Evaluation Of Furlow Z-Plasty Technique With Addition Of Buccinator Myomucosal Flap On Palatal Lengthening For Primary Cleft Palate Repair

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ABSTRACT

INTRODUCTION: Cleft palate is considered as one of the most frequent congenital abnormalities of the face. Short palates with misoriented musculature is always a problem affecting speech. These considerations have pushed surgeons to modify palatoplasty techniques to get better speech outcomes.

AIMS: To assess the significance of the buccinator myomucosal flap use combined with Furlow double z palatoplasty on lengthening of the palate in primary cleft palate.

METHODS: Forty cleft palate patients were done using classical furlow z-plasty operation without suturing the right sided anteriorly based mucosal flap to the edge of the hard palate. This space was further filled with a left posteriorly based buccinator myomucosal flap.

RESULTS: Among 40 patients with an age range of 9-18 months, the palatal lengthening was of a mean 29.65 (±4.72 ) compared to preoperative mean of 21.65 (±4.25 ).Paired t-test was used showing significant difference of pre and postoperative (P<0.001).

CONCLUSION: Buccinator myomucosal flaps are effective and safe for palatal lengthening in primary cleft palate repair. they provide length and further more attachment by soft pliable tissue to the hard palate making it more mobile . however long term follow up is needed to validate this effect on speech.

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Velopharyngeal incompetency is defined as the incomplete closing of the sphincter, resulting in air escape from the nose and/or hyper-nasality (1). Disturbed speech resonance from velopharyngeal insufficiency is considered a major problem associated with palatoplasty, with about one third of the patients that suffer from abnormal resonance caused by anatomical abnormalities and pharyngeal flap as a second surgery is commonly needed with this treatment modality to treat this attained insufficiency (7-10). That’s why Velopharyngeal competence is needed for the proper production of sounds to close the velopharyngeal sphincter intimately and totally (11).

Furlow was the first surgeon to report a palatal repair technique, where the levator veli palatini muscle is dissected and released free from its position attached to the hard palate and retro-positioned in a Z-plasty lengthening procedure without using of releasing incisions (12). Primarily Furlow’s technique aims at constructing a correct palatal muscular sling and an increasing in velar length (13). Moreover it produces minimal scar with no raw area in the hard palate (12).

However, among the problems related to the applying the Furlow palatoplasty is its limitation of the procedure in wide clefts. Furthermore, possibility of higher fistula rate associated with the technique’s use (13). This has led toward the thinking of the use of the buccinator myomucosal flaps to lengthen the palate. It was described in 1989 for the wide cleft palatal repair by Bozola recording a great improvement in nasality (14).

In 1997, Robert Mann described the addition of buccal flaps to the double Z-plasty for closure of wider clefts with minimal tension and the rare need for lateral relaxing incisions along the alveolus. These merits decrease scar formation and maximize blood supply to the alveolus (15). The origin of the buccinator muscle is from the alveolar processes of the mandible and maxilla. The posterior half of the muscle is supplied by the buccal artery which is a branch of the internal maxillary artery. The facial artery sends several branches to the buccinator muscle, the posterior buccal is the largest branch, that supplies the posterior half of the buccinator muscle. The parotid gland duct has a significant anatomical relation to the muscle and enters the buccinator muscle opposite the upper second molar. Some modifications were made to increase the mucosal flaps vascularity were stated by Maeda et al., that also stated buccal ’myomucosal’ flaps for cleft palate repair (22).

Bozola et al. was the first to describe a posteriorly based axial myomucosal flap on the buccal artery. The buccal mucosa and the buccinator muscle were incised to the buccopharyngeal fascia level, and the flap was then elevated in the posterior direction in the area of the loose areolar plane between the buccopharyngeal fascia and the buccinator muscle. The dissection continues in the posterior direction before reaching the pterygomandibular raphe, where the main neurovascular bundle pierces the flap. (14) The aim of this study is to assess the significance of the use of buccal myomucosal flap combined with Furlow double z palatoplasty on lengthening of the palate in primary cleft palate.

Methods

**Study design and setting:**
One arm clinical trial was held in the Oral and Maxillofacial Surgery department operative theatre, faculty of Dentistry, Alexandria University and department of plastic surgery, Cairo university. This study was reported according to CONSORT guidelines (23) and registered on clinicaltrials.gov PRS with ID NCT04346173.

**Participants:**
A minimum sample size of 25 children was required based on assuming 95% confidence level and 80% study power. Velar closing ratio was used as indication for primary cleft palate repair (24). The mean difference in velar ratio after Furlow palatoplasty was 0.21 mm with pooled SD of 0.26 (25).

**Eligibility criteria**
Patients included in the study were in the age frame between 9 and 18 months, have not done any previous palatal repair. Their Haemoglobin level was above 10 grams and weight above 10 pounds (4.5 kilograms). Syndromic patients and medically compromised patients contradicting operation were excluded. Informed consents were gained from the parents and guardians of the patients to ensure and confirm their understanding of the outcome of the operation and the risks they might be subjected to during the intervention.

**Preoperative assessment**
Full Personal data in details were obtained including name, age and gender. In addition to name, address and telephone number of parents. Patients were asked if they had underwent any previous operations for the treatment of the palatal cleft. General health state was examined. Haemoglobin level and bleeding profile laboratory investigations were done.

**Operative procedure**
All patients were treated under general anaesthesia. Inhalational induction using SevoFluorane. Intraavenous access obtained by inserting a cannula then Atropine injection of 0.02 mg/kg followed by Propofol of 2 mg/kg. Endotracheal intubation then shifting from SevoFluorane to IsoFluorane.

The surgical field was scrubbed with povidone-iodine (Betadine, Purdue Products L.P.), followed by draping of the patient with sterile towels exposing only the area of surgery. Insertion of a Dingman mouth retractor to allow good exposure of operating field, followed by infiltration of local anaesthetic with Adrenalin for its haemostatic effect (1:20000 Adrenalin with xylocaine) (Figure 1). The parotid duct is marked with a coloured suture and the donor site of the future Buccinator flap is also infiltrated with local anaesthetic.

**Designing the Double Opposing Z-Plasty:**
Refreshing of the edges of the uvula was first done and sutured together using 6-0 PDS suture. Then the classical Furlow z palatoplasty technique is made without suturing the anteriorly based right side oral mucosa flap to the edge of the hard palate leaving L-shaped defect which would be filled the next step by the Buccinator flap.

**Designing the Buccinator Myomucosal Flap:**
The left buccinator myomucosal flap was outlined inferior to the parotid duct with average 3.5 to 5.0 cm in length and 1.2 cm in width. Its position on the buccal mucosa is 2 mm anterior to the base of the retromolar trigone and extends anteriorly to within 6 to 8 mm of the oral commissure. First, the mucosa was incised along the full length of the flap on the markings revealing the buccinator muscle below, followed by dissection through the buccinator muscle at the tip of the flap to the level of the buccal fat. The flap was then rotated such that its mucosa faces orally and sutured into the L-shaped defect as far forward into the hard palate defect. Finally, the buccal flap cheek donor areas will be then loosely closed using 4-0 vicryl sutures (Figure 2).
Khodir et al. Palatal Lengthening Using Buccinator Myomucosal Flaps With Z-Plasty

**Postoperative phase**
Special attention was given for the early postoperative care as airway may be compromised in the early postoperative period. Soft, fully liquid diet was instructed for all patients for 4 weeks postoperatively. Solid foods have to be of a pureed consistency. Arm restraints were used to prevent the patient disrupting the repair with fingers or thumb.

**Postoperative medications**
All patients were given Intravenous IM Cefotaxime (Cefotax, E.I.P.I.C.O, Egypt) 25mg/kg/12 hours daily for the next 5 days, Miconazole (Daktarin gel, Johnson & Johnson, Ireland) gel 2cc three times/day, Xylometazoline (Otrivin nasal drops, GlaxoSmithKline Ltd, United Kingdom) Nasal drops three times/day and Paracetamol (Calpol drops, Johnson & Johnson, Ireland) 2.5 cc as needed with maximum 4 times/day.

**Clinical Outcomes**
Palatal lengthening outcome was recorded by comparing the immediate postoperative measurements with the preoperative ones. The measurements were performed in curved dimension using a flexible paper ruler while the patients were anesthetised with a Dingman retractor placed. The point connecting the hard and soft palate were determined as a starting point, while the uvula base was set as an end point (Figure 3).

**RESULTS**
The study was conducted on forty patients selected based on the inclusion criteria from those admitted to the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University and plastic surgery department, Cairo university. They consisted of twenty five males and fifteen females; with a ratio of 5:3.

Out of the forty patients of this study; twenty eight patients had complete unilateral cleft (twenty two in the left side and six in the right one), nine with incomplete cleft while three with bilateral cleft lip and palate.

Among 40 patients with an age range of 9 - 14 months, the palatal lengthening was of a postoperative mean 29.65 (±4.72) compared to preoperative mean of 21.65 (±4.25). Paired t-test was used showing significant difference of pre and postoperative (P<0.001). (Table 1)

<table>
<thead>
<tr>
<th>Palatal length</th>
<th>Pre (n = 40)</th>
<th>Post (n = 40)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. – Max.</td>
<td>12.0 – 32.0</td>
<td>20.0 – 40.0</td>
<td>19.948*</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Mean ± SD.</td>
<td>21.65 ± 4.25</td>
<td>29.65 ± 4.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>21.0</td>
<td>30.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

t: Paired t-test
p: p value for comparing between pre and post
*: Statistically significant at p ≤ 0.05

**DISCUSSION**
Among various problems conducted with different techniques of cleft palate repair, speech problems remains the cleft
surgeons' main concern(26-29). Our concern here is directed towards double opposing z-plasty of the palate which is first described by Furlow in 1986(30) with addition of buccinator myomucosal flap to assess the significance of their use on lengthening of the palate in primary cleft palate repair and enhancement of speech results.(15)

Our sample has shown increased male to female prevalence in all cleft palate types, this is in contrast to Antoszewski and Fijalkowska in their study in 2016 in isolated cleft palate type and in accordance with them in unilateral cleft lip and palate patients. They cited that the most common type of cleft was the isolated cleft palate whilst in our results it was the unilateral cleft lip and palate type (31). Gatti GL et al in 2017 stated that the unilateral cleft lip and palate type is most prevalent in their study followed by isolated cleft palate type and these results are in accordance with ours (32). Left unilateral type was most frequent in our study compared to right type , this was agreed by Begum F et al in 2019 whom had same results and the bilateral is the least frequent type.(33)

Timing of surgery is always a controversial topic between surgeons , it has a major effect on speech scores; however, this was caused by persistent compensatory articulation errors. This finding highlights the significance of doing palatal repair before the acquisition of language. Shaw et al in 2019 supported the range of six to twelve months(34). Shi and Losee in 2015 has proved that operating in earlier stages affect maxillary growth and they recommended delayed palatal closure till fifteen years of age.(35)

However koberg and koblin in 1973 has reported that the effect of the technique of repair used is more significant on maxillary growth despite the timing , where they found that Veau’s pushback and Langenbeck’s technique with relaxing incisions were most damaging to growth.(36)

Jackson et al in 2013 reported better results when operating using furlow double z-plasty technique,(37) and chate et al in the year 1997 cited excellent growth results using intravelar palatoplasty without lateral relaxing incisions as well (38). In our study we aspire good results of growth when using furlow z-plasty technique along with addition of buccinator flap at nine to eighteen months. Having a long active palate with normal musculature position is always the main concern of surgeons , in our study combining furlow z plasty technique with buccinator myomucosal flap showed us significance elongation of the palate , this was also cited by Mann in 2017. Moreover adding an anatomical tissue between hard and soft palate decreased significantly its shrinkage and rebound giving healthy nourished palate. (15)

Furlow z-plasty is believed to form a tight pharyngeal sphincter as the levator veli muscles are mobilized fully each time, regardless the operator, and are significantly overlapped at the posterior soft palate.(30) This technique is opposite to the intravelar veloplasty that is based on the midline suture repair. Moreover, it preserves an intact musculomucosal layer in each of the flaps improving vascularity and thus decreasing scarring and consequent stiffness of the soft palate. Another surgeon named Jackson et al. published a large series on speech results after repairing using the Furlow technique. According to the findings, three quarter of the patients had a competent velopharyngeal mechanism, 85.3 percent showed no or inaudible nasal emission, and 8.1 percent of the patients underwent secondary surgeries to correct velopharyngeal incompetence.(37)

However, criticism has repered high fistula rates when the Furlow method is used in wider clefts without the use of relaxing incisions, and the fear for damaging effects on facial growth when the operator uses relaxing incisions (39). Mann in the year 2017 used bilateral buccinator flaps , one facing nasal cavity and the other facing oral cavity , he assumed that this technique releases tension along all palatal planes and decreased fistula occurrence.(15) In our study we used only the left buccinator myomucosal flap, posteriorly based on buccal artery in an L-shape pattern facing only oral cavity. It fill in the space between hard and soft palate with anatomical tissue preventing muscle relapse with no contracture , increasing palatal tissue vascularity and eliminating dead spaces. We believe to leave a backup right flap if we need it in the future in secondary surgeries whether fistulation or dehiscence occurs.

The overall results of this study necessitated the acceptance of the hypothesis that there is no effect of using buccinator myomucosal flaps on palatal lengthening.

**CONCLUSION**

Within the limitation of this study, using buccinator myomucosal flap along with furlow z plasty technique is of a great advantage on lengthening the palate , decreasing tension and contracture and nourishing palatal vascularity. However long term follow up is needed to validate this effect on speech.

Conflict of Interest

The authors declare that they have no conflict of interest.

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**REFERENCES**


