OUTCOMES OF PALATAL LENGTHENING USING MEDIAL LANGENBECK AND SUBMUCOSAL DISSECTION FOR PRIMARY CLEFT PALATE REPAIR

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ABSTRACT

INTRODUCTION: Cleft lip and palate is one of the most common *craniofacial* congenital anomalies in the human race which results from failed fusion of the embryonic facial processes. The goal of reconstructive surgery to repair a cleft palate is to separate the oral cavity from the nasal cavity. The best physiological technique should be used, with a return to a state as close anatomically to normal as possible.

AIMS: To assess different postoperative outcomes of two modified surgical techniques for primary cleft palate repair with an emphasis on palatal soft tissue length.

METHODS: Twenty cleft palate patients underwent palatoplasty using Medial Langenbeck and submucosal dissection as two modified palatoplasty surgical techniques of von Langenbeck.

RESULTS: There was no significant difference between Medial Langenbeck and submucosal dissection in the palatal lengthening after primary cleft palate repair.

CONCLUSION: Medial Langenbeck and submucosal dissection are significantly superior to von Langenbeck palatoplasty in patients undergoing primary cleft palate repair in achieving the required palatal lengthening and development without creating raw areas or scarring.

KEYWORDS: Medial Langenbeck, Palatal lengthening, Submucosal dissection, Von Langenbeck.

RUNNING TITLE: Palatal lengthening using two modifications of von Langenbeck

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INTRODUCTION

Orofacial clefts, specifically cleft lip and palate, are the most common craniofacial birth defects in humans and represent a high emotional and societal burden (1). As a result of inappropriate palatal shelf growth, delayed or insufficient elevation, and blocked fusion, palatal disorders can occur at any development stage resulting in cleft palate, either alone or in combination with cleft lip. Palatal clefts can occur alone or combined with either a bilateral or unilateral cleft lip and can also take a variety of forms. The soft palate, portions of the hard palate, or the entire palate may be affected (2).

Historically, all the studies on the effects of cleft palate included information on speech characteristics. Children with clefts are at a higher risk of speech problems due to structural issues with velopharyngeal function, occlusal or dental abnormalities, fluctuating middle ear illness, and hearing loss (3).

In terms of function, the palate consists of two parts: the soft palate, which supports velopharyngeal competence, and the hard palate, which enhances maxillary growth and provides mechanical support. When the velopharyngeal opening closes, it normally follows a forward, downward, and medial path, allowing the soft palate to move laterally, anteriorly, and cranially. The muscle's position prevents it from executing its posterior, lateral, and upward pull (4).

Cleft palate repair goals have remained consistent throughout the years, focusing on three areas: normal speech production, minimizing growth disturbances, and anatomical closure of the palatal defect (5-7).

Reconstruction of the velopharyngeal valve, as well as separation of the nasal and oral cavities, aids in mastication, feeding, and prevention of malnutrition (8).

Although surgeons disagree on the benefits of various techniques, they generally concur that the repair goals define the following principles: anatomical closure of the defect in layers with tension-free suturing, reconstruction of the levator veli palatini by relocating malposed soft palate muscles, retro-positioning and lengthening of the soft palate and minimizing the denuded areas of bone and nasal or oral mucosa. (5, 8-10).

The selection of the surgical approach depends on numerous factors, including the order and timing of palatal repair, the patient's age at the time of closure, the amount of sufficient tissue retro-positioning, and the required number of anatomical layers to repair the cleft. There is controversy over the outcomes of denuded regions following reconstruction and the optimal dissection approach for realigning the palatal muscles (11).

Of all the cleft palate surgeries done today, about 60% are the Langenbeck procedure, which is the oldest palatal repair method. By using lateral releasing incisions, von Langenbeck was able to create a midline tension-free closure. It is regarded as being rather simple, requires less dissection than many other techniques, and provides results that are on par with those of other techniques. It is criticized nonetheless for inadequate velopharyngeal competency and failing to utilize the levator veli palatini muscle to reinforce the soft palate. Several of the more recent methods outlined essentially aim at overcoming these drawbacks (12).

By establishing two parallel incisions, one along the cleft boundary and the other along the lingual side of the alveolus, the original von Langenbeck palatoplasty technique intended to create bilateral bipedicled mucoperiosteal flaps. In the midline, these flaps are relocated and approximated. Our modern methods for repairing the palate are based on procedures created by Langenbeck, Veau, Ruppe, and others while working under the limitations of anesthesia and technology from the 19th century. All of these operations leave the oral mucosa with significant scarring, which is most likely the cause of the associated skeletal and dental anomalies in the arch. These procedures, which involve large mucosal incisions, have continued despite modifications to anesthesia and other surgical protocols because there appears to be insufficient palatal tissue in the cleft children (13).

Reid and Watson have recently modified the original design by attempting palatal closure with just a single incision on either side of the cleft margin. They performed a procedure that required extensive subperiosteal undermining, preserving the greater palatine vascular pedicle, and making incisions on the inner side of the palatal flap, allowing the approximation of the mucoperiosteal flaps without the need for a second incision along the alveolar margin (14).

Murison and Pigott modified a technique known as "medial Langenbeck," which involved altering the von Langenbeck repair. The lateral releasing incision's medial side became the site of the greater palatine artery. Compared to von Langenbeck or pushback palatoplasty, this procedure results in a smaller region of the denuded palate and greater maintenance of the alveolus's main vascularity (15-17).

The aim of this study is to assess the outcome of two modifications of von Langenbeck palatoplasty in the repair of cleft palate cases regarding the postoperative palatal length in addition to the healing of the denuded area of the palate.

MATERIALS AND METHODS

Setting and Location

This study was first approved by the Research Ethics Committee, Faculty of Dentistry, Alexandria University.

Participants were selected from the outpatient clinic of the Oral and Maxillofacial Surgery Department and operated in the operative theatre of the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University.

Before the operation, informed consent was obtained to confirm that the children's parents understood the expected outcomes after palatal repair and any potential risks associated with the intervention.

Study design: This study was a randomized clinical trial with a 1:1 allocation ratio. It was set up and reported according to the CONSORT guidelines (http://www.consort-statement.org).

Eligibility criteria:

Patients have not previously had a palatal correction. They weighed more than 10 pounds (4.5 kilograms) and had a hemoglobin level exceeding 10 grams. Children with syndromic disorders and those with medical conditions were excluded.

Preoperative assessment:

Name, gender, and age were recorded in addition to all other relevant personal data. The parents' names, contact information, and address are also documented. The cases underwent *echocardiography*. Laboratory investigations, including hemoglobin level and coagulation profile, were obtained.

Operative procedure

The surgery procedures were performed in the operating theatre under general anesthesia. Sevoflurane used for inhalational induction and a cannula was inserted to provide intravenous access, and then an intravenous injection of atropine (0.02 mg/kg) and 2 mg/kg of propofol was given. following that switching from sevoflurane to isofluorane after endotracheal intubation.

After scrubbing the surgical area with povidone-iodine 10% (BETADINE®, EL-NILE Co. for Pharmaceuticals and Chemical Industries, Cairo, Egypt), the patient was draped in sterile towels to ensure that only the surgical field was visible. A

Dingman mouth retractor is inserted to ensure enough operating field visibility and accessibility, and then local anesthetic is infiltrated with adrenalin (1:200000 adrenalin with xylocaine) for its hemostatic effect. The preoperative palatal length was estimated.

Performing the (Submucosal dissection) **technique for group 1: (Figure 1)**

A bilateral incision was made at the point where the oral and nasal mucosa met along the cleft margins.

The soft palate incision was made and extended to the muscle, but the muscle was not dissected.

The incision was extended anteriorly along the margin of the palatal bony shelf.

A sharp elevator was used to raise the mucoperiosteum from the underlying bone anteriorly and laterally to the alveolus.

As needed, the nasal mucosa was also raised from the lateral nasal wall and the hard palate bone.

A nasal lining was set up using a vomerine flap.

This allowed the mucosal elevation on the medial aspect of the medial pterygoid plate and the muscular attachments to the posterior border of the hard palate to be loosened. The vascular pedicle of the greater palatine artery was exposed and approached using conventional dissection.

There was a closed nasal layer. The mucoperiosteum was kept under tension by a skin hook, and the periosteum was incised by making many incisions with an angled blade. The main incision extended parallel to the alveolus and laterally to the vascular pedicle.

The periosteum was divided into strips that emerged from the vascular pedicle by multiple minor incisions done medially. The cleft was carefully stitched up with either 5/O Vicryl or 4/O chromic catgut. Firstly, nasal layer repair was made. The oral mucosa and muscle were stitched up in the midline with a vertical mattress suture (14).

Performing (Medial Langenbeck) technique for group 2: (Figure 2)

The cleft margin was incised well onto the oral side of the cleft, along the white line that separates the nasal and oral mucosa.

A deep incision was carefully made through the mucous glands with the blade angled laterally to leave glands along the cleft edge for the upcoming formation of the uvula ridge, then it was clear to identify the fan of muscle fibers running through the length of the soft palate through the cleft margin.

Approximately 2 or 3 mm medial to the predicted position of the greater palatine foramen was the intended site of the medial Langenbeck incision line. It proceeded forward to the anterior extent of the cleft, situated around 2 centimeters in front, then back to the mid-soft palate.

The incision was made deeper into the mucosa of the hard palate, exposing the mucosal glands, and the edges of the wound were pulled apart. The oral layer was then released sufficiently to facilitate the anterior approximation.

The soft palate was gently incised, with the incision extending through the mucosa and into the mucosal glands. Gradually raising the incision lines apart revealed the lesser palatine nerve branches and arteries over the muscles. The mucoperiosteum was freed from the medial pterygoid plate and extended up to the base of the skull by making a deeper incision posterior to the hard palate.

Everting mattress sutures were used to close the nasal and oral layers once the palatopharyngeal and levator muscles were exposed as they traveled along the cleft's margin. To restore the normal median dorsal ridge, two mattress sutures were placed in the mid-soft palate to evert mucosal glands and musculus uvulae onto the dorsum of the combined levator-palatopharyngeal slings. Laterally, these sutures were moved to the mucosal glands that were still present at the cleft edge. After passing through the muscles to reach the back and biting into the mucosa, they passed back through the muscles to reach the other side (16). The postoperative palatal length was estimated.

Postoperative phase

Regarding the airway, in the early postoperative phase, it might be affected. A tongue stitch placed during surgery might be an effective emergency measure. If complications were found, a nasopharyngeal airway could be highly beneficial. Parents were instructed to start infant feeding in the fourth week after the surgery; they were given instructions to follow a soft, entirely liquid diet. Arm restraints are frequently placed, along with telemetry and pulse oximetry during patient convalescence. A comprehensive evaluation, including a speech assessment, is scheduled for the cleft team three months following surgery (18-21).

Postoperative medications

All patients were given intravenous IM Cefotaxime (Cefotax, E.I.P.I.C.O., Egypt) 25 mg/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 a maximum of 4 times/day.

Clinical outcomes

The palatal lengthening outcome was estimated by comparing preoperative and immediate postoperative measures. While patients were sedated and a Dingman retractor was in place, a flexible paper ruler was used to take measurements in a curved dimension. The base of the uvula was chosen as the end point and the connection point between the hard and soft palate as the starting point.

Statistical analysis
The collected data were analyzed using the Statistical Package for Social Science (SPSS) program for statistical analysis (ver 25) (22). Data were described using minimum, maximum, mean, standard deviation, standard error of the mean, 95% CI of the mean (23). During sample size calculation, beta error accepted up to 20% with a power of study of 80%. An alpha level was set to 5% with a significance level of 95%. Statistical significance was tested at p-value <.05 (24).

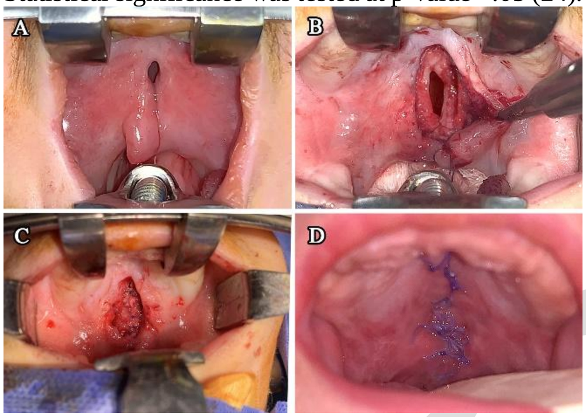

Figure (1): Submucosal dissection technique **a:** Preoperative photograph showing complete unilateral cleft palate. **b:** Intraoperative photograph showing submucosal dissections. **C:** Reconstruction and repair of the nasal layer. **d:** Postoperative photograph showing the completed repair with only a midline suture line.

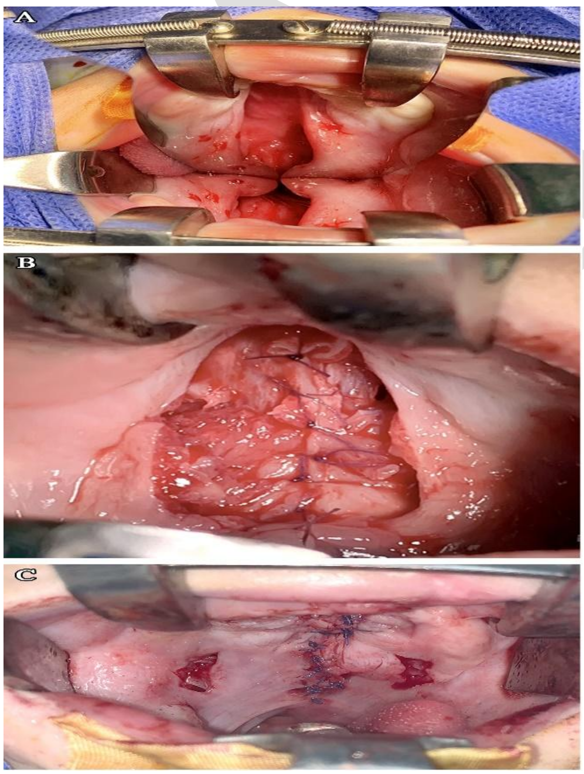

Figure (2): Medial Langenbeck. **a:** Preoperative photograph showing complete unilateral cleft palate. **b:** Reconstruction and repair of the nasal layer. **C:** Immediate postoperative photograph showing closure of the palatal cleft with small releasing incisions laterally.

RESULTS

Demographic data: In the submucosal dissection group, the age ranged from 9.00 to 12.00 months, with a mean ± SD. of 10.25±0.86 months (6 males and 4 females), while in the Medial Langenbeck group, it ranged from 9.00-18.00 months, with a mean ± SD. of 11.75±3.20 months (7 males and 3 females). There was no statistically significant difference in age between the two studied groups (p = .182). There was no statistically significant difference in sex between the two studied groups (p = 1).

Palatal Length (mm)

Preoperative: In the submucosal dissection group, the palatal length (mm) ranged from 18.00 to 30.20 mm, with a mean ± SD of 22.13 ± 3.66 mm, while in the Medial Langenbeck group it ranged from 18.50 to 32.00 mm, with a mean ± SD of 23.49 ± 3.56 mm.

Postoperative: In the submucosal dissection group, the palatal length (mm) ranged from 23.30 to 36.30 mm, with a mean ± SD. of 28.21 ± 3.85 mm, while in the Medial Langenbeck group, it ranged from 24.60 to 40.00 mm, with a mean ± SD. of 30.69 ± 4.63 mm.

There was no statistically significant difference in palatal length between the two studied groups preoperatively and postoperatively (p =.209 and .411, respectively). However, in each group, repeated measures analysis showed a statistically significant increase in the palatal length between preoperative and postoperative results in the submucosal dissection group and the Medial Langenbeck group (p < 0.001)

Absolute changes between immediate postoperative and preoperative: In the submucosal dissection group, the palatal length absolute changes between immediate postoperative and preoperative (%) ranged from 20.20 to 33.97 %, with a mean ± SD. of 27.99±4.52 %. In the Medial Langenbeck Group, the palatal length Absolute change between immediate postop. and preop (%) ranged from 21.10 to 41.94 %, with a mean ± SD. of 30.74 ± 6.00 %. There was no statistically significant difference in palatal length Absolute change between immediate postop. and preop. between the two studied groups (p=.262).

DISCUSSION

Primary cleft palate closure has been the subject of several surgical procedures. Despite the variety of procedures, no one operation is the best option for every patient. As a result, there is still debate over the best surgical approach for various cleft palate types. But each technique's aims and principles of guidance stay the same. The main goals of a palatal cleft repair are to minimize the dentoalveolar defects and maxillary growth problems, generate anatomical closure of the defect, and construct equipment for the development and production of normal speech (6, 25).

Compared to the isolated cleft palate study conducted by Antoszewski and Fijakowska in 2016 and their results for patients with unilateral cleft lip and palate, our sample showed a higher male-to-female prevalence in all types of cleft palate. Our study revealed that, while males are more likely than females to have any type of palatal cleft, unilateral cleft lip and palate were the most common types (26).

The primary determinant of growth in cases of complete unilateral cleft lip and palate is the timing of cleft palate surgery. The optimal timing for palatoplasty is a contentious topic among surgeons, as it significantly impacts speech scores, particularly due to compensatory articulation errors; Therefore, it is crucial to repair the palate before language acquisition, with the recommended timeframe being from six to twelve months, according to Shaw et al. in 2019 (27, 28).

Shi and Losee conducted a study in 2015 that demonstrated how operating during earlier stages can have an impact on maxillary growth. As a result, they recommend delaying palatal closure until the age of fifteen (29).

With modifications to the von Langenbeck approach, we aimed for satisfactory growth results in our study while applying it between six months and two years. The primary goal of surgery is to create a long, active palate with proper muscular positioning. In our study, a Medial Langenbeck procedure with limited lateral releasing incisions and a submucosal dissection technique without lateral releasing incisions resulted in a significant lengthening of the palate and negligible scarring, resulting in a healthy, nourished palate. This result is matched with previous studies (14, 16).

Submucosal dissections are thought to be the major cut that runs parallel to the alveolus and lateral to the vascular pedicle. The periosteum can be divided into strips radiating from the vascular pedicle by making a number of minor incisions medially. The periosteum covering the vessel may be gently raised under magnification without causing vascular injury, increasing vascularity, minimizing scarring, or toughening the soft palate (14).

In 2017, Ogata et al. studied the consequences of the scar caused by a mucosal defect after a lateral relaxation incision and found that the scars resulting from the lateral releasing incisions had an impact on maxillary growth (30).

Based on injection studies by Maher and Swindle in 1964 that showed multiple arcades of vessels forming chains near the midline of the intact palate and similar arcades in the cleft, medial Langenbeck is thought to form a relaxing incision placed medial to the greater palatine artery. A medial incision that seldom needs to extend past the mid-hard palate has good vascular support as a result. given that the most effective method for closing the anterior hard palate is the vomer flap (16, 31).

Delaire et al. reported the Von Langenbeck incision's medial relocation in 1989, asserting that a bony palatine cleft should only be closed once the vault has grown to a respectable size. Fibro mucosal flaps from the Palatine shelves elevated medially to the greater Palatine pedicles were used to close the narrower Palatine clefts in a single step. The two modifications are opposite to the von Langenbeck technique, a method of palatoplasty that involves relaxing incisions along the lateral edge of the hard palate and a bipedicle mucoperiosteal flap to close the palatal cleft (32).

Bardach and Kelly demonstrated in 1990 that minimizing the amount of exposed bone can result in less severe maxillofacial growth aberrations (16). Chate et al. In 1997, researchers reported highly favorable outcomes using intravelar palatoplasty without lateral relaxing incisions, indicating remarkable growth results (33).

In 1992, Spauwen showed that postoperative lengthening by the techniques of Langenbeck and Furlow was comparable. On the other hand, postoperative scarring and contractures can lead to poor facial growth and an increased risk of hearing and middle ear complications. The retardation of posterior facial growth was thought to be caused by scarring of the denuded bone areas anteriorly and laterally (32).

According to a study in 1994, cleft palates can be closed with a 98% success rate using a surgical technique without lateral release incisions. The procedure comes with special care when managing the flaps and making the suture, but the good results are well worth it from an anatomical perspective: one is left with only the midline scar, regular palatal morphology, and a dental alignment that can be easily corrected, if necessary, by early orthodontic treatment (34).

Criticisms have been made about the high fistula rates that occur with palatoplasty in wider clefts without relaxing incisions. Additionally, there are concerns about the potential negative impact on facial growth when operators use relaxing incisions (35).

This study revealed no significant differences between the study groups in palatal lengthening after primary cleft palate repair.

CONCLUSIONS

The present clinical study results demonstrate that there is no significant difference between Medial Langenbeck and submucosal dissection techniques in palatal lengthening after primary cleft palate repair. Both of these techniques have a considerable benefit for palatal vascularity, lengthening, and development without scarring.

RECOMMENDATIONS

Further research with long-term and repeated follow-ups should be initiated to confirm this impact on facial growth and speech.

CONFLICT OF INTEREST

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