Effect of Cleft Palate Repair Using Alveolar Extension Palatoplasty Technique on Eruption of Primary Teeth

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Abstract:

Objective: To evaluate the effect of alveolar extension palatoplasty technique and Bardach two flap palatoplasty technique in a split mouth design on the eruption of primary teeth after 6 months of surgery. **Materials and Methods:** Eight cleft palate patients aged 9-12 months were operated with alveolar extension palatoplasty technique on one side and with Bardach technique on the other side. The patients were followed up clinically at first week, second week, first month, third month, and sixth month. Rubber base impression was taken for the maxillary arch at baseline,1 and 6 months. Both sides were compared to each other in the eruption pattern of primary first molar and canine at baseline,1 and 6 months, then data was collected and statistically analyzed. **Results:** Alveolar extension palatoplasty technique led to significantly faster teeth eruption than Bardach technique. **Conclusion:** Alveolar extension palatoplasty technique gave more favorable eruption pattern than Bardach technique.

Introduction

Cleft lip and palate are the most frequent cranio-facial abnormalities, with a global prevalence of 0.28 to 3.74 per 1000 live births[1]. Cleft lip and palate occur in around 3 out of every 1000 infants in Egypt[2].

The management of the cleft patient begins with quick care to the newborn's needs. Surgical repair of cleft palates (palatoplasty) is typically performed by one year of age, primarily to facilitate the acquisition of normal speech and feeding, as this corresponds to the age at which the majority of children begin to speak.[3]

There are numerous surgical treatments for cleft palate correction[4]. Veau-Wardill-Kilner, Von Langenbeck and Bardach's two-flap palatoplasty techniques were the most often used procedures for palatoplasty. However, they leave a large raw area anteriorly and laterally along the alveolar edge, exposing bare membranous bone. With secondary intention, the raw area heals. This results in palate shortening and velopharyngeal incompetence.[5]

It was found that lateral incision reduced maxillary growth more than mucoperiosteal palatal detachment alone.[6] Furthermore, some studies[7] reported that cranial base and skeletal face are not extensively malrelated in individuals with either unoperated clefts of the lip and palate or of the lip and alveolus when compared to matched norms. These findings suggest that cleft patients have the potential for normal growth.[8]

The anterior alveolar mucoperiosteum is deprived of blood supply from the facial-internal maxillary artery in traditional cleft lip repair techniques. Later, during palate repair, the lingual incisions permanently isolate the lingual mucoperiosteum from the greater palatine artery, transforming the osteogenic alveolar mucoperiosteum from a densely blood-supplied zone between the two arteries into an isolated tissue that survives primarily on osseous backflow.[9]

The alveolar extension palatoplasty (AEP) approach results in a tension-free flap with minimal palatal bone exposure following surgery, as the raw area is located on the alveolar crest or tooth border. It maintains the gingiva and periosteum's blood flow.[(10)] Numerous researches have been conducted on the effect of this benefit, as well as the alveolar crest incision, on unerupted primary teeth. Thus, it will be beneficial to investigate the influence of AEP on erupting teeth.

Materials and Methods:

2.1. Case selection:

Eight cases were selected from outpatient clinic of oral and maxillofacial surgery, Tanta University and operated in its theatre .The children age ranged from 9-12 month with complete cleft palate. Also, they should not have been operated before and medically fit for general anesthesia. Children with syndromic cleft palate were excluded.

2.2. Ethical considerations:

The study protocol was approved by the ethical committee of Faculty of Dentistry, Mansoura University with code (A 09060819). The study and all procedures were explained in detail to the parents and written informed consents were obtained from them before participating in the study.

2.3. Grouping:

The cases were operated in a split mouth design by "Bardach two-flap" technique[11] on one side of the cleft which acted as a control group. The other side was operated by "AEP"[9].

2.4. Procedures:

a) Preoperative assessment:

1) Medical history was taken for every case, patient underwent laboratory investigations including bleeding profile and hemoglobin level.

2) Medical records were reviewed to check patient's fitness for general anesthesia.

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3) Preoperative rubber base impression for the upper arch and photos were taken for every child and kept as a record.

b) Surgical procedures:

1) All patients were anesthetized using endotracheal intubation using cuffed armoured tube to prevent its kink during the surgery.

2) The surgical field was scrubbed with povidone-iodine surgical scrub solution 10%, followed by draping of the patient with sterile towels exposing only the area of surgery.

3) After placing the patient in the supine position with the neck extended, the Dingman mouth gag was applied for better visibility and accessibility to the operating field.

4) Local anesthetic with vasoconstrictors was infiltrated into the palatal tissues for hemostasis.

5) After 5 to 7 minutes, the incisions were made with number 15 blade. The incision ran along the edge of the cleft, over the gingiva and just medial to the line of dental eruption in one side (AEP technique) and on the palate-alveolar junction on the other side (Bardach technique) (Figure 1).

6) Careful dissection of nasal mucosa performed first, followed by tension free closure with 5-0 Polyglycolic Acid (PGA) sutures, then functional repair for velar muscles was performed.

7) Sub-mucoperiosteal dissection was done for oral flaps to preserve vascular integrity of the flaps, with a careful dissection for AEP side at alveolar crest area by supraperiosteal dissection above the tooth follicles to preserve the integrity of the erupting teeth.

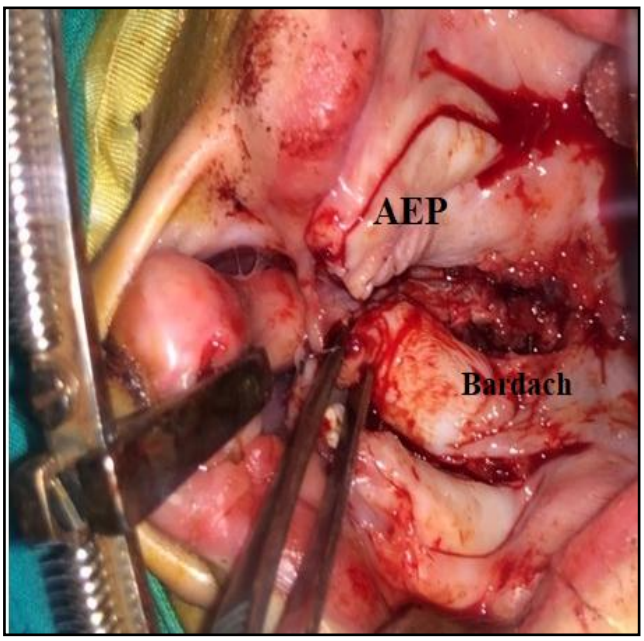

Figure (1) showing Flap design in a 9 month cleft palate patient during palatoplasty

8) Oral mucoperiosteal flaps were closed in an interrupted fashion with 5-0 PGA. Once the hard palate closure was begun, the interrupted sutures were alternated with horizontal mattress sutures that were anchored along the nasal closure, thereby reducing the dead space between the oral and nasal layers and prevent tenting of the palate.

9) During and after completing all surgical procedures, photographs were taken for every case.

c) Postoperative phase:

1) Special attention was given for the airway which could be easily compromised in the early postoperative period. A tongue stitch inserted during operation was a useful emergency measure. If problems were anticipated, a nasopharyngeal airway would be very helpful.

2) Soft, fully liquid diet was instructed for all patients for 4 weeks postoperatively and solid foods were of a pureed consistency.

3) Arm restraints were applied to prevent infants from disrupting the repair with fingers or thumb.

d) Follow ups

1.The children were followed up clinically at first week, second week, first month, third month and sixth month post-operative to assess the healing, success of the surgery and to detect any fistula formation. The dental arch, teeth and their supporting structure were examined clinically.

2.Rubber base Impressions were taken at one month and six months follow up visits.

3.After pouring the casts, Teeth eruption (first primary molar and canine) was compared between the 2 sides and was given the following scores:

a) (0): the tooth hasn't erupted yet.

b) (1): the cusp tip has emerged.

c) (2): the tooth has erupted till the contact area.

d) (3): the tooth has fully erupted.

2.5. Statistical analysis and data interpretation:

Data were analyzed using IBM SPSS Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. Monte Carlo test as correction for Chi-Square test when more than 25% of cells have count less than 5 in tables (>2*2).

Results:

This clinical study included surgical correction of cleft palate for eight children using two different techniques. Palatoplasty in each side was done by AEP technique or Bardach technique. The children were followed up for six months postoperative for eruption scores.

The children were followed up after the surgery till two weeks for the surgical wound and their general health which ran well. No specific complications like oronasal fistula have occurred after the surgery.

The operator conceded the treatment was not blinded and coded the patient data to be assessed by the evaluators who were blinded to the generation and implementation of the treatment assignment. Evaluators didn't know which treatment was done to the patient, each author evaluated the data separately and more than one time for inter-examiner and intra-examiner reliability which was not less than 85%.

a) Eruption scores:

The recorded values for the rate of eruption of first primary molar and the primary canine erupted at the follow up period for both surgical techniques used showed variable scores from 0 up to 3. Also it was observed that teeth erupted at the side operated by AEP technique were slightly deviated palatally in the contrary to the side operated by Bardach.

a) Primary first molar eruption scores:

For the first primary molars, the scores at one month showed a range from 0 up to 2 where as the scores ranged from 0 up to 3 at 6 months follow up. There was no statistically significant difference between the two sides of cleft concerning the eruption of teeth in all children contributed in the study (P=1.0).

At the beginning of the study all cases showed score 0 (100%) at both sides of cleft for the two types of incisions. At one month follow up for Alveolar Extension Palatoplasty technique two cases showed score 0 (25%), two cases showed score 1 (25%) where as four cases showed score 2 (50%). For Bradach technique,six cases scored 0 (75%),2 cases scored 1 (25%) where as none of the cases scored 2.

There was a significant difference between AEP and Bardach surgical techniques at the follow up period one month (P=0.05) concerning the rate of first primary molar eruption. There was a significant difference at six months follow up period regarding the Alveolar Extension Palatoplasty that showed much faster eruption rate than Bardach technique.

b) Primary Canine eruption scores:

All cases showed score 0 in both sides at the beginning of the study. At follow up one month, still all cases kept score 0 for both surgical techniques, whereas at six months follow up the score record ranged from 0 up to 3.

For AEP,3 cases recorded score 0 (37.5%),3 other cases recorded score 1 (37.5%) and 2 cases recorded score 2 (25%). None of the cases recorded score 3. For Bardach technique at six month follow up period,1 case showed score 0 (12.5%),1 case scored 1 (12.5%),3 cases recorded score 2 and 3 cases recorded score 3.

Table (1): Comparison of eruption scores between studied techniques at different follow up time.

Erupted teeth			Techniques		
	follow up times/ months	scores per stage	AEP n=8(%)	Bardach n=8(%)	test of significance (Monte Carlo test)
M (First primary molar)	0	0	8 (100)	8 (100)	P=1.0
	1	0 1 2	2 (25) 2 (25) 4 (50)	6 (75) 2 (25) 0	P=0.05*
	6	0 1 2 3	0 0 2 (25) 6 (75)	4 (50) 1(12.5) 3 (37.5) 0	P=0.01*
C (Primary canine)	0	0	8 (100)	8 (100)	P=1.0
	1	0	8 (100)	8 (100)	P=1.0
	6	0 1 2 3	3 (37.5) 3 (37.5) 2 (25) 0	1 (12.5) 1 (12.5) 3 (37.5) 3 (37.5)	P=0.158

Discussion:

This study investigated how much surgical correction of cleft palate using two different flap designs can affect eruption of teeth.The incision to make the flap usually extend into the area of alveolar crest and the future gingiva which is the site for upcoming teeth to erupt. Eruption of teeth is a continuous process and can be affected by the healing after surgery and amount of blood supply to alveolar crest[12,13].

The age of children included in the study ranged from nine to twelve months,this age was selected as most children begin to talk at this age and the procedure may also improve hearing and swallowing by aligning the cleft palatal musculature. The ideal technique of palatoplasty is the one which solves the dilemma of obtaining perfect speech without affecting the maxillofacial growth and hearing.[3]

Also the selected children were non syndromic patient as the resulting palatal cleft should not be related to other

malformation. It is known that growth is disturbed in many locations as nearly half of the syndromic cleft palate presentations are associated with the triad of micrognathia, glossoptosis, and airway obstruction (Pierre Robin sequence)[14].

To follow up the children through out the study, it was necessary to have a permanent record for each case (dental cast). It was produced using rubber base impression material, as the presence of communication between oral and nasal cavity can be a significant risk factor for aspiration of impression material during impression taking which can produce respiratory distress.[15] Also we decided to use the addition silicone impression material in its putty form as it has high tensile and shear strength which makes it ideal in cases of cleft palate as it resists distortion and tearing and gives excellent details with minimal flow and also can be poured several times.[15]

Our results showed that there was no significant difference in molar eruption score between the two sides with either of the flap design at one month follow up but there was such significant difference between one and six months follow up. This denotes that AEP technique accelerated eruption rate especially at six month follow up, which comes in the contrary with the claims of pediatric and plastic surgeons about AEP technique that it affects the unerupted primary teeth leading to the limited number of studies about its effect on growth and primary dentition.

This acceleration of eruption can be explained on the basis that surgical procedures in this side removed physical barriers from the eruption path with maintaining proper blood supply which allows accelerated eruption but with some deviation due to formation of fibrous scar tissue at the incision line at the alveolar crest which may be the original point for emergence. This comes in agreement with Shimada et al who reported that Angiotensin II caused constriction of the peripheral vascular smooth muscle resulting in an increase of arterial blood pressure and a decrease of regional blood flow, followed by a decrease of fluid volume and then a reduction of either the pressure within the socket or of the eruptive forces, which suggests that interruptions in the blood supply to growing teeth affects eruption.[12]

The absence of significant difference in canine eruption rate may be related to delayed eruption date for the canine and limited observation period for its eruption in this study as the primary canine usually erupts at eighteen months[16].

Limitations:

- Limited number of cases due to a lack of available cases.
- Limited follow up period.
- Medical condition of the patients.

Conclusion:

Within the limitations of this study, it can be concluded that AEP technique did not negatively affect eruption of primary teeth. More specifically, it accelerated first primary molar and canine eruption more than Bardach technique.

References:

1.Parker SE, Mai CT, Canfield MA, Rickard R, Wang Y, Meyer RE, Anderson P, Mason CA, Collins JS, Kirby RS, Correa A: Updated National Birth Prevalence estimatesfor selected birth defects in the United States, 2004-2006. Birth defects research. Part A, Clinical and molecular teratology. 2010, 88(12):1008-1116.

2.Shawky RM, Sadik DI: Congenital malformation prevelant among Egyptian children and associated risk factors. Egyptian journal of medical human genetics. 2011, 12(1):69-78.

3.Vinson LW, Huebener DV, Jones JE, Flores RL, Dean JA: Multidisciplinary team approach to cleft lip and palate management. McDonald and Averys Dentistry for the child and Adolescent, 2016, 4(23):479-481.

4.Agrawal K: Cleft palate repair and variations. Indian Journal of plastic surgery. 2009, 42:102-109.

5.Dorrance GM, Bransfield JW: The pushback operation for repair of cleft palate. Plastic and reconstructive surgery. 1946, 1:145-169.

6.Maluf I, Doro U, Fuchs T, Dos Santos DE, dos Santos SF, Freitas R: Evaluation of Maxillary Growth: Is There Any Difference Using Relief Incision During Palatoplasty?. Craniofacial surgery Journal. 2014, 25(3):772-774

7.Bishara SE, Krause CJ, Olin WH, Weston D, Ness JV, Felling C: Facial and dental relationships of individuals with unoperated clefts of the lip and/or palate. Cleft Palate journal. 1976, 13:238-252.

8.Shi B, Losee J: The impact of cleft lip and palate repair on maxillofacial growth. International journal of oral science. 2015, 7(1): 14–17

9.Carstens M: Sequential cleft management with the sliding sulcus technique and alveolar extension palatoplasty. Craniofacial surgery Journal. 1999, 10(6):503-518

10.Devakumari S: Management of palatal fistula with modified alveolar extension palatoplasty - A Promising technique. Pakistan Oral & Dental Journal. 2012, 32(2).

11.Bardach J: Two-Flap palatoplasty: Bardach's technique Operative Techniques in Plastic and Reconstructive Surgery. 1995, 2(4):211-214.

12.Shimada A, Shibata T, Komatsu K: Relationship between the tooth eruption and regional blood flow in angiotensin II – induced hypertensive rats. Archives of oral biology. 2004, 49(6):427-433.

13.Marks SC, JR, Cahill DR, Wise GE: The cytology of the dental follicle and adjacent alveolar bone during tooth eruption in the dog. The American Journal of Anatomy.1983, 168:277-289.

14.Cohen MM: Etiology and pathogenesis of orofacial clefting. Oral and Maxillofacial Surgery Clinics of North America. 2000, 12(3):379-398.

15.Grayson BH, Maull D: Nasoalveolar Molding for§ infants born withclefts of the lip, alveolus and palate in Brerkowitz S (ed) Cleft lip andpalate–Diagnosis and management. Springer Verlag Berlin Germany, pp. 451–458, 2006.

16. Dean JA, Turner EG: Eruption of the teeth: Local, Systemic and congenital factors that influence the process. McDonald and Averys Dentistry for the child and Adolescent, 2016, 4(19):349-350.