Islandized mucoperiosteal flaps: A versatile technique for closure of a wide palatal cleft

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BACKGROUND: A variety of surgical methods have been described to repair wide cleft palate; they are all challenging to perform and yield consistently good results. The islandized mucoperiosteal flap, the technique described in the present article, is very versatile because it can close palatal defects of any size without undue tension. Moreover, it provides adequate length and mobility of the soft palate with improved speech and feeding functions without fistula formation.

METHODS: Between 2005 and 2011, 36 patients with wide cleft palate were operated on using islandized mucoperiosteal flaps. This technique involves dissection of the neurovascular bundle from the mucoperiosteal flaps for approximately 1 cm and dissecting the muscle from the posterior edge of the hard palate with intravelar veloplasty. The flaps subsequently become freely mobile in all directions. It can move medially to close palatal defects of any size without tension. In addition, posterior or backward mobilization lengthens the soft palate and renders it freely mobile.

RESULTS: All repairs were successful, with no complications and no patients requiring secondary procedures. All patients regained normal feeding function three weeks postoperatively. All patients showed normal nasal resonance of speech except for two (three and five years of age) who experienced abnormal resonance in the form of open nasality that required regular speech therapy for six months. There was significant improvement and no secondary procedures were required for either.

CONCLUSIONS: A technical modification for closure of wide palatal clefts is introduced. The islandized mucoperiosteal flap, which is a very versatile technique, can close cleft palates of any width without tension, lengthens the soft palate and renders it freely mobile for proper speech functions. Using this technique, good speech and feeding function with no complications were achieved.

Key Words: Cleft; Islandized; Mucoperiosteal; Palate; Palatoplasty

The palate functions in concert with the pharyngeal musculature to close the velopharyngeal valve. Clefting of the palate results in an absence of velopharyngeal closure and the inability to build and sustain intraoral pressure. This has significant effects on both early feeding and the development of normal speech. In addition, the abnormal muscle anatomy present in cleft palate has an indirect effect on the function of the middle ear through the resultant anatomical disturbance present along the eustachian tube orifice from which the primary palatal muscles originate (1).

The goals of cleft palate repair are to produce anatomical closure of the defect, to create a competent velopharyngeal valve for the development and production of normal speech, and to minimize maxillary growth disturbances and dentoalveolar deformities (2).

The various techniques of cleft palate repair that are practiced today are the results of principles learned through many years of modification. These principles include closure of the defect, correction of the abnormal position of the muscles of the soft palate, especially levator palati, repositioning of the soft palate so that during speech, the posterior part of the soft palate comes in contact with the posterior pharyngeal wall, minimal or no raw area should be left on the nasal or oral surface and a tension-free repair with two-layered closure in the hard palate and a three-layered closure in the soft palate (3).

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Des lambeaux mucopériostés en îlot : une technique polyvalente pour fermer une large fente labio-palatine

HISTORIQUE : On a décrit diverses méthodes chirurgicales pour réparer de larges fentes labio-palatines. Elles sont toutes difficiles à effectuer, mais donnent uniformément de bons résultats. Le lambeau mucopériosté en îlot, la technique décrite dans le présent article, est très polyvalent parce qu'il peut fermer des fentes palatines de toutes dimensions sans causer de tension induite. De plus, elle assure une longueur et une mobilité convenables du palais mou, favorisant l'amélioration des fonctions d'élocution et d'alimentation sans former de fistule.

MÉTHODOLOGIE : Entre 2005 et 2011, 36 patients ayant une large fente labio-palatine ont été opérés au moyen de lambeaux mucopériostés en îlot. Cette technique consiste à disséquer le faisceau neurovasculaire des lambeaux mucopériostés d'environ 1 cm et à disséquer le muscle du bord postérieur du palais dur par véloplastie intervélair. Les lambeaux peuvent ensuite bouger librement dans toutes les directions. Ils peuvent se déplacer vers le centre pour fermer les déficiences palatines de toute dimension, sans créer de tension. En outre, la mobilisation postérieure ou inversée rallonge le palais mou et lui permet de bouger librement.

RÉSULTATS : Toutes les réparations ont réussi sans complications et sans qu'un seul patient ait besoin d'interventions secondaires. Tous les patients avaient retrouvé leur fonction alimentaire normale trois semaines après l'opération. Ils présentaient tous une résonance nasale normale à l'élocution, sauf deux (de trois et cinq ans), qui ont manifesté une résonance anormale sous forme de nasalisation ouverte, laquelle a exigé de l'orthophonie pendant six mois. Leur résonance s'est considérablement améliorée et ils n'ont pas eu besoin d'intervention secondaire.

CONCLUSIONS : Les auteurs présentent une modification technique pour fermer une large fente labio-palatine. Le lambeau mucopériosté en îlot, une technique très polyvalente, peut fermer des fentes labio-palatines de toute dimension sans créer de tension, rallonger le palais mou et lui permettre de bouger librement pour assurer des fonctions d'élocution correctes. Au moyen de cette technique, on parvient à une bonne fonction d'élocution et d'alimentation, sans complications.

While many standard techniques can be used for the closure of most palatal clefts, they cannot be easily applied to the repair of wide and extremely wide palatal clefts. Attempts at closure of such clefts with these techniques may place the palatal tissue under great tension and result in a higher incidence of postoperative fistula formation.

Bardach (4) defined a wide cleft palate as one in which the distance between the medial edges of the hard palate is >1.5 cm (4). An extremely wide cleft palate has been defined as a palatal defect >60% of the width of the entire palate or in which the width of both palatal shelves is less than the width of the palatal defect (5).

The challenges in the repair of a wide cleft palate are to reduce the incidence of wound dehiscence and fistulae, and to minimize the amount of denuded palate after palatal repair. A variety of surgical methods have been described to repair wide cleft palatal defects, including primary pharyngeal flap with palatoplasty (5-7), the double transposition flap (8), free tissue transfer flaps (9-11), buccal musculomucosal flaps (12,13) and a mucoperiosteal hinge flap with push-back palatoplasty. (14).

The multitude of advanced techniques for the repair of an extremely wide cleft palate are all challenging to perform, but yield consistently good results. In the present article, we describe our favourable experience in the closure of the wide and extremely wide cleft palate by introducing a technique called islandized mucoperiosteal flaps. This is

Figure 1) A Diagram of left complete cleft palate with the drawing of the incisions (dashed line). The alveolar incision extending posteriorly to the Ernst space and both the alveolar and cleft incisions meet at the anterior end of the palate. B Diagram showing the two mucoperiosteal flaps elevated from the bone of the hard palate anteriorly and from the muscle posteriorly, with the bundles dissected from the flaps for approximately 1 cm. C Diagram showing the repair starting with the nasal layer followed by the muscle layer in an end-to-end pattern to form a sling

Figure 2) A Diagram showing post-alveolar incomplete cleft with the incision marks (dashed line). B The mucoperiosteal flaps are dissected showing the dissected bundles underneath. The muscles are detached from their abnormal insertion (posterior edge of hard palate) and repaired (in the mid-line) to reconstruct the muscular sling. C Two surgical packs of tincture benzoin-soaked gauze are carefully secured in the lateral gutters

actually a modification of two-flap palatoplasty described by Bardach and Salyer (15) and Bardach (16) in which the two mucoperiosteal flaps are dissected from the neurovascular bundles for approximately 1 cm starting from the palatine foramen and from the muscle behind the exit of the bundles, giving them significant free mobility in any direction without compromising their blood supply.

This technique is surgically less complicated than current techniques for the closure of wide clefts, achieves tension-free closure, lengthens the palate and produces rewarding results.

METHODS

The islandized mucoperiosteal flap technique was performed in the Plastic Surgery Department of Ain Shams University Hospitals (Cairo, Egypt). The study duration was six years (April 2005 to April 2011). Thirty-six consecutive patients presented to the outpatient department (OPD) with cleft palate. All of these patients were thoroughly evaluated according to routine preoperative assessment and other systems review. Local cleft assessment was performed to determine the type, width and unilaterality of the cleft, and also its association with cleft lip. Patients with narrow-to-moderate clefts and those with submucosal clefts were excluded from the study, as were patients >5 years of age. This is in addition to any syndromic cleft (eg, facial clefts) except the Pierre-Robin sequence.

The patients were subjected to close, regular and comprehensive follow-up as long as possible with the parents' compliance. The follow-up schedule consisted of an OPD visit one week after discharge for early assessment of the repair. Then, a regular visit was planned every two weeks for one month to evaluate any wound complications and to allow oral soft diet intake. The patients were then asked to attend the OPD every month for six months. At each visit, the patients underwent careful examination of the suture line, palatal mobility, uvular centralization or notching, and for the presence of any wound dehiscence, infection or

Figure 3) Top left Extremely wide right palatal cleft. Top right After islandization of the two mucoperiosteal flaps, which become freely mobile, the bundles are shown clearly dissected from the undersurface of the flaps. The nasal layers are repaired together. Bottom left After complete closure, the packs are secured in the lateral defects. Bottom right Three weeks postrepair with completely healed lateral defects

fistulas. Subsequently, all patients were referred to the Cleft Palate Committee at Ain Shams University Hospitals whose primary role is to assess palatal and speech function following palatal repair.

Surgical technique

The repair was performed under general anesthesia with an intraoral endotracheal Ring-Adair-Elwyn tube. A Dingman mouth gag is placed and the patient positioned in a neurosurgical head holder so that the neck is in the fully extended position. A throat pack should be applied around the tube before prepping and draping. The entire hard and soft palate is injected with a solution of 1% lidocaine with 1:100,000 epinephrine. In addition to antibiotics, patients are given 0.5 mg/kg of dexamethasone to reduce tongue and throat edema associated with the procedure.

The design and drawing is the same as the Bardach two-flap palatoplasty, which is a modification of the Von Langenbeck technique in which an incision is made along the cleft margin and the alveolar margin. These two incisions are joined anteriorly to free the mucoperiosteal flaps. The incision along the cleft margin is made to the bone of the hard palate and slightly on the oral side to provide a small amount of extra tissue for nasal closure. This incision is then continued across the soft palate to the tip of the uvula. The incision along the alveolar margin is made to the underlying bone starting from the Ernst space posteriorly and extended anteriorly along the alveolar ridge to meet the cleft incision at the anterior limit of the palate (Figure 1).

The flap is dissected off the bone using a dissector until the palatine neurovascular bundle at its foramen in the palatine bone is reached. After the flap is elevated, the mucosa is raised from the nasal side of the bone. Regardless of whether the cleft is complete or incomplete unilateral or bilateral, isolated or associated with cleft lip, the elevation will include elevation of a vomerine flap anteriorly.

A loop magnification (3×) is usually used to dissect the neurovascular bundle from the flap using fine blunt scissors. Dissection started from the lateral side in a retrograde manner (starting from the palatine foramen) while gentle retractions of the flap medially is applied using a fine skin hook. The neurovascular bundle is then dissected for a distance of approximately 1 cm. The dissection proceeds posteriorly (elevating the flap from the posterior edge of the hard palate and the muscle attached to it) and medially in a retrograde manner while the flap is retracted laterally. Now the mucoperiosteal flap is completely freely mobile and can move toward the midline without any undue tension (Figures 2 and 3).

Figure 4) Left Wide complete postalveolar cleft. Middle After repair using islandized mucoperiosteal flaps. Right Three-week postoperative photograph showing complete healing of the lateral defects

Figure 5) Left extremely wide incomplete postalveolar cleft in a case of Pierre-Robin sequence. Middle Intraoperative photograph after completion of the procedure, the flaps are closed without any tension. Right Four-week postoperative photograph

Dissection of the bundle from the mucoperiosteal flap for approximately 1 cm in this region makes it an island flap and provides two vectors of mobilization: one medially serves closure without any tension while the other posteriorly serves in palatal lengthening.

After the oral and nasal sides of the hard palate are elevated, the muscles are dissected from the oral and nasal sides of the soft palate using blunt scissors. Now the muscles are ready for detachment from the posterior edge of the hard palate using sharp, curved scissors after performing retraction of both oral and nasal layers together with the bundle anteriorly. There is no need for excessive dissection of the muscles, especially from the oral layer because these muscles will retropose with the freely mobile mucoperiosteal flap allowing posterior elongation of the palate.

These steps should be repeated on the other side before palatal closure, starting with the nasal layer. Sometimes the nasal layer will incur iatrogenic injury during dissection. In that case, it may be left without repair because it is protected by the repaired underlying palatal muscles posteriorly and palatal layer anteriorly. The muscle layer is then repaired in an end-to-end pattern (intravelar veloplasty) followed by the oral layer, which is repaired using horizontal mattress sutures (Figure 1). All repairs are performed using absorbable 4/0 sutures. Two small packs of gauze soaked with tincture of benzoin are placed on the lateral defects to act as a hemostatic, support the flaps and enhance the re-epithelialization process and should be left for approximately 48 h (Figure 2).

By adhering to this technique, a tension-free multilayered repair will be achieved. It will provide three layers in the soft palate (intravelar veloplasty) and two layers in the hard palate (Figures 3, 4 and 5).

Postoperative care

Postoperative airway observation should be performed with pulse oximetry monitoring until the child is fully awake and is able to maintain normal oxygen saturation with room air without any support. Analgesia (nonsteroidal anti-inflammatory drugs) in the form of rectal suppositories and oral syrup (paracetamol) can effectively alleviate postoperative pain. Arm restraints may be used to avoid any self-inflicted trauma by

uncontrolled hand movement. Oral fluids are given as soon as the child is fully recovered. Liquid diet is allowed for three weeks followed by a soft diet for an additional three weeks.

RESULTS

During the six-year study period, 36 cleft palate patients were treated surgically. The demographic and clinical characteristics of the patients are summarized in Table 1. Female sex was predominant in the present study, accounting for 20 (55.6%) patients. The patients' age at the time of repair ranged from nine to 60 months, with a mean age of 15.5 months. Isolated cleft palate was found in 12 (33.3%) patients whereas complete cleft palate was found in 24 (66.7%). Of the patients with complete cleft palate, only eight (33.3%) had unilateral cleft and the remaining 16 (66.7%) had bilateral cleft. Six patients (16.7%) had extremely wide cleft palate (a palatal defect >60% of the width of the entire palate or in which the width of both palatal shelves is less than the width of the palatal defect) (5) and the remaining 30 patients (83.3%) had a wide cleft palate (the distance between the medial edges of the hard palate >1.5 cm). (4) The postoperative follow-up period ranged from three to 25 months, with a mean of 10.9 months.

For the 36 patients, all repairs were successful with no major complications, such as wound dehiscence, disruption, infection, fistulae formation, or partial or total flap loss, and none required any secondary procedures. All patients showed complete healing of the lateral gutters with no evidence of scarring or contractures and regained normal feeding three weeks postoperatively (Figure 4). Minor complications, such as uvular notching (n=14), intraoperative nasal mucosal tears (n=26) and postoperative transient loss of appetite (n=9), were recorded.

Regarding speech outcome as evaluated by the Cleft Palate Committee, all patients showed normal nasal resonance of speech with normal palatal mobility, even in patients with uvular notching. Only two patients (three and five years of age) had abnormal resonance in the form of open nasality, which required regular speech therapy for six months. There was significant improvement and no secondary procedures were required for either.

TABLE 1
Clinical and demographic data of the study patients

Patient	Sex	Age, months	Cleft palate			Follow-up period, months
			Unilateral/bilateral	Width	Complete/incomplete	
1	Male	9	–	Wide	Incomplete	3
2	Female	10	Unilateral	Extra wide	Complete	5
3	Female	11	Bilateral	Extra wide	Complete	6
4	Male	36	Unilateral	Wide	Complete	19
5	Female	60	–	Wide	Incomplete	15
6	Female	15	Unilateral	Wide	Complete	25
7	Female	16	–	Wide	Incomplete	14
8	Male	13	Unilateral	Wide	Complete	12
9	Female	11	–	Wide	Incomplete	19
10	Female	10	–	Wide	Incomplete	22
11	Male	9	–	Wide	Incomplete	8
12	Female	11	Unilateral	Wide	Complete	9
13	Female	13	Bilateral	Extra wide	Complete	23
14	Female	15	Unilateral	Wide	Complete	5
15	Male	14	Bilateral	Wide	Complete	6
16	Female	15	–	Wide	Incomplete	8
17	Male	16	Bilateral	Extra wide	Complete	9
18	Male	22	Unilateral	Wide	Complete	11
19	Male	20	Bilateral	Wide	Complete	14
20	Male	18	Bilateral	Wide	Complete	14
21	Female	17	Unilateral	Wide	Complete	10
22	Female	15	Bilateral	Wide	Complete	11
23	Female	13	–	Extra wide	Incomplete	9
24	Male	18	–	Extra wide	Incomplete	8
25	Female	9	Bilateral	Wide	Complete	5
26	Male	11	Bilateral	Wide	Complete	6
27	Male	12	Bilateral	Wide	Complete	14
28	Female	13	Bilateral	Wide	Complete	15
29	Male	15	Bilateral	Wide	Complete	14
30	Male	11	Bilateral	Wide	Complete	9
31	Male	11	Bilateral	Wide	Complete	6
32	Female	13	Bilateral	Wide	Complete	5
33	Female	15	–	Wide	Incomplete	6
34	Female	13	–	Wide	Incomplete	12
35	Male	15	Bilateral	Wide	Complete	13
36	Female	12	–	Wide	Incomplete	3

DISCUSSION

Surgical repair of a wide cleft palate has proven to be a formidable task for surgeons. Attempts to close wide clefts with standard palatoplasty techniques may place the palatal tissue under great tension and result in a high incidence of postoperative oronasal fistula formation. As a result, a variety of techniques for closure of extremely wide cleft palates have been specifically developed and are described in the literature.

Bengt Johanson first described an elongated pharyngeal flap for extremely wide cleft palate closure as reported by Bardach (4). Bumsted (5) subsequently applied this method in four patients. Holmstrom et al (7) performed the procedure on 11 patients with wide clefts who were obturator dependent using a Wardill-Kilner palatoplasty in combination with pharyngeal flap. None of their patients required additional surgery; however, two patients developed fistulae postoperatively.

Bilateral buccal musculomucosal flaps have also been used for wide cleft palate closure. Chen and Zhong (13) reported their experience in 26 patients with no postoperative complications. This use of buccal flaps for wide clefts is well established in the literature, with another report (12) combining this technique with the Furlow double opposing

z-plasty. This combination achieves lengthening of the palate from the Furlow technique and reduces tension from the closure in wide clefts by adding bilateral buccal flaps.

Although the double-transposition flap is a simple technique and can close wide palatal defects without tension (8), it is not an anatomical repair and it does not produce palatal lengthening to close the velopharyngeal space during speech. Furthermore, it requires too much dissection of the muscles to be closed in the midline, which will affect its blood supply and, subsequently, its function.

Free tissue transfers are commonly reported in the literature to close extremely wide palatal defects by providing well-vascularized tissue to the area with minimal scarring (9-11,17). Free flaps can correct large defects with minimal dissection of the palate; however, they require a long operating time and can be technically very difficult.

The above techniques are not basic techniques for palatal repair because they depend mainly on either additional tissues in the form of regional and distant flaps or extensive dissection of local tissues, especially the muscles. This will affect the function of the palate, especially speech, in addition to the donor site morbidities.

The fixed position of the neurovascular bundles originating from their bony foramen has traditionally limited successful palatoplasty procedures. Management options of the greater palatine structures include osteotomy of the greater palatine foramen, described by Limberg in 1927 (18) to free the neurovascular bundle, increasing mobility of the palatal flaps and decreasing the tension of closure. Dorf and Curtin (19) and Dado (20) described foraminal osteotomies similar to those of Limberg. Osteotomy is a traumatizing procedure and retro displacement achieved in this way can be effective only if it is performed extensively, which is an unpredictable procedure and can do more harm than help.

Stretching (21,22) or lengthening (15,23,24) the neurovascular bundle by sharp dissection from the mucoperiosteal flaps can increase the mobility of the flaps at the expense of major complications because stretch elongation as well as extensive dissection (>2 cm) of the bundles puts the mucoperiosteal flaps at a higher risk of vascular compromise and partial or total flap loss.

The islandized mucoperiosteal flap, as described in the present article, is a versatile technique that has advantages because islandization of the flap renders it freely mobile in any direction. It can move medially to close palatal defects of any size without undue tension regardless of whether they are wide or extremely wide. In addition, posterior or backward mobilization lengthens the soft palate and renders it freely mobile, supple and floppy. Therefore, this technique can be used to repair all clefts: narrow, wide, incomplete and complete clefts of the primary and secondary palate.

This is in contrast to two-flap palatoplasty, in which there is no additional length to the repaired palate to allow normal speech function.

This technique releases the tethering effect of the palatal mucoperiosteum around the proximal part of the bundles and also releases the muscles from the posterior edge of the hard palate, making the soft palate longer and freely mobile. Backward mobilization of the palatal layer limits muscle dissection and brings the muscle in a more favourable position for function.

This technique provides adequate length and mobility of the soft palate in addition to the reconstruction of the muscle sling in the normal position, which are the most important elements for soft palatal function. The lateral defects healed completely within three weeks in all patients, with no evidence of scarring or contractures.

During follow-up, all of the patients regained normal feeding and speech function, with normal nasal resonance and no need for any secondary procedures. Only two patients required speech therapy for six months because the repair in these two patients was performed after two years of age (three and five years of age).

Noordhoff et al (25) found that children undergoing delayed palatoplasty for cleft palate had significantly poorer articulation skills than children of the same age group who did not have clefts. Many authors have recognized that a cleft palate should be repaired before

two years of age (26,27) and others agree that the best speech outcomes are correlated with closure of the palate near the time of language skill acquisition, which for a normally developing child, is before 12 months of age (28,29). However, Rohrich et al (30,31) and the University of Texas Southwestern Medical Center (Texas, USA) recommend a two-stage palatoplasty, with soft palate repair at three to six months of age, and hard palate repair at 15 to 18 months of age to allow normal maxillary development.

Maxillary relationship and development are better in unrepaired cleft patients than in those who undergo early palatal surgical intervention. For this reason, many surgeons used to perform palate repair in two stages. The soft palate is repaired early, while the hard palate is repaired later (32,33). Reports based on long-term follow-up indicate that neither the objective of good speech nor the avoidance of maxillary collapse is achieved using the Schwegendiek procedure (34).

Although there are still no standard protocols to address the issues of ideal timing for cleft palate repair to attain optimal speech and to avoid

abnormal maxillofacial growth after repair, normal speech should be the most important consideration in the therapeutic plan. Growth disturbance should be minimized but not at the expense of speech impairment because facial distortion can be satisfactorily managed with orthodontia or future orthognathic surgery after full maxillary growth, whereas speech impairment can often be irreversible.

CONCLUSIONS

Repair of wide palatal clefts can be difficult by incomplete mobilization of palatal flaps. In the present article, a technical modification for closure of wide palatal clefts was introduced. The islandized mucoperiosteal flap is a very versatile technique that can close cleft palates of any width, and lengthens the soft palate and makes it freely mobile for proper speech function. Using this technique, patients achieved good speech function with no fistula formation, and no evidence of significant scarring or contracture in the lateral defects of the palate.

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