



EVALUATION OF THE EFFICACY OF BUCCAL MYOMUCOSAL FLAP FOR THE CORRECTION OF VPI IN PRIMARY CLEFT PALATE.

Dr T. Mohana Rao	MS MCH, Associate Professor, AMC, Visakhapatnam.
Dr P. Rajakullayappa*	EX S.R NIMS, Hyderabad. *Corresponding Author
Dr D. Mukunda Reddy	Professor & H.O.D, NIMS, Plastic Surgery Department.
Dr R. Srikanth	Professor, Plastic Surgery Department, NIMS, HYD.
Dr N. Rambabu	Additional Professor, Plastic Surgery Department, NIMS, HYD.

ABSTRACT **Background:** Normally the cleft palate patient is operated with intravelar veloplasty at the age of around 9 months to one year to attain optimal results. Following primary palatal surgery 5 to 39% of patients have velopharyngeal incompetence causing them to have abnormal speech. There are many surgical procedures described in literature for primary correction of velopharyngeal incompetence in children. In Our pilot study of 10 cases to evaluate the efficacy of buccal myomucosal flap for VPI correction in primary cleft palate group was inspired by Ian T Jackson's study, but was used for older age groups. VPI evaluation was done clinically by speech pathologists and assessed objectively by using videofluoroscopy in lateral view for velopharyngeal closure and nasal endoscopy for sphincteric action of velopharyngeal muscles.

Aims and objectives: To know normal palatal length in adults and normal velopharyngeal gap. To know whether soft palate length achieved following cleft palate repair with use of buccal myomucosal flap on nasal side was normal length or not. Observations were made immediately following surgery, after six months and after 2 years. To evaluate Velopharyngeal competence clinically, videofluoroscopy and with nasalendoscopy. To evaluate speech outcome based on the above parameters.

Methods and materials : Study was prospective type. Measurement of Soft palate length in 10 normal adults under anesthesia. 10 Primary cleft palate includes complete and incomplete that were attended during 2007 -2014. Age ranges between 8 – 25 years were included and Both sexes included. Soft palate length measured prior to surgery under anaesthesia

Cleft palate repair done with intravelar veloplasty and nasal layer lengthening done with use of buccal myomucosal flap interposition at hard and soft palate junction, Oral layer closed in straight line were included. Immediate post operative soft palate length measures were included. Soft palate length and velopharyngeal gap measured at 6 months and at 2 years are included. Speech evaluation done clinically by speech pathologist at interval of 6 months and 2 years. Objective speech evaluation done by using videofluoroscopy and nasal endoscopy at 6 months and at 2 years

Results : Clinical evaluation of speech in study cases were done after 6 months showed, in 40% of cases normal speech observed, 20% cases reasonable speech and remaining 40% cases had bad speech with articulation problems and nasal emission. These patients are subjected for speech therapy. When velopharyngeal incompetence was objectively assessed with videofluoroscopy we found that in 6 out of 10 cases (60%) velopharyngeal competence seen.

Conclusion: Though this study showed the usefulness of the buccal myomucosal flap in the improvement of speech significantly, especially in grown up children when compared to adults clefts, it improved the length of palate as well. However this study being a small study, though having good results when compared previous study groups. It needs further expansion with more data analysis to show more accurate results.

KEYWORDS :

BACKGROUND:

Cleft palate has a wide spectrum of severity, with varying degrees of anatomical and functional abnormalities of the velopharyngeal muscles. Analysis of the velopharyngeal sphincter shows it to be a highly specialized mechanism that requires more than anatomic integrity for its dynamic function. Inherent factors of the cleft such as width, position and degree of hypoplasia of the palatal muscles are as important for the outcome as the technique of palatal repair.

Success of palate repair is judged mainly by speech. This is an extremely complex function, in which the palate must be mobile and have well-coordinated movement. Normal velopharyngeal closure is primarily the result of levator muscle contraction which pulls the velum upward and posteriorly towards the pharynx. To a lesser extent, velopharyngeal closure is produced by a sphincteric action of the palatopharyngeus and the superior constrictor muscles. Normally the cleft palate patient is operated with intravelar veloplasty at the age of around 9 months to one year to attain optimal results. Following primary palatal surgery 5 to 39% of patients have velopharyngeal incompetence causing them to have abnormal speech. There are many surgical procedures described in literature for primary correction of velopharyngeal incompetence in children, viz posterior pharyngoplasty, Hynes pharyngoplasty, sphincter pharyngoplasty, posterior pharyngeal wall augmentation and palatal lengthening procedures like primary Furlow's palatoplasty and Sommerlad's anatomical reposition of levator muscle.

We observed that for a successful outcome in palatal repair, tensionless

closure of the flaps and adequate palatal length at the end of surgery are important. Ian T Jackson et al, has used buccinator myomucosal flap interpositioning at junction of soft and hard palate on nasal side to decrease tension and to lengthen the palate which is more physiological for sphincter action and proved to have good speech in 95% cases in one year old cleft palate children.

Our pilot study of 10 cases to evaluate the efficacy of buccal myomucosal flap for VPI correction in primary cleft palate group was inspired by Ian T Jackson's study, but was used for older age groups. If this study shows a good outcome this procedure can be standardized for the age groups concerned. VPI evaluation was done clinically by speech pathologists and assessed objectively by using videofluoroscopy in lateral view for velopharyngeal closure and nasal endoscopy for sphincteric action of velopharyngeal muscles.

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10 Primary cleft palate includes complete and incomplete that were attended during 2007 -2014.

Age ranges between 8 – 25 years were included and Both sexes included Soft palate length measured prior to surgery under anaesthesia Cleft palate repair done with intravelar veloplasty and nasal layer lengthening done with use of buccal myomucosal flap interposition at hard and soft palate junction, Oral layer closed in straight line were included.

Immediate post operative soft palate length measures were included.

Soft palate length and velopharyngeal gap measured at 6 months and at 2 years are included.

Speech evaluation done clinically by speech pathologist at interval of 6 months and 2 years.

Objective speech evaluation done by using videofluoroscopy and nasal endoscopy at 6 months and at 2 years

Data analyzed for speech outcome

Velopharyngeal incompetence is the term used when the patient is diagnosed as to unable to close the velopharyngeal sphincter completely. The sphincter permits the speaker to separate oral from nasal cavities. Closure of the sphincter is achieved by tension in velum and elevation towards the posterior pharyngeal wall, Along with assisted posterior and lateral pharyngeal walls which move towards raising velum thus reducing lumen of pharynx.

Velopharyngeal incompetence can occur due to inadequate length or inadequate movement of soft palate, deep pharynx and inadequate pharyngeal wall movements,etc. this manifests as hyper nasality and nasal air escape³. The acquired secondary compensatory components like glottal, pharyngeal articulations are extremely difficult to correct once acquired even when competent velopharyngeal mechanism is constructed. Speech therapy may improve the intelligibility of these patients.

The abnormal position of the levator muscle in the cleft palate and submucous cleft palate has been demonstrated by Veau¹⁹, Ruding, and Maurice⁴,Kriens,Hoopes et al, Millard¹⁴ et al, Fara and Dvorak and Edgerton and Dellon. These levators have a normal origin on the eustachian tube and lip of the carotid canal, but they insert abnormally onto the posterior margin of the hard palate into the tensor tendon instead of inserting into the medial raphe of the soft palate.The Von Langenbeck¹⁷ and Veau-Wardill¹ palate repairs bring the medial muscle fibers to a side-to-side position; however, the lateral muscle fibers are either isolated in the soft palate, or they remain attached to the hard palate and do not form a levator sling. The objective of a levator sling reconstruction is to maximize velar elevation and posterior closure by establishing physiological levator muscle relationships².

Edgerton and Dellon⁴ described one method of levator retrodisplacement for correction of velopharyngeal incompetence. In their technique, the levator muscles are dissected from both the oral mucosa and the nasal mucosa so that the muscles are a "sandwich" between the mucosal linings. The method was described for the treatment of velopharyngeal incompetence in repaired cleft palates, however, and not for the initial palate repair. Millard¹⁴ et al, Fara et al,Kriens,and others have advocated methods of levator sling reconstruction during primary closure of a cleft. Jacksonson¹⁶ and et al. separates the oral mucosa of the soft palate from the palatine muscles so that the levator muscle and the nasal mucosa are rotated as a composite unit. The advantages of this technique are that because there is no dissection of the nasal palate mucosa, there is less scar with its resultant restriction and less possibility of devascularizing or injuring the levator muscle. In our method we separates the Levator muscle from nasal mucosa for sling formation at the base of uvula, and for scarless and tension free closure we used buccinators myomucosal flap, Thinking that it will normalize the soft palate length and curvature and correct the VPI.

Rationale for the buccal mucosal flap Without lining, the raw nasal surface of the soft palate would undergo contraction thus pulling the surgically repositioned muscles towards the operative scar. The value of muscle reconstructing the muscles would be never by the excessive scar formed and the resultant reattachment of the levator muscle to hard palate. If the nasal side palate has been lined, however, there should be less scar and a longer soft palate. Furthermore the lining should prevent reattachment of the reconstructive levator muscle because it is interposing between the hard palate and the levator muscle

The use of buccal mucosal flap was used for palate lining has several advantages In cleft palates Buccal mucosa is available in adequate amounts for nasal mucosa lining.

Can be applied to any type of palate repair Diminishes tension centrifugally on palate closure Reconstructs a tight nasal layer as well as augments a normally closed nasal layer.

Reattachments of levator palatini muscle to hard palate is prevented.

Breaks the linear suture line in the palate and thereby limits contracture.

Does not impede soft palate mobility The palate is lengthened on the nasal surface No detrimental effect at donor site.

More physiological form of soft palate reconstruction.

Assessment of Velopharyngeal Function and Speech :

Velopharyngeal function was assessed by a certified speech-language pathologist .The screening test used for velopharyngeal incompetence(VPI) was that designed by Bzoch³(1977),which consists of evaluation of nasal emission, hypernasality, hyponasality, and phonation and error pattern screening articulation tests. The quality of the speech was ranked as normal, mild, moderate, or severely compromised in speech.

The Bzoch³ screening test :

Articulation	Degree of resonance
Normal	Normal
Developmental errors	Hyper nasal
Sibilant distortions	Mild
Consonant errors	Moderate
Nasal air emission	Severe
	Hyponasal
Speech intelligibility	
Good	: > 85 % correct consonant production
Mild	: 65 – 84% of consonants are correct
Moderate	: 50- 64 % of consonants are correct
Severe	: < 59 % consonants production are correct

Objective evaluation of VPI

Video fluoroscopy

This multi-view video fluoroscopy is gold standard for objective evaluation of mechanics of velopharyngeal closure. The equipment consists of fluoroscopy unit which delivers x-rays and television system with video recording. Initially nasal layer of soft palate and nasopharynx should be coated with diluted barium sulphate. Dynamic motion of velum is recorded in lateral and frontal views for assessment of VPI. Lateral view gives elevation and posterior movement of velum, velopharyngeal gap and soft palate length and thickness. Frontal view gives lateral wall movements of pharynx. Though these procedures can provide both anatomical and physiological information regarding the velopharyngeal function , A primary limitation in using these techniques is their inability to provide absolute measurements of structural relations , as is possible in using cephalometric roentgenography.

Review of literature

Outcome assessment after palate repair demands strict review of patient understanding of previous surgeries and a critical analysis of the results in terms of speech and craniofacial growth(Witt and Marsh.1997)^{15,16}. The main reason for techniques using hard palate mucoperiosteal flap to achieve the anatomical union of the palate shelves has been to improve speech(Von Langenbeck,1861)¹⁷; (Wardill,1937)^{1,18}; (Dorrance and Bransfield,1943)²; (Furlow,1986;Brothers et al.,1995)¹. However, a large number of patients who undergo these surgical techniques still develop VPI

because of the inability to reconstruct the palatal mechanism adequately to allow for normal speech. An ideal and successful palatal repair depends on soft palate myomucosal closure without tension. It should lengthen the palate and reconstruct the muscular sling to allow an efficient velopharyngeal valving action during speech thus establishing conditions for good velopharyngeal closure.

Although the muscular reconstruction can be very effective in achieving levator sling, it is not enough to merely lengthen the soft palate. Thus,insertion of the buccal mycomucosal flap complements the palate repair and prevents any possible anterior movement of the muscle sling and lengthen the palate. In the first description of the buccal mucosal flap,Mukherji(1969)¹² stated that short soft palate is a relative term because its length is dependent on the depth of the nasopharynx. He noticed that children with distances greater than 5mm between the soft palate and the posterior pharyngeal wall(57.1% of children with cleft in his study)were more likely to have speech problems that needed to be corrected further. His rationale for the use of the buccal flap was the possibility of lengthening the palate and to avoid surgeries such as the pharyngeal flap in small children.

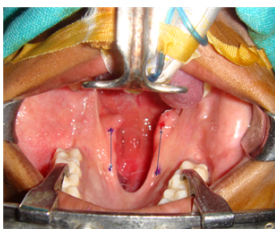
Ganguli ^{8,9} (1971)reported the use of submucous cheek pedicle to lengthen the short palate. Kaplan(1975)¹⁰described the technique in primary palatal repair as a unilateral buccal mucosal flap to be turned in for nasal lining after the nasal mucosa division following the pushback. Maeda et al.(1987)¹¹modified the initial buccal mucosal flap to a buccal myomucosal flap, including a thin layer of the buccinator muscle, in attempt to improve the blood supply. They also used bilateral buccal flaps to lengthen the nasal layer and to cover the oral surface of the palate,as Nakikita et al.(1991)¹² also reported.

Freed lander and Jackson(1989)⁶ studied the reliability of the buccal flap over time. They showed by endoscopic examination that the buccal flap remained viable and kept its initial dimensions for lengthening of the nasal layer. They hypothesized that the flap would prevent reattachments of the reconstructed levator sling by interpositioning between the hard palate and the velar muscles (Kaplan,1975;Freedlander and Jackson,1989). They achieved about 90 % good speech and 3.7 % fistula rate in < 1 year children. The ability to achieve total closure of the whole palate without raw areas with or without periosteum, and without tension decreases the adverse effects of scar contraction of the palate on facial growth and that can be achieved with interpositioning buccal myomucosal flap on nasal side.

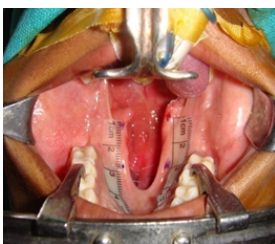
Several variations of the buccal flap and its use in cleft palate repair have been reported.

- Depending on the type of flap—mucosal/myo mucosal
- Based on vascular pattern --random /axial pattern flaps
- Based on anatomy of vascular base --- pedicled /island flap
- Based on the location of vascular base ---anterior /posteriorly based
- Depending on shape of the flap ---- unilobed/ bilobed
- Based on number of buccal flaps --- unilateral/ bilateral flaps.

Surgical protocol



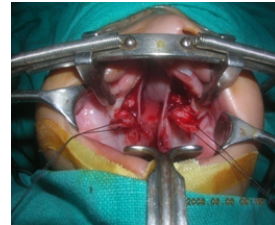
Soft palate length measured from Posterior nasal spine to base of uvula marked



Soft palate length measured on both sides of cleft and average taken



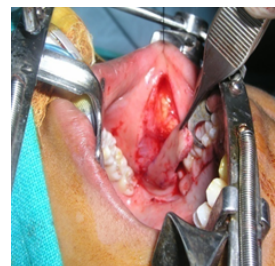
Velopharyngeal gap measured at base of uvula



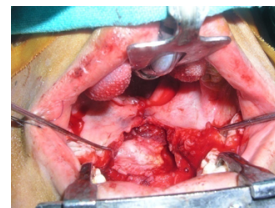
Elevation of Both mucoperiosteal flaps on oral layer and Nasal layer closed. Intravelar veloplasty done.



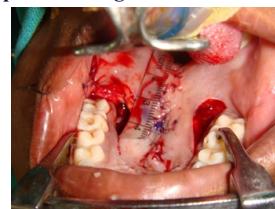
1. **Left side buccal myomucosal flap marked with width of 1.5 cm Base is at posteriorly based**
2. **Anteriorly flap elevated 1.5 cm posterior to oral commissure.**
3. **Parotid duct was identified and should not included in flap**



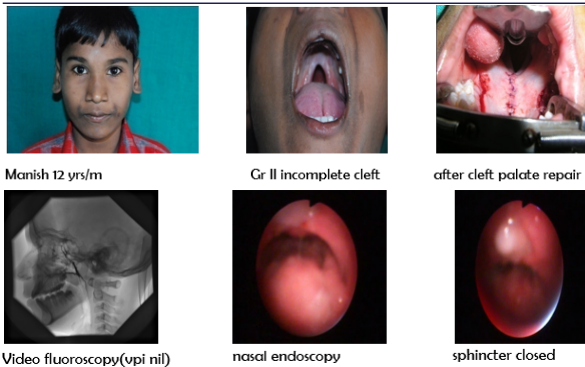
The flap elevated including a thin layer of the buccinator muscle to have better vascularity. Dissection continued up to median raphe at retromolar area This is important to avoid opening of buccal fat fascia. If this occurs, repositioning fat and simple closure will be enough to treat the problem.



Division of nasal layer transversely approx. 0.5 cm behind the palatal shelves. created of tunnel posterior to greater palatine vessels and buccal flap is passed through it to fill the nasal layer defect.



Closure of oral layer in straight line with 4.0 monocril. Measurement of soft palate length peroperatively .



Manish 12 yrs/m

Gr II incomplete cleft

after cleft palate repair

Video fluoroscopy(vpi nil)

nasal endoscopy

sphincter closed

Speech evaluation

Hyper nasality	Mild
Intelligibility	100% for known context 70% for unknown context
Articulation	Good
Nasal emission	No

pre op : soft palate length : 17 mm
 Velopharyngeal gap : 27 mm
 Immediate po softpalate length : 25 mm
 Gain of length : 8 mm (47.05 %)

6 month follow up
 Soft palate length : 24 mm, gain 7 mm (41.17%)
 Velopharyngeal gap : 10 mm
 Velopharyngeal incompetence : nil
 Nasal endoscopy : sphincter closing and VPI nil

RESULTS

Pre operative and post operative soft palate length evaluation:

	Pre op Soft palate length	Immediate post op palate length	Soft palate length after 6 month follow up	Gain of length after 6 months
1	16 mm	25 mm	25 mm	56.25 %
2	18 mm	24 mm	24 mm	33.33 %
3	9 mm	22 mm	21 mm	133.32 %
4	14 mm	21 mm	23 mm	64.28 %
5	17 mm	25 mm	24 mm	41.11 %
6	17 mm	22 mm	22 mm	29.41 %
7	16 mm	20 mm	22 mm	37.5 %
8	18 mm	28 mm	24 mm	33.33 %
9	15 mm	24 mm	23 mm	53.33 %
10	18 mm	24 mm	25 mm	38.88 %

For Pre op soft palate length: Mean value is-15.8 ,Median value is 16.5 ,IQR value is-3.25

For immediate post operative palate length: Mean value is 23.5,Median value is 24,IQR value is 3.25.

For Soft palate length after 6 month follow up: Mean is 23.3,Median value is 23.5,IQR value is 2.25 P value is<0.00001: significant(p<0.05).

Average pre operative soft palate length-15.8 mm,:Average immediate post operative length -23.5 mm,:Average soft palate length after 6 months-23.3 mm,:Average gain of Soft palate length after 6 months : 47.46 %.

Pre and post operative velopharyngeal gap :

	Pre op vp gap	Post op vp gap	% of reduced vp gap
1	20 mm	10 mm	50 %
2	22 mm	9 mm	59.09 %
3	17 mm	5 mm	70.58 %
4	20 mm	5 mm	75 %
5	28 mm	16 mm	42.85 %
6	20 mm	8 mm	60 %
7	27 mm	10 mm	62.95 %
8	30 mm	11 mm	63.33 %
9	24 mm	7 mm	70.82 %
10	23 mm	9 mm	60.86 %

For pre op VP gap: Mean value is23.1, Median value is-22.5,IQR value is-7.25.,

For post op VP gap: Mean value is 9,Median value is-9,IQR value is 3.75.,

Average pre operative velopharyngeal gap : 23.1 mm,Average post operative velopharyngeal gap : 9 mm,Reduced velopharyngeal gap : 61.03 %.

VPI evaluation with videofluoroscopy

	Resting vp gap	Vp gap on phonation	VPI
1	10 mm	5 mm	Present
2	9 mm	4 mm	Present
3	5 mm	0 mm	No
4	5 mm	0 mm	No
5	16 mm	8 mm	Present
6	8 mm	0 mm	No
7	10 mm	0 mm	No
8	11 mm	4 mm	Present
9	7 mm	0 mm	No
10	9 mm	0 mm	No

VPI was evaluated with videofluoroscopy after six month from surgery date and found :

Velopharyngeal competence was observed in 6 cases (60%)
 VPI was seen in 4 cases (40%)

Average VPI gap on phonation : 5.25 mm

VPI evaluation with Nasal endoscopy

	Buccal flap	Latera wall movements	Sphincter action
1	Viable	Little lateral wall motion	Not Closing
2	Viable	Adequate	Not Closing
3	Viable	Adequate	Closing
4	Viable	Adequate	Closing
5	Not seen	Adequate	Not closing
6	Viable	Adequate	Closing
7	Viable	Adequate	Closing
8	Viable	Adequate	Closing
9	Viable	Adequate	Closing
10	Viable	Adequate	Closing

In 9 out of 10 cases buccal myomucosal flap was viable.

In 9 out of 10 cases had adequate lateral wall movements Sphincter was closing in 7 cases (70%)

All above are results of 6 months follow up. They should be remeasured after 2 years.

DISCUSSION

The final out come of any cleft palate repair is good speech. The good speech is possible in cleft palates in which reconstruction of near normal palate both in length and muscle. And repair should be done before child develops speech. In our series when we operated in children less than one year had good speech outcome with intravelar veloplasty. Ian T Jackson et al. used buccal flap for nasal layer lengthening by interposing at soft and hard palate junction in addition to intravelar veloplasty in less than one yeaer children and this was more physiological one, with 90 % good speech outcome. In our previous studies we found that adult and elderly children cleft palates that were operated with intravelar veloplasty had short palates and velopharyngeal incompetence. The average soft palate length was 21.3 mm which was less than normal soft palate length. And 90% cases VPI was found. This provokes us to go for palatal lengthening procedures.

In present study the average normal soft palate length in resting condition in adults and grown up children was 26.2 mm and velopharyngeal gap was 7.5 mm. In study cases the average pre operative soft palate length was 15.8 mm and at 6 month follow up the average soft palate length was 23.3 mm (gain 47.46%). This was more than the length gained in cleft palate repaired with intra vela veloplasty only, but less than normal.

The average pre operative velopharyngeal gap in this study was 23.1 mm and post operatively it was reduced to 9 mm (reduction 61.03 %). This was near normal velopharyngeal gap and less than in case of intravelar veloplasty only.

Clinical evaluation of speech in study cases were done after 6 months showed ,in 40 % of cases normal speech observed, 20 % cases reasonable speech and remaining 40 % cases had bad speech with articulation problems and nasal emission. These patients are subjected for speech therapy.

When velopharyngeal incompetence was objectively assessed with videoflouroscopy we found that in 6 out of 10 cases (60%) velopharyngeal competence seen.

Nasal endoscopy showed buccal flap was viable in 9 cases (90 %) and 9 cases (90%) had good lateral pharyngeal wall movements. In 70 % cases sphincter closure was seen, contrary to videoflouroscopy showed velopharyngeal closure in 60 % (6 cases). This gives apparent closure of sphincter on nasal endoscopy. In the view of the above data for accurate assessment of velopharyngeal incompetence both videoflouroscopy and nasal endoscopy are indispensable. As this study included a small group of patients, a statistical evaluation was not possible.

CONCLUSION

Though this study showed the usefulness of the buccal myomucosal flap in the improvement of speech significantly, especially in grown up children when compared to adults clefts, it improved the length of palate as well However this study being a small study ,though having good results when compared previous study groups. It needs further expansion with more data analysis to show more accurate results.

REFERENCES:

1. Brothers DB, Dalston RW, Peterson HD, Lawrence WT. Comparison of the Furlow double opposing Z-palatoplasmy with the Wardill- Kilner procedure for isolated clefts of the soft palate. *Plast Reconstr Surg.* 1995;95:969-977.
2. Dorrance GM, Bransfield Jw. Cleft palate. *Ann Surg.* 1943;117:1-27.
3. Bzoch K, Communicative Disorders Related to Cleft Palate. Boston: Little, Brown; 1977:340-345.
4. Edgerton MT. Surgical lengthening of the cleft palate by dissection of the neurovascular bundle. *plast reconstr Surg.* 1962;29:551-560.
5. Emory RE jr, Clay RP, Bite U, Jackson IT. Fistula formation and repair after palatal closure: an institutional perspective. *Plast Reconstr Surg.* 1997;99:1535-1538.
6. Freedlander E, Jackson IT. The fate of buccal mucosal flaps in primary palatal repair. *Cleft palate J* 1989;26:110-112.
7. Furlow L Jr. Cleft palate repair by double reversing Z-plasty. *Plast Reconstr Surg.* 1986;78:724-738.
8. Ganguli AC, Lengthening the short palate by submucous pedicle cheek flap. presented at the 5th Annual Meeting of the International Plastic and Reconstructive Surgeons; Melbourne, Australia; 1971.
9. Jackson IT, McLennan G, Schecker LR. primary veloplasty or primary palatoplasty: some preliminary findings. *Plast Reconstr Surg.* 1983;72:153-157.
10. Kaplan EN. Soft palate repair by levator muscle reconstruction and a buccal mucosal flap. *Plast Reconstr Surg.* 1975;56:129-136.
11. Maeda K, Ojimm H, Utsugi R, Ando S. A T-shape musculomucosal buccal flap method for cleft palate surgery. *Plast Reconstr Surg.* 1987;79:888-896.
12. Mukherji MM. cheek flap for short palates. *Cleft Palate J.* 1969;6:415-420.