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Buccal Mucosa Graft for Cleft Palate Surgery

Dr Talib Mustafa Jawad[1], Dr Ali Haroon Dhumad Lami[2], Dr Amir Abdul-Adhim Albakaa[3]

[1]MBChB, FICMS plastic, Specialist of Plastic and reconstructive surgery, Specialized Burn hospital, Medical City, Baghdad, Iraq.

[2]FICMS, Specialist of Plastic Surgery, Specialized Burn hospital, Medical City, Baghdad, Iraq.

[3]MBChB, FABMS plastic surgery, JMC plast, Specialist of Plastic and Reconstructive Surgery, Specialized Burn Hospital, Medical City, Baghdad. Iraq.

ABSTRACT

Background: Cleft palate repair aims at producing closure of the cleft with reasonable lengthy palate in order to have competent velopharyngeal closure. There are various procedures concentrate on the lengthening of the palate like: Veu Wardill and Kilner, Furlow double opposing Z-plasty, Mukherji bilateral mucosal cheek flap, and Kaplan unilateral mucosal cheek flap etc. Buccal mucosal flap for nasal layer combined with Z-Plasty in the oral layer of the soft palate is one of these procedure provide reasonable length for cleft palate repair.

Objective: The aim of this study is to evaluate palatal lengthening by combination of unilateral retromolar buccal mucosal flap with Z-plasty and assessment of speech improvement.

Patients and methods: A prospective study of 22 patients of non-syndromic cleft palate underwent palatoplasty by unilateral retromolar buccal mucosal flap combined with Z-plasty of the mucous membrane of the oral layer in period from December 2008 to September 2009.

All patients evaluated regarding the type of the cleft by Veau's classification, the length and the width of the cleft palate measured by using a ruler and the depth of eth nasopharynx (from the posterior margin of the soft palate to the posterior pharyngeal wall) also measured .

Result: The most common type of the cleft was unilateral cleft lip and palate (50%). The mean age at repair was 18 months. All patients developed acceptable palatal length intra-operatively; the gain in length was ranged from 1.7-2.5cm the mean was (2.2cm). One patients developed oronasal fistula at the junction of soft and hard palate was.

Conclusion: This technique was effective for lengthening the nasal as well as oral layer, also had advantage of achieving good muscular reconstruction.

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INTRODUCTION

Careful anatomic evaluation of each patient with cleft palate is of paramount importance in considering palatoplasty. Anatomic variability within the broad diagnosis of cleft palate will influence the timing and sequence of surgical repairs as well as the type of the repair. Optimal functional results depend directly on accurate analysis of available structures and understanding of their long – term significance to function and facial growth.[1]

Many surgical techniques were described for palatoplasty, but an effective procedure depend first, upon having sufficient posterior displacement of the soft palate and muscle mass to accomplish velopharyngeal closure, and second upon keeping it in new position by minimizing the effect of contracting scar tissue.[2]

In 1975 Ernest Kaplan proposed a unilateral cheek flap, to be turned in for nasal lining upon incising the nasal layer as a part of palatal pushback. This flap can either be harvested from the retromolar trigone or from the posterior alveolar buccal sulcus.[3] In this study we present our results of palatal lengthening with unilateral retromolar buccal mucosal flap combined with Z-plasty in the soft palate oral layer.

Embryogenesis of clefting:

The face proper is composed of primordia: the midline frontonasal process which give rise to the primary palate; the maxillary processes which contribute to the secondary palate.[1]

The development of the embryonic primordial occurs in two phases: growth and contact of the medial nasal, lateral nasal,

and maxillary prominences followed by elevation and fusion of palatal shelves as shown in figure 1.[4]

Interruptions in the rate, the time, or the extent of the proliferation in the frontonasal primordial lead to a failure in epithelial fusion and subsequently the formation of the cleft.

Cleft of the primary palate results from failure of fusion of the frontonasal process and maxillary processes.

The maxillary primordia undergo intramembranous ossification to form the palatal shelves, which initially extend vertically on either side of the tongue and subsequently rotate to a horizontal plane dorsal to the tongue. The shelves grow toward the midline, and the medial edge epithelium of each shelf approximates and forms the midline epithelial seam. Then mesenchymal confluence between the two shelves starts. Genetic, mechanical, or teratogenic factors can occur at any of these steps result in a cleft of secondary palate.[1-5]

The early phase occurs approximately during gestational days (30-37), while the later phase of development occurs approximately during the gestational days (50-60).[4]

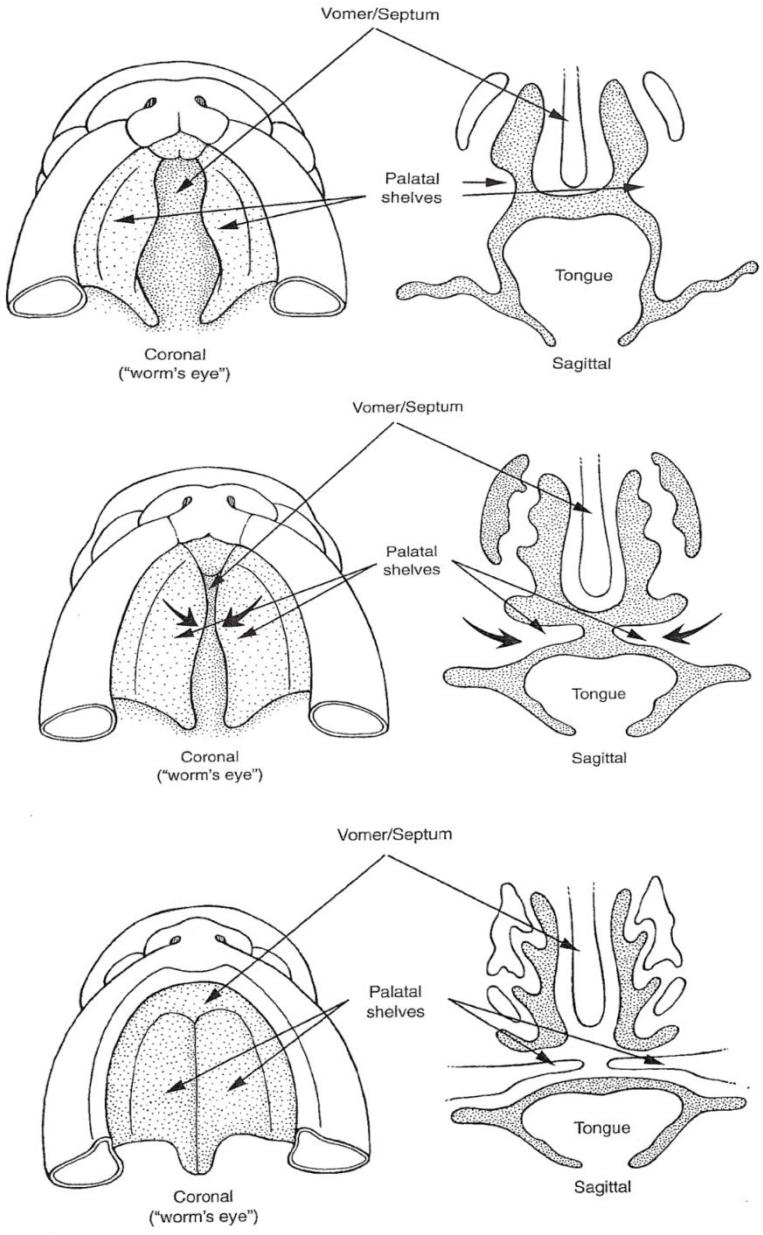

Figure 1: the normal embryology of the palate.

Morbid Anatomy

Abnormal musculature of the cleft palate was described by Ferguesson[6] and then by Veau[7] who describe the abnormal tensor veli palatini in cleft palate.

The tensor veli palatine muscle is triangular with a fleshy belly and tendinous at each end. The tendon of the tensor hooks around the anterior aspect of the hamulus forming a 90- degree turn as it enters the soft palate, then the tendon spread out to become the horizontal sheet like aponeurosis occupying the anterior quarter of the velar length and extending from the posterior nasal spine to the tip of the uvula as shown in figure 2.[1]

The tensor veli palatini is thinner in cleft palate, few fiber are attached to the hamulus. The front part of its bundles extend

along the rudimentary palatine aponeurosis towards the posterior nasal spine or run laterally to the posterior edge of the palatine bone as shown in figure 3. The main tendon arches backward to eth cleft margin and end in two different manners: either the tendon is partially dispersed, and a triangular portion passes into the anterior bundle of the levator, or the tendon does not disperse and passes anteriorly into the levator veli palatini to form a thick musculotendinous bundle.[8]

The levator veli palatini is a cylindrical muscle forming a sling that suspends the soft palate from the cranial base. It occupies the middle 50% of the velar length measured from the posterior nasal spine to the tip of the uvula. The fibers cross the midline to meet the fibers from the opposite side. Anteriorly it's attached to the posterior margin of the aponeurosis of the tensor in figure 2.[9]

The levator is hypoplastic and thin in the cleft palate. The posterior bundles run posterolateral toward the palatopharyngeus. The medial bundles radiate into the margin of the cleft. The anterior bundles are attached to the triangular tendinous area to the posterior edge of the palate or directly linked to the tendon of the levator veli palatine in figure 3.[10]

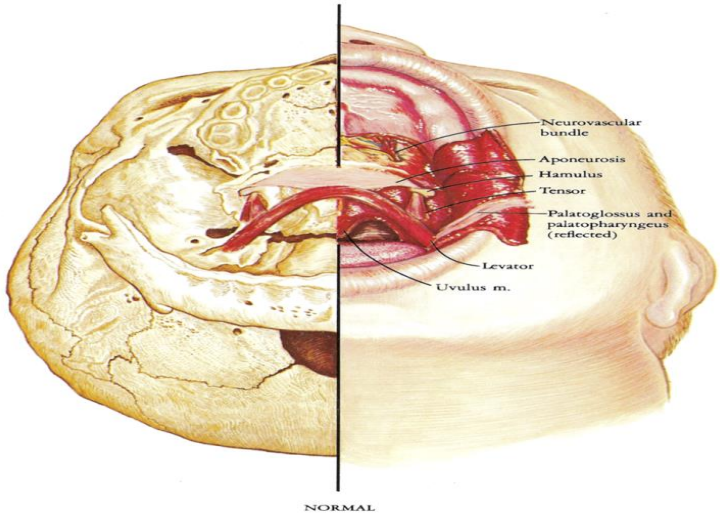

Figure 2: the normal anatomical orientation of the muscles in the palate.

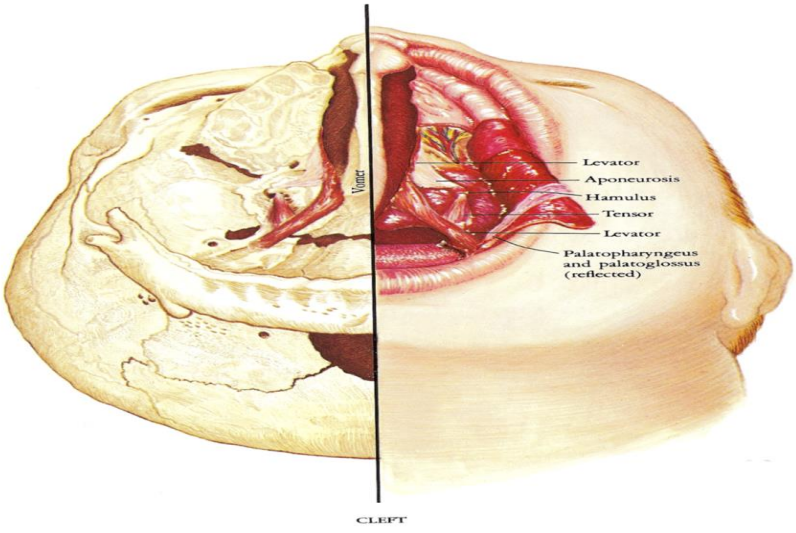

Figure 3: the abnormal anatomical orientation of the muscles in the cleft palate.

Etiology

The causes of cleft palate appear to be multifactorial. Some instances of clefting may be due to an overall reduction in the volume of the facial mesenchyme, which leads to cleft by virtue of failure of mesodermal penetration. In some patients, clefting appears to be associated with increased facial width, either alone or in association with encephalocele, idiopathic hypertelorism, or the presence of a teratoma.

The characteristic U-shaped cleft of the Pierre Robin anomaly is thought to be dependent upon a persistent high position of the tongue, perhaps associated with a failure or delay of neck extension. This prevents descent of the tongue, which in turn prevents elevation and a medial growth of the palatal shelves. The production of clefts of the secondary palate in experimental animals has frequently been accomplished with several teratogenic drugs. Agents commonly used are steroids, anticonvulsants, diazepam and aminopterin. Phenytoin and diazepam may also be causative factors in clefting in humans. Infections during the first trimester of pregnancy, such as rubella or toxoplasmosis, have been associated with clefting.[11]

In 25% of patients, there is a family history of facial clefting, which does not follow either a normal recessive or dominant pattern.[12]

Classifications:

In the field of scientific study classification should represent an accurate structural framework for understanding the relationship among parts, so that present knowledge can be represented, and future information added or even predicted.[13] There are many classifications used in cleft palate includes:[14]

Davis and Ritchie classification (1922), Veau classification (1931), Pruzansky classification (1953), Kernhan and Stark classification (1958) based on the embryology. (figure 4) , Harkins classification (1962), Kernhan striped Y classification (1971), Elsahy modification of striped Y classification (1973) and Millard modification of striped Y classification.

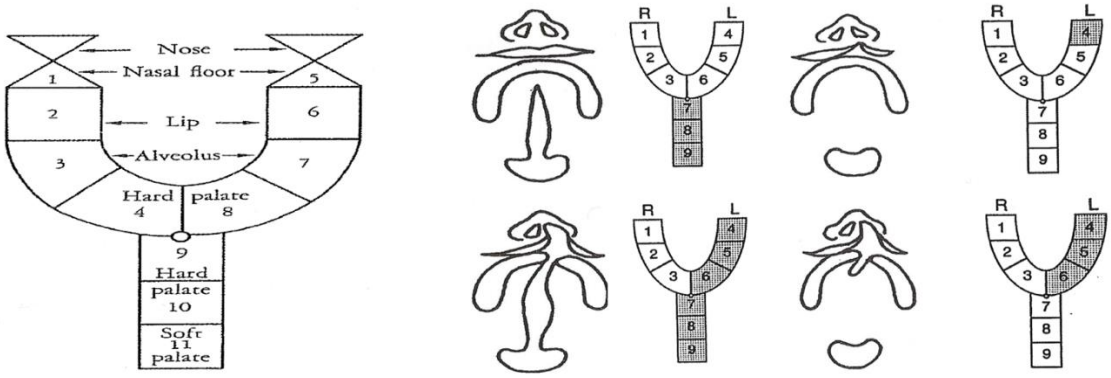

Figure 4: the Kernhan strip Y and Millard modification of striped Y classification in cleft palate.[8]

We use Veau classification of cleft lip and palate in our study that classifies cleft palate:

I. Soft palate.
II. Palate complete.
III. Palate complete + unilateral prepalatal cleft (UCLP).
IV. Palate complete + bilateral cleft lip (BCLP).

Palatal Lengthening:

The palatal lengthening is one of the main goals in cleft palate repair which is considered as a predictor of speech outcome in the cleft palate repair.[15]

Short velum is one of the main causes of velopharyngeal incompetence.[16]

Many procedures concentrate on the lengthening of the palate, the following are some of these procedures:[8]

1. William S. Forbes (1879) he proposed lengthening of the uvula by transverse incision is closed vertically that result in lengthening of velum.
2. Kuester (1882) lengthening of velum with slanted lateral incision in a V-Y type principle.
3. Palatal push-back procedure with anterior obturator were reported by Suersn(1869), Passavant (1878), Garel(1894), Kingsley(1897) and Gillies and Fry (1921). These techniques involved dividing the hard palate and soft palate and placing obturator in the intervening space.
4. Blair (1911) used angled releasing incision to form triangular flap of the velum, by advancing palatal mucoperiosteum and cheek mucosa medially.
5. T.P.Kilner (1950) by performing Z-plasty in the nasal layer.
6. Veau and Ruppe (1922) using widely undermined mucoperiosteal flaps that were dependent on posterior palatine vessels, with closure of the nasal layer with vomerine flap.
7. Veau, Wardill, Kilner technique by using V-Y mucoperiosteal flap.
8. Furlow double opposing Z- Plasty technique.
9. Baxter (1942) using skin graft to close the nasal raw area in push back technique.
10. Stark (1976) using nasal mucosal transposition to cover the nasal mucosal raw area.
11. Mukherji (1969) used bilateral mucosal cheek flap to cover nasal mucosa transverse incision.
12. Ganguli (1971) used bilateral submucous pedicled cheek flap for both nasal and oral layer.
13. Kaplan (1975) used unilateral mucosal cheek flap either retromolar trigone design or posterior alveolar buccal sulcus design for nasal lining in any type of push back procedure.

PATIENTS AND METHODS

A prospective study was carried on 22 patients with non-syndromic cleft palate in Surgical Specialty and Al-Wasty Teaching hospitals/ Baghdad, period from December 2008 to the September 2009.

All patients had evaluated regarding history, including previous surgeries, maternal obstetric history, family history, medical history of associated illness.

The type of cleft was classified according to Veau's classification, that were 5 patients with cleft of soft palate only, 4 patients with cleft of the soft and partial hard palate, 11 patients with unilateral complete cleft lip and palate, and 2 patients with bilateral complete cleft lip and palate.

All patients underwent measurement of the width, length of the cleft, depth of the nasopharynx, and postoperative gain in length by folded ruler.

The width of the cleft was measured at the widest area of the soft palate was ranged (0.7-1.1cm). The length of the palate measured from incisive foramen to the uvula ranged (3.5-5.5cm). The depth of the nasopharynx measured from the posterior margin of the soft palate to the posterior pharyngeal wall that ranged (1.8-2.5cm).

All patients in this study had repaired by unilateral retromolar buccal mucosal flap for covering the raw area in the incised nasal layer, combined with Z-Plasty for the closure of the soft palate oral mucosa.

All patients were operated under general anesthesia, with neck extension. Dingmann mouth gag retractor used for opening of the mouth, oral and oropharyngeal area are stained by antiseptic, wet oropharyngeal pack was placed.

Marking of the operative procedure started by bilateral mucoperiosteal flap with Z- plasty in the oral layer of soft palate, the marking of the mucoperiosteal flap extend beyond the alveolar margin. Figure 5. Intraoperative measurement of the length, width of the cleft palate, and depth of the nasopharynx was performed by a ruler. The operative field was infiltrated by small amount of lidocaine 1% with adrenaline 1:200000.

Mucoperiosteal flaps were elevated from hard palate based on greater palatine artery, the incision was carried beyond the alveolar margin but care is taken not to dissect at the flap side, meticulous dissection continued until separation of oral and nasal layers achieved. Figure 6.

Suturing of the nasal layer is performed after adequate mobilization by simple interrupted inverted 4/0 polyglactin 910, this will facilitate the release of the abnormal levator aponeurosis attachment to the posterior hard palate, the muscle is gently dissected off the nasal layer, then the muscle sutured in the midline backward at the base of the uvula by 3/0 polyglactin 910, Fig (8).The repaired nasal layer is horizontally transected 2-3mm behind the margin of the hard palate to facilitate suturing of the buccal flap, Fig (6). The buccal region is exposed by using traction 3/0 silk stitch on the upper and lower lip near the commissure, the Stensons duct is identified at the upper 2nd molar, then unilateral retromolar buccal mucosal flap was designed in such way that the length not more than 4cm the width betwwen 1.5-2 cm, and harvested in a plane not including the buccinator muscle to cover the defect created in the nasal layer, the flap is hinged in way that the mucosal surface facing the nasal cavity taking care not to twist the pedicle, and pulled through a tunnel lateral and posterior to the greater palatine vessels, the flap is fixed to the defect of the nasal by 4/0 polyglactin 910 interrupted suture. If the buccal fat exposed it should be closed by 3/0 polyglactin 910running suture. Figure 7.

Closure of the oral layer was performed by 3/0 polyglactin 910 interrupted suture after designing Z- plasty of 60 degree angle in the soft palate region as shown in figure 8. Hemostasis is achieved by bipolar electrocautery. Tongue stitch was used for all patients; the patients were hospitalized for 1 day with injectable antibiotics for 3 days and then continue with oral antibiotics for 5 days.

We instruct the parents for liquid diets by spoon or syringe for 15 days, and all solid diet is forbidden until complete healing of the flaps.

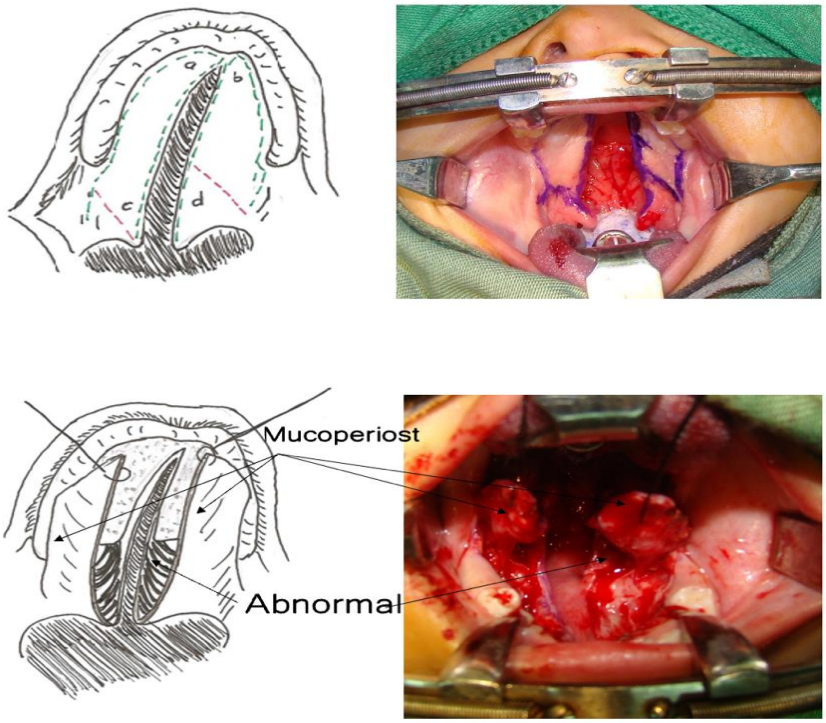

Figure 5: operative start-up.

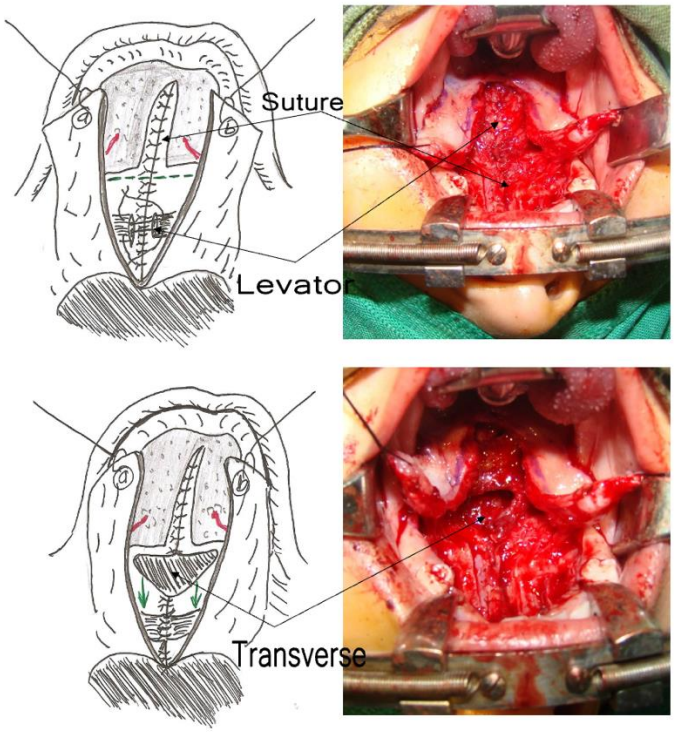

Figure 6: the levator.

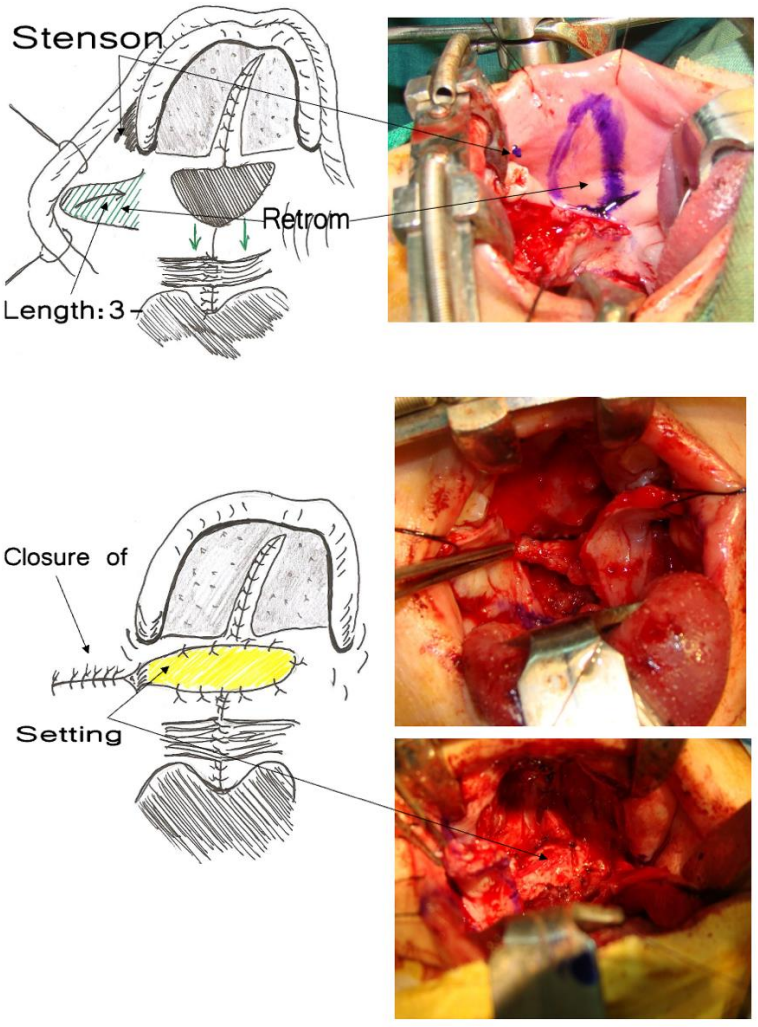

Figure 7: the design.

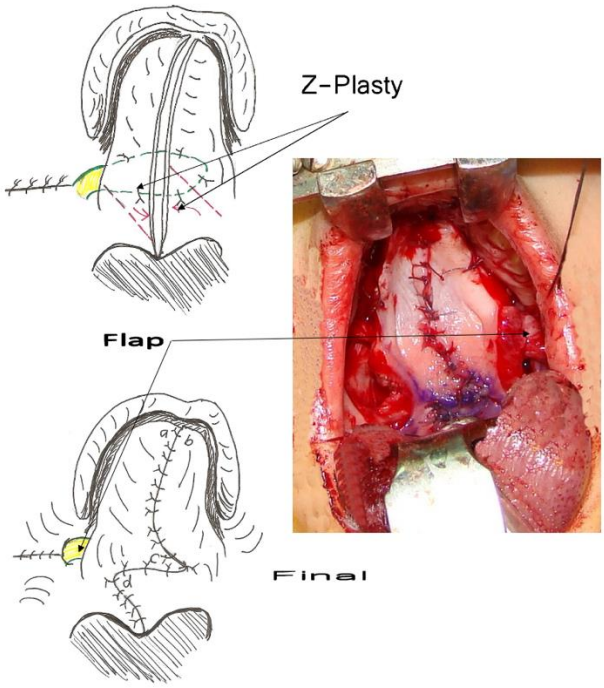

Figure 8: the final design.

RESULTS:

Twenty two patients were operated, and the age of patients ranged from 10months to 41months (the mean age was 18 months). Patients classified into groups according to age. Figure 9

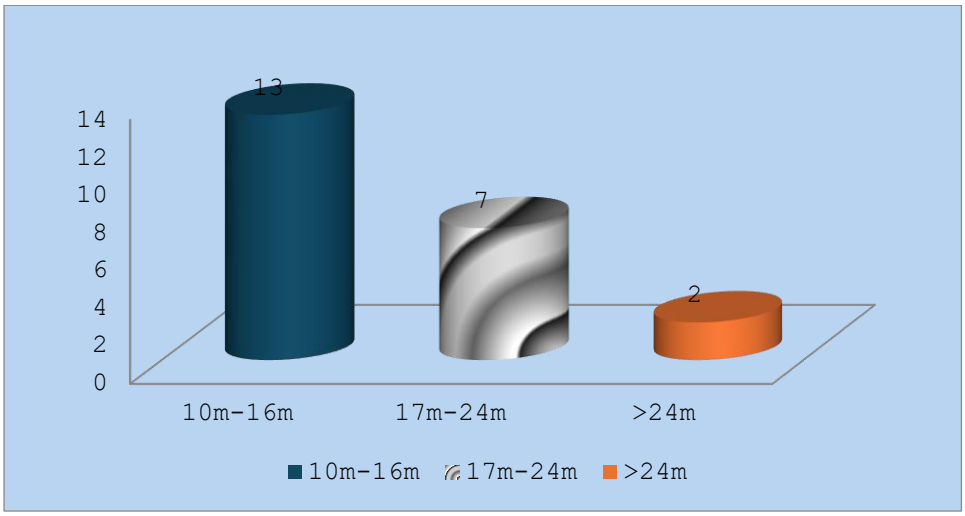

Figure 9: Shows the number of patients according to age group.

The gender distribution was male 54.5% and female 45.5%.

The type of palatal cleft according to the Veau classification is shown in the table (1) below:

Table 1: patient's distribution according to the type of the cleft.

Veau classification	ents	
Soft palate		
Complete palate		
Complete palate +unilateral Prepalatal cleft (UCLP)		
Complete palate +BCLP		

The preoperative measurement of palatal length, width and depth of the nasopharynx was measured in centimeter summarized in Table (2).

Postoperative length gain was measured, the lengthening achieved post operatively ranged from 1.7-2.5cm (mean was 2.2 cm). Table (2)

Table 2: preoperative measurement and postoperative gain in length of palatal cleft according to age group.

Age group (month)	Width range (cm)	Depth of the Nasopharynx (cm)	Length range (cm)	Gain in length range in (cm)
10-16	0.7-1	1.8-2.4	3.5-4.5	1.7-2.5
17-24	0.8-1.1	1.9-2.5	3.5-5.5	2-2.4
>24	1-1.1	1.8-2.3	4.3-4.5	2-2.2

Unilateral retromolar buccal mucosal flap for nasal layer with Z-plasty in the oral layer of the soft palate was performed in all cases in this study.

No major complication was observed like bleeding, breathing problem. One patient (4.5%) developed oronasal fistula after 3-4 days postoperatively, also one patient (4.5%) developed infection.

Table 3: postoperative complication.

Type of complication	No.	%
Bleeding	-	-
Breathing problem	-	-
Infection	1	4.5
Fistula	1	4.5

Only one patient developed moderate cheek swelling, the remaining were mild cheek swelling, no other major complication of the donor site was observed such as: herniation of the buccal fat, infection, and stenosis of the parotid duct. Healing of the donor site was observed in all patients.

DISCUSSION

Cleft palate is one of the most common deformities in the craniofacial skeleton, so careful anatomic evaluation of each patient with cleft palate is of paramount importance in considering palatoplasty. Many surgical techniques were described for palatoplasty, but an effective procedure depend first, upon having sufficient posterior displacement of the soft palate and muscle mass to accomplish velopharyngeal closure, and second upon keeping it in new position by minimizing the effect of contracting scar tissue.[2]

All patients included in this study had short palate and were tested intraoperatively as mentioned before.

In our study we measure the distance between the posterior margin of the soft palate and posterior pharyngeal wall, it was > 10mm in all cases, so when performing palatal repair it should give enough length to overcome this distance, we use unilateral buccal mucosal flap for nasal layer combined with Z-plasty in the oral layer soft palate, this gives excellent length to the palate and the uvula will rest on the posterior pharyngeal wall, as was postulated by Mukherji (1969) stated that short palate is a relative term because its length is dependent on the depth of the nasopharynx even though the actual length of the palate is fairly satisfactory, he classified the patients according to the nasopharyngeal distance into 3 groups (<5mm,5-10mm,>10mm) patients with third group and a few of the second group needs an a local tissue to give enough length to overcome the gap.[17]

According to Sommerlad (2003)[18] the whole nasal layer was sutured first, this will provide the tension necessary for dissection of the abnormal attachment of the levator veli palatini muscle from the nasal layers and sutured backward at the base of the uvula (intravelar veloplasty). The intravelar veloplasty which was postulated by Sommerlad (2003)[18] is adopted in this study and it had been seen of great benefit to correct the abnormal anatomy and create a sling for velar elevation for good velar function, this was compatible with Peter Randall that postulated “abnormal position of the levator palatine muscle is the most important anatomic disorientation seen in a child with cleft palate”[15], in comparison with Kapaln method of levator retrodisplacement he did no separate the levator muscle from the nasal layer that will rotate as a composite unit relied on the transverse cut of the nasal layer.[3]

The defect which was created by the transverse cut in the nasal layer should be replaced by a local tissue to decrease the scar tissue formation on the nasal layer that may not keep the palate in its new gain in length, this fact shared with A.C. Watson[19] that the advantage will be lost following the laws of healing, also it will decrease the fistulae formation by

performing multiple layer closure instead of one layer closure of the palate, as it was stated by Arajy(2008) that one layer closure may explain high incidence of fistulae in patients that underwent retro-positioning technique without buccal flap coverage.[20] So the defect created in the soft palate was replaced by unilateral buccal flap that will maintain the length of the soft palate by decreasing the raw area created in the nasal layer, and eliminate the scar contracture, and keep the nasal layer in its new length, as it was postulated by Kaplan (1975) that the buccal flap will remain in its width that will maintain the length gain.[3]

Z-plasty was designed with 60-80 degree angle in the oral layer of the soft palate, this will redirect the scar in the soft palate thus prevent straight line scar contracture in the soft palate and will provide lengthening of the oral layer as stated by Furlow (1986)[21] Walter and Meisel (1978)[22], in conjunction with buccal flap an overall gain in length ranging between 1.7-2.5cm, in comparison with the study carried by Ian T.Jackson(2004) who achieved (1.5-2cm) length gain by using buccal flap alone[23], our study demonstrated greater gain in length.

Lateral release incisions were used to facilitate Z-plasty closure without tension especially with 1cm width of the cleft, but care is taken not to dissect at the base of the buccal flap which may endanger the blood supply, this is shared with Tawfiq (1998) who stated that lateral relaxing incision can be used for closure of the Z-plasty.[24]

One patient developed oronasal fistula after 3-4 days postoperatively. The fistulae occurred at the junction of the soft and hard palate which will need further surgery. Starting solid food early may explain the fistulae. The other patient developed local infection and had good healing on extending course of antibiotics.

One patient developed moderate cheek swelling that subsided after 7 days with extended course of antibiotics. The etiology was unclear, buccal space hematoma may explain the cause. No other complications observed like herniation of buccal fat, parotid duct stenosis, airway obstruction or hemorrhage.

These children should be followed up during the dentitions period to avoid any problem of eruption of permanent molars under the pedicle of the buccal flap that may require division. The effectiveness of such surgery can be evaluated by various parameters: the clinical impression of palatal mobility, cephalometric measurement, nasopharngoscopy, air pressure and most important speech analysis. After 3 months video nasoendoscopy was used in our evaluation, unfortunately only few of children in our study are old enough to cooperate for nasoendoscopic evaluation; and those patients had being shown good mobility of the velum with complete closure of the velopharynx on nasoendoscopy.

After 6 month post operatively acceptable speech production in 4 patients was achieved. The other patients cannot be regularly followed up because of their poor complains.

CONCLUSIONS AND RECOMMENDATIONS

1- Combination of unilateral buccal flap with Z-plasty will give enough length for both oral and nasal layers.
2- Using Z-plasty in the oral layer of soft palate help in prevention of straight line scar contracture.
3- Z- plasty in the oral layer is not advised for >1cm width of the cleft.
4- We recommend using this method for repair any cleft palate except those with > 1cm cleft width.
5- A long term follow up is required for proper evaluation of this technique regarding velopharyngeal function, speech improvement, and during eruption of permanent molars under the buccal flap that need division.

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