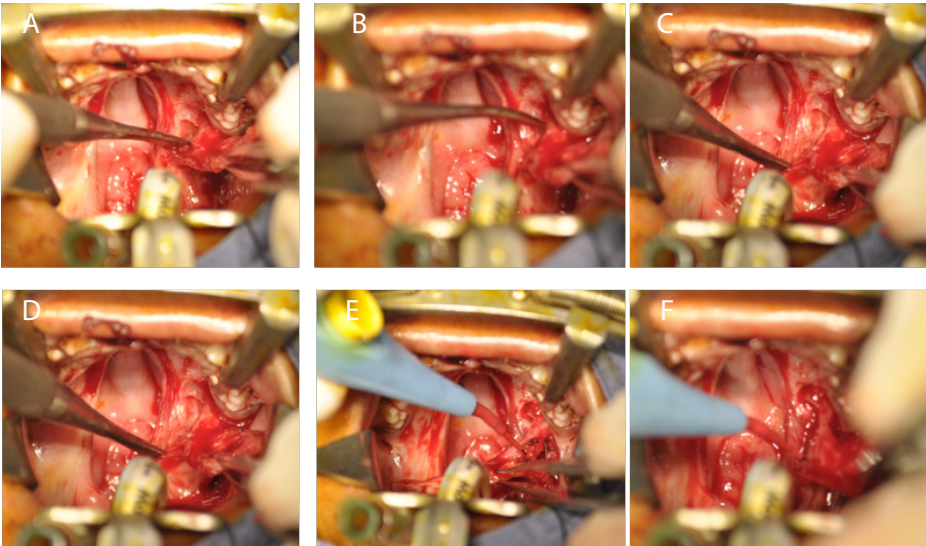
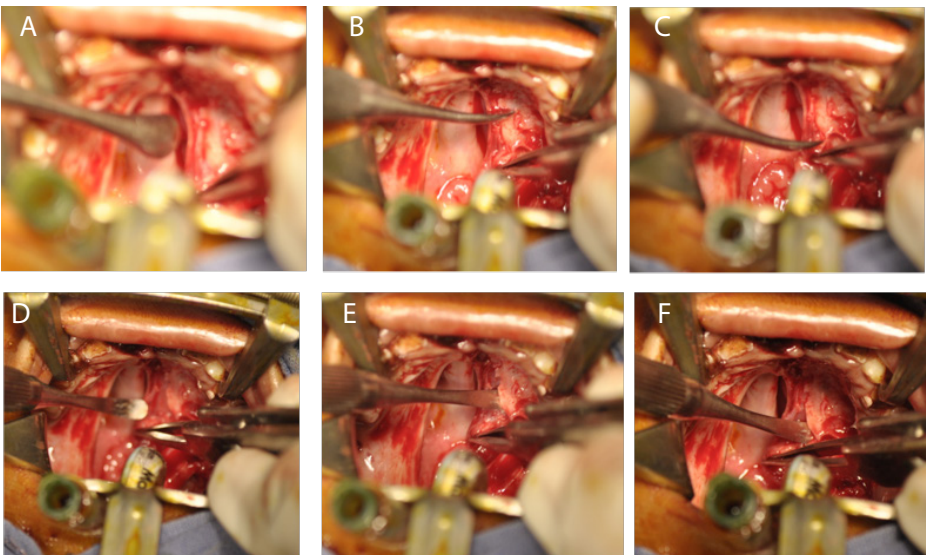


Figure 10-9. Greater palatine artery released from periosteum on either side for improved flap mobilization. © 2017 A Campbell, C Restrepo

- Nasal mucosa is dissected and mobilized from the nasal surface of the palatal shelves palate using an angled dissector.
 - Nasal mucosa dissected from both sides in Veau class 2 palate.
 - Nasal mucosa dissected from both sides in Veau class 2 palate.
 - Nasal mucosa dissected from both sides in Veau class 4 palate.
- Nasal mucosa is dissected and mobilized from the nasal surface of the palatal shelves palate using an angled dissector.
- The muscle dissection proceeds division of palatal musculature divided from the posterior margin hard palate, continuing laterally to pterygoid hamulus.

Key Tip: Postoperative fistulas correlate strongly with suture line closure tension, and numerous maneuvers are used for adequate mobilization of all tissues for a tension-free repair. A tempting mistake is to perform inadequate mobilization with narrow or incomplete clefts. Do not hesitate to mobilize tissues fully to relieve tension.

Key Tip: With very wide clefts, the nasal layer can be extensively mobilized by continuing the dissection to release the flaps from the lateral maxillary walls in the region of the inferior nasal meatus. This allows for extensive mobilization of the nasal mucosa, allowing for complete closure in cases of wide bilateral clefts with atrophic vomer.



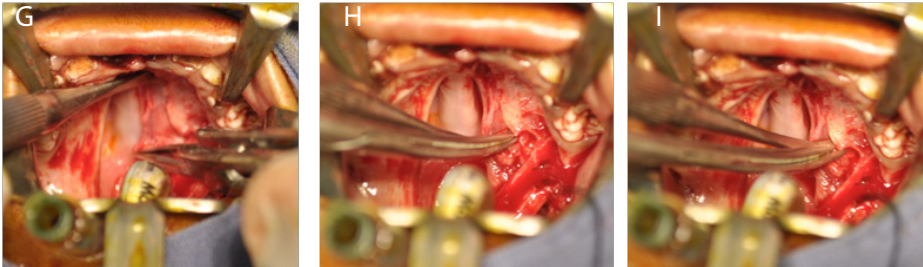


Figure 10-10. A broad periosteal elevator is used to scrape the medial edge of the hard palate to facilitate nasal mucosa dissection (A,B,C). An angled periosteal elevator is used to mobilize nasal mucosa from superior surface hard palate (D,E,F). Note that retraction is performed by grasping internal muscular fibers rather than mucosal edge (G). A fine scissors is used to release muscle insertions onto posterior nasal spine (H) and additional muscular insertions are dissected from the posterior edge of the hard palate (I). © 2017 A Campbell, C Restrepo

- Same maneuvers performed on contralateral side.
- Vomer mucoperiosteal flap(s) mobilized as needed for reconstruction of nasal lining deficiency in Veau class 3 and Veau class 4 palates.
 - Single side flap (Veau 3) -- incision is made along the junction between the vomer and the palatal shelf, continuing posteriorly to the free border of the soft palate. The nasal mucosa of the soft palate is a continuation of the vomer flap. The vomerine mucoperiosteal tissue is raised cranially and sutured to the nasal mucosa on the lesser segment.
 - Double side flaps (Veau 4) -- T-shaped incision is made over the free caudal border of the vomer with the horizontal limb anteriorly. The vomerine mucoperiosteum is raised as two flaps, one on either side of the midline. These flaps are sutured to the nasal mucosa of the lesser segments of the respective sides.

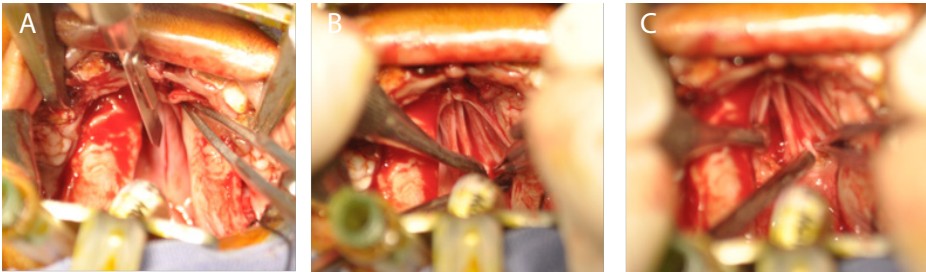


Figure 10-11. A midline incision on the vomer (A) followed by elevation of bilateral vomer flaps (B,C). © 2017 A Campbell, C Restrepo

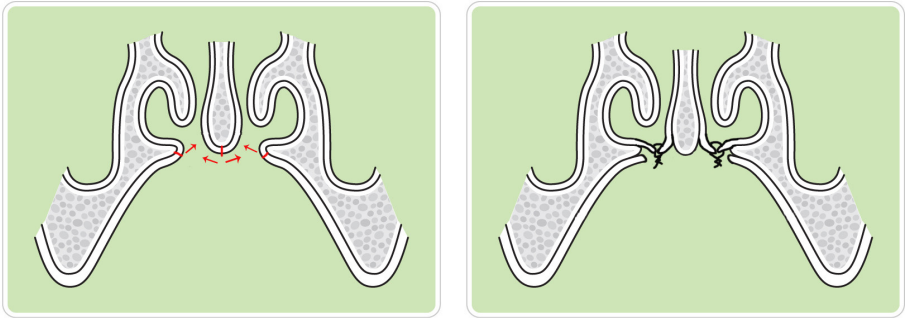


Figure 10-12. Closure of vomer flaps to nasal mucosa flaps. © 2017 A Campbell, C Restrepo

- Nasal closure performed either before or after muscle dissection according to surgeon preference.
 - Sutures are tied with cephalic-facing knots in order to evert the wound edge into the nasopharynx.
 - The soft palate nasal mucosa of the two sides are sutured together posterior to the vomer.
 - The anterior nasal layer is closed according to anatomy of flaps present
 - Veau 2 - nasal mucosa to nasal mucosa
 - Veau 3 - nasal mucosa to vomer flap
 - Veau 4 - nasal mucosa to vomer flap bilaterally

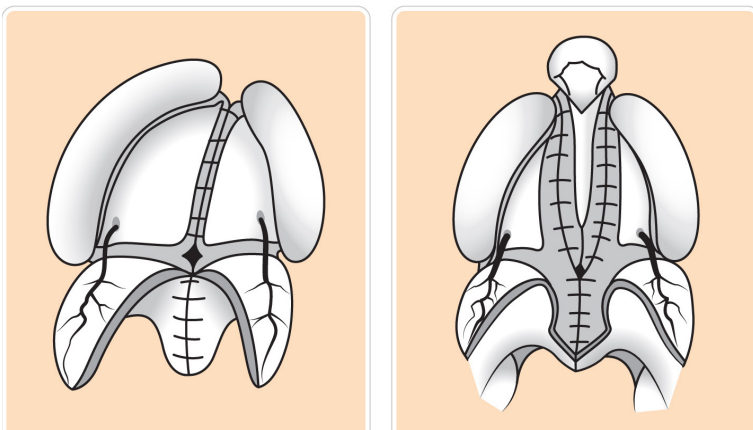


Figure 10-13. Closure of nasal mucosa in unilateral (A) and bilateral (B) clefts. © 2017 A Campbell, C Restrepo

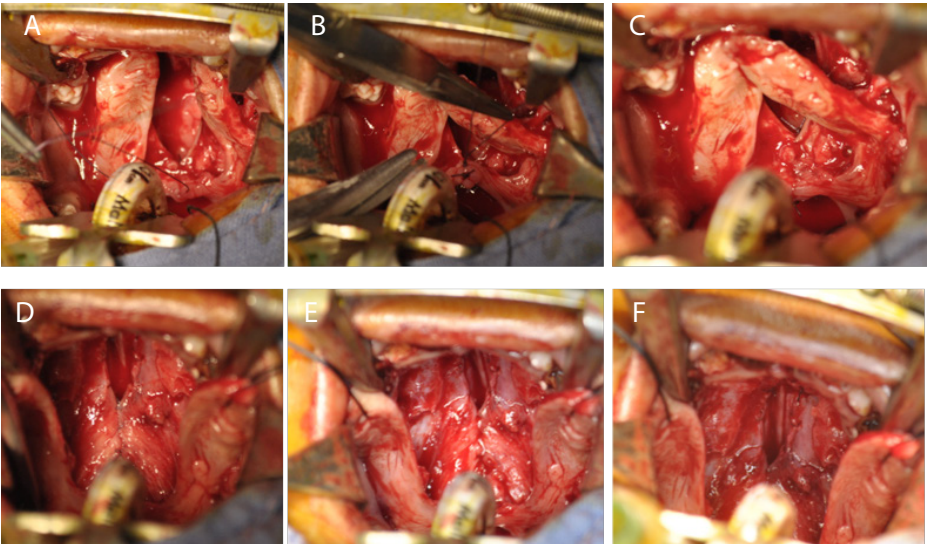


Figure 10-14. Closure of nasal mucosa in prior to muscle dissection in this case. Closure begins with uvula posteriorly (A,B) and proceeds through soft palate (C,D) and incorporates vomer flaps anteriorly (E,F). © 2017 A Campbell, C Restrepo

- With tension maintained on the muscle the combined levator veli palatini and palatopharyngeus muscle is dissected from the bluish colored nasal mucosa and retrodispaced with a combination of sharp and blunt dissection.
- The levator veli palatine should be identified laterally on the nasal surface of the muscle complex, within a thin sheath and passing cranially within its tunnel towards the skull base. Dissection continues until the muscle bundle is dissected from the nasal layer and freely mobile.

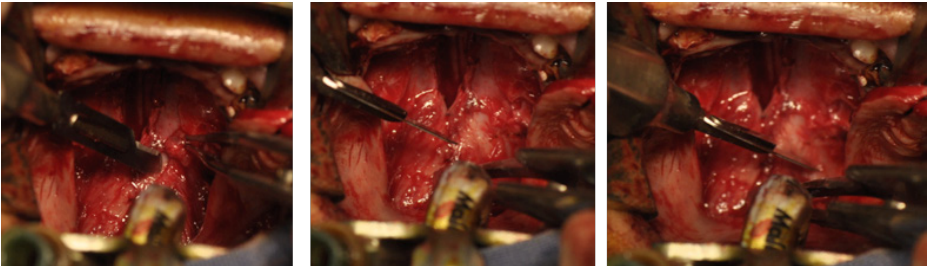


Figure 10-15. The combined levator veli palatini and palatopharyngeus muscle complex is dissected from the bluish colored nasal mucosa and retrodispaced with a combination of sharp and blunt dissection. © 2017 A Campbell, C Restrepo

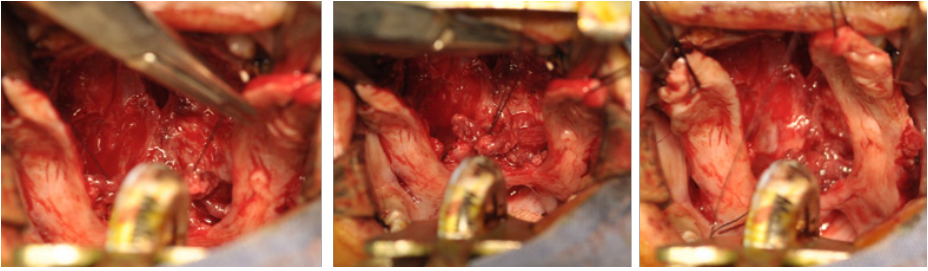


Figure 10-16. The intravelar veloplasty is performed with the levator veli palatine muscles under gentle tension, repositioning the muscle into the posterior half of the velum. © 2017 A Campbell, C Restrepo

- The intravelar veloplasty is performed with the levator veli palatine muscles under gentle tension, repositioning the muscle into the posterior half of the velum. At the completion of the veloplasty an anatomic sling should be visualized definitively incorporating both levator veli palatine muscles.
- Uvula is reconstructed by closure nasal and oral surfaces, along with deep one suture to repair the muscularis uvulae. This created an attractive and bulky (functional) repair.
- Closure of the oral layer is performed with everting sutures, simple interrupted in the soft palate and horizontal mattress in the mucoperiosteal flaps.
- Two or three sutures are used to incorporate both oral nasal layers to oppose them and obliterate the intervening dead space.
- Several sutures are placed between the alveolar ridge and lateral / anterior palatal flaps. These are tied to be completely tension free.

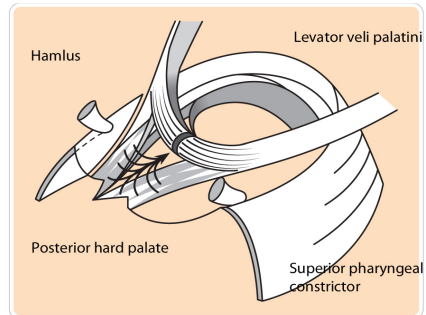


Figure 10-17. Retropositioned levator veli palatine after dissection, mobilization, and repair during intravelar veloplasty.

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Key Tip: When opposing the oral and nasal layers, take special care to offset incisions to minimize incision overlap of nasal/oral closure and lower the risk of postoperative fistula.

Key Tip: Use a tongue stitch in all patients, and if there is any difficulty with bleeding, suture in a palate pack to minimize risk of postoperative bleeding.

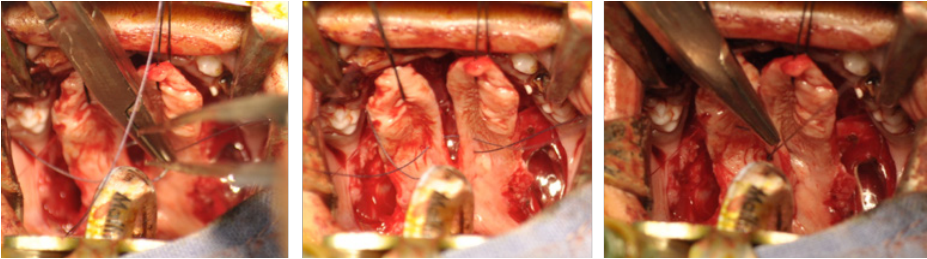


Figure 10-18. Everting horizontal mattress sutures are used to oppose the mucoperiosteal flaps. © 2017 A Campbell, C Restrepo

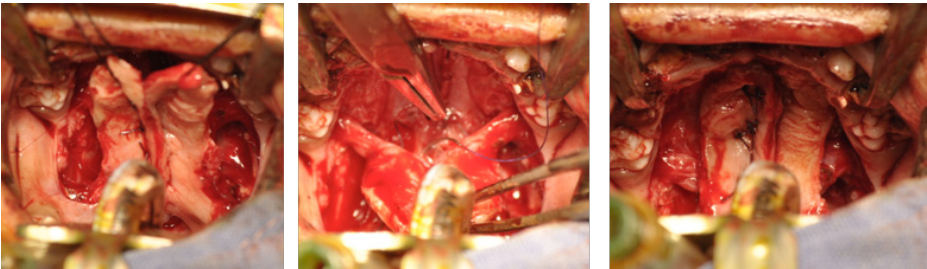


Figure 10-19. Closure is complete and repaired mucoperiosteal flap is affixed to the nasal mucosa offsetting the suture lines to decrease risk of fistula.


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POSTOPERATIVE CARE

- Standardized protocols improve understanding, compliance, and outcomes.
- 1 dose perioperative antibiotic IV before incision.
- 5 days of postoperative oral amoxicillin was statistically significant as an independent variable that decreased complications.⁵
- May breast feed after surgery.
- Liquid diet by syringe / spoon for 1 week.

Directions for Post-Operative Care Following Cleft Palate Repair


Feeding Instructions and Oral Care:



- Your child may breast feed immediately after surgery.
- Feed your child using a cup, syringe, or spoon.
- After each feeding give your child water to drink to clean the mouth.
- Brush your child's teeth two times per day with clean water and toothpaste.

Weeks First Week - Full liquid diet including:

- MB.
- Formula (see dilute)
- Juice
- Liquid OJ, cream soup



Weeks Second Week - Soft and mashed foods:

- Mashed (d), mashed rice, mashed beans, mashed eggs
- Mashed fruits and mashed vegetables
- Yogurt and pudding

Weeks Third Week - Any food that is not hard or crunchy.

DO NOT DO

- DO NOT GIVE CHIPS, NO BETTEL NUT
- Do not allow your child to place any objects in mouth, including fingers.

Relief of Pain:

- Give your child pain medicine as instructed

Return for Your Postoperative Visit:

- Come to the scheduled appointment.
- Bring ALL Operation Smile papers
- If you cannot keep this appointment, you must call Operation Smile to report on the status of your child.

Report any Problems to Operation Smile:




Figure 10-20. Post operative care instructions with pictographs.

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- Soft diet for three weeks.
- Nothing in mouth.
- Oral hygiene including washing mouth after eating and brushing teeth twice a day with toothbrush and toothpaste.
- Patient education program shown as a statistically significant independent variable that decreases complications.
 - Teaching sessions on the ward after surgery before discharge where the nurses go through all discharge instructions.
 - Handouts in the local language with pictographs.

SURGICAL OUTCOMES

Fistula Rates

Deshpande and Campbell (2014) reviewed 428 consecutive patients with two flap repair and reported a 5.1 % fistula rate in a challenging environment with 92.4% patients presented for surgery after 2 years of age, and none receiving preoperative orthopedics.⁷ Salyer (2006) reported a fistula rate of 10% in his review of 171 patients receive two flap repair.⁸ Koudounakis (2012) reported a symptomatic fistula rate of 5.4% in his review of 257 consecutive patients.⁹

Speech Outcomes

Salyer (2006) reviewed 171 consecutive cases and reported a VPI rate requiring surgery of 6.4%.⁷ Koudounakis (2012) reviewed 257 consecutive cases and reported VPI rate requiring surgery of 5.3%.⁸

KEY CONSIDERATIONS:

The stakes are high for cleft palate operations, and complication rates are several times higher than those of lips. Complications of the original CP operation are much harder to repair with revision surgery, and can have permanent effects on that child's ability to speak.

Cleft palates seen in developing regions are especially complicated, and even experienced surgeons can have had relatively high complication rates in these patients. Complications are also higher for repair of complete cleft palate (Veau classification 3 and

4) and for older patients. In a series examining outcomes in 1408 palate patients, each of these three factors (operating surgeon, patient age, initial cleft severity) had a statistically significant impact on outcomes.¹⁰

The implication is that palates should only be done by surgeons with ample experience in palate repair, and that more complicated cases should be given to the most experienced surgeons.

- Complete Unilateral CP (Veau class 3)
- Complete Bilateral CP (Veau class 4)
- Older Patients (>age 6)

KEY READING

1. Leow A, Lo L. Palatoplasty: evolution and controversies. *Chang Gung Med J.* 2008 Jul-Aug;31(4):335-45.
2. Sekhon, P, Ethunandan M, Markus, et al. Congenital anomalies associated with cleft lip and palate-an analysis of 1623 consecutive patients. *Cleft Palate Craniofac J.* 2011 Jul;48(4):371-8.
3. Bardach J. Two-flap palatoplasty: Bardach's technique. *Operative Techniques in Plastic and Reconstructive Surgery* 1995;2:211-4.
4. Sommerlad B. (2009) Cleft palate Repair. In: Losse J, Kirschner R: *Comprehensive Cleft Care* (pp. 399-412). McGraw-Hill Companies.
5. Aznar M, Schönmeyr B, Echaniz G, Nebeker L, Wenby L, Campbell, A. Role of Postoperative Antimicrobials in Cleft Palate Surgery: Prospective, Double Blind, Randomized, Placebo-Controlled Clinical Study in India. *Plast Reconstr Surg.* 2015 Jul;136(1):59e-66e.
6. Schonmeyr B, Restrepo C, Wendby L, Gillenwater J, Campbell A. Lessons Learned from Two Consecutive Cleft Missions and the Impact of Patient Education. *J Craniofac Surg* 2014;25: 1610–1613.
7. Deshpande G, Campbell A, Restrepo C, Jagtap R, Dobie H, Keanan T, Sarma H. Early Complications After Cleft Palate Repair: A Multivariate Statistical Analysis of 709 Consecutive Patients. *J Craniofac Surg* 2014; 25:1614–1618.
8. Salyer KE, Sng KW, Sperry EE. Two-flap palatoplasty: 20-year experience and evolution of surgical technique. *Plast Reconstr Surg.* 2006; 118:193–204.
9. Koudoumnakis E, Vlastos IM, Parpounas K, Houlakis M. Two-flap palatoplasty: description of the surgical technique and reporting of results at a single center. *Ear Nose Throat J.* 2012 Mar;91(3):E33-7.
10. Schonmeyr B, Wendby L, Restrepo C, Campbell A. Surgical complications in 1408 primary cleft

