



Comparison of two-flap palatoplasty plus intravelar veloplasty technique with and without double-layer Z-plasty on the soft palate length in children with cleft palate

Shahin Abdollahi Fakhim¹ · Masoud Nouri-Vaskeh^{2,3} · Faezeh Amiri¹ · Nikzad Shahidi¹

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Abstract

Purpose Velopharyngeal failure occurs as a result of a nasopharyngeal gap following inadequate velopharyngeal closure for structural or functional cause. We aimed to compare the soft palate length in two-flap palatoplasty with intravelar veloplasty (IVV) and two-flap palatoplasty with IVV plus double-layer Z-plasty combination in patients with cleft palate.

Methods This clinical trial was conducted on infants aged 9 to 12 months with cleft palate in two groups. The method of two-flap palatoplasty with IVV technique and two-flap palatoplasty with IVV plus double-layer Z-plasty was compared in terms of soft palate length which was measured during operation and short-term complications.

Results This study was conducted on 62 infants including 30 patients in two-flap palatoplasty with IVV group and 32 patients in two-flap palatoplasty with IVV plus double-layer Z-plasty group. The soft palate length in two-flap palatoplasty and IVV with and without Z-plasty groups before surgery was 17.56 ± 2.05 and 17.68 ± 1.88 mm, respectively ($P = 0.561$). After surgery, the soft palate length was significantly higher in two-flap palatoplasty with IVV plus Z-plasty group (22.43 ± 2.73 mm vs. 20.56 ± 2.42 mm) ($P = 0.032$).

Conclusion The two-flap palatoplasty with IVV plus Z-plasty technique is a suitable method for increasing the palatal length in infants with cleft palate. On the other hand, the addition of Z-plasty method could increase the length of the palate. Moreover, the complications are very low and further trials for development of this method on patients with cleft palate are recommended.

Trial registration number (TRN) IRCT2017032423559N11

Keywords Cleft length · Cleft palate · Cleft lip · Palatoplasty · Velopharyngeal function

Introduction

Velopharyngeal insufficiency (VPI) is characterized by nasal congestion, nasal emission, and non-speech related symptoms, such as nasal regurgitation. Velopharyngeal failure occurs as a result of a gap that is associated with inadequate velopharyngeal closure due to structural or functional cause

[1, 2]. Velopharyngeal failure often occurs in children with cleft palate in 20 to 30% after initial palatoplasty and significant progress has been made in the outcomes of the primary palate surgeries in developing countries [3, 4]. A large percentage of repaired cleft palate cases have been seen this complication, despite the success of surgery in closing cleft, the correct speech is lost due to the lack of contact by the soft palate with the posterior pharyngeal wall [5]. The main goals in restoration of normal speech are ideal velopharyngeal function with minimal gap on palatal closure [5]. There are several techniques for repairing the cleft palate. All these methods are aimed to closing the anatomical defect, preventing the fistula formation, providing a suitable valve for speaking, and allowing proper growth of the face [6]. The necessary factors for the function of the soft palate and correct speech are the following: palatal length, proper movement, and surface contact of dorsal soft palate to pharyngeal wall [7]. The importance of palate length is often confirmed by proper

✉ Nikzad Shahidi
nikzadsh@yahoo.com

¹ Department of Otorhinolaryngology, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran

² Immunology Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

³ Network of Immunity in Infection, Malignancy and Autoimmunity (NIIMA), Universal Scientific Education and Research Network (USERN), Tehran, Iran

velopharyngeal function and correct postoperative speech. In the study of Radall et al., it has been shown that patients with longer palatine significantly had a better speech outcome than shorter one [8].

In our tertiary center, two-flap palatoplasty technique with intravelar veloplasty (IVV) is a routine procedure in infants with cleft palate. Despite the soft palate of infants at the end of the surgery is longer than the palatal length in the beginning of procedure, in some patients, this technique is not able to give adequate palatal length. Hence, we aimed to evaluate the efficacy of Z-plasty in patients with cleft palate who underwent two-flap palatoplasty with IVV on the length of the soft palate and short-term complications of the patients operated with the technique of two-flap palatoplasty with IVV technique plus double Z-plasty in two layers of oral and nasal mucosa with those operated with two-flap palatoplasty technique.

Methods and materials

This clinical trial (IRCT Registration code: IRCT2017032423559N11) was conducted on 62 patients aged 9 to 12 months with cleft palate who referred to the cleft palate clinic and were candidates for surgery between 2017 and 2018. This study was approved by Medical Ethics Committee of Tabriz University of Medical Sciences (Approval code: IR.TBZMED.REC.1396.252). Before the inclusion of infants to the intervention, informed consent was obtained from their parents. After determining the soft palate length in 62 patients in two groups, considering 0.05 Alfa error with a power of 80%, an acceptable difference in sample size was calculated (case group = 32). Patients were randomly assigned and coded in two groups based on random number table.

Atypical and midline clefts, mandible anomalies, and submucous cleft palate were excluded. After injection of vasoconstrictive solution (diluted Adrenalin 1/200000), mucosal incisions was done at the free margin of cleft and dissection of oral mucoperiosteal flap of hard palate was performed, at the lateral relaxing incisions done and releasing of oral mucoperiosteal flap with care of neurovascular pedicle; then, the full nasal layer was dissected under the palatine plates, following oral flap of the soft palate dissection in the plane of subminor salivary gland, extensive palatal muscle dissection was done, after the careful elongation of neurovascular pedicles and suturing of the nasal mucosal layer in the anterior part of the cleft (hard palate) and the distal third of the soft palate, the muscular layer was sutured meticulously (IVV was performed); then, we design bilateral Z-flap in nasal layer and sutured the flaps carefully, after suturing of oral mucoperiosteal flap and distal part of oral layer of the soft palate, again design the bilateral Z-flaps in contrast direction of nasal layer Z-flaps; after that, Z-flaps was sutured

completely. In the control group, we did two- or three-flap palatoplasty in relation with the type of cleft palate with IVV. First, the soft and hard palate junction was marked in midline; then, the cleft length was measured between this point and base of uvula by an anesthetic paper ruler in the operating room before and immediately after surgical procedure. Then, increased length of soft palate between the two surgical procedures was studied in patients and short-term complications of operation (fistula and opening of the wound site) were determined over 1 month.

Finally, the data were analyzed using SPSS version 18 (SPSS Inc., Chicago, IL). Normality of variables distribution was analyzed using the Kolmogorov-Smirnov test and histogram. Between groups, comparisons were made by chi-squared test, and independent sample *t* test, as appropriate. In this study, the significance level was considered to be less than 0.05.

Results

This study was performed on 62 infants with cleft palate including 30 patients (52% male) in two-flap palatoplasty with IVV group and 32 patients (48% male) in two-flap palatoplasty with IVV plus double-layer Z-plasty group. The demographic characteristics of patients are shown in the Table 1.

The results showed that there was no statistically significant difference between age of patients in two group ($P = 0.45$) as well as palatal length ($P = 0.089$). Also, there was no significant difference between palatal length and gender of patients in two groups ($P = 0.89$). The soft palate length was increased in all types of cleft palates. The highest increase was in the incomplete unilateral cleft palate, but this difference was not statistically significant between cleft types ($P = 0.418$).

The soft palate length before surgery was not significant between the two groups ($P = 0.561$). After the surgery, the palate length was significantly higher in two-flap palatoplasty with IVV plus Z-plasty group in comparison with the other group. Also, the increased length of palate in the infants of the case group was significantly higher than the other group ($P < 0.001$) (Table 2).

Discussion

In double Z-plasty, which consists of alternating Z-plasties of the oral and nasal flaps, the placement of levator veli palatine muscle is moved into the posterior flap. The soft palate becomes longer when direction of palatal muscles changes. This method is also effective in closing the submucosal cleft palate and secondary correction of velopharyngeal insufficiency [9,

Table 1 Baseline characteristics of patients

Characteristics		Two-flap palatoplasty with IVV	Two-flap palatoplasty with IVV plus Z-plasty	
No.		30	32	
Gender	Male	16 (52%)	15 (48%)	0.89
	Female	14 (45%)	17 (55%)	
Age (month)		10.28 ± 0.98	10.35 ± 0.89	0.45
Cleft family history		4	3	0.74
Associated anomaly		4	5	0.64
Cleft type	Unilateral cleft lip and palate	6	5	0.84
	Bilateral cleft lip and palate	4	4	
	Bilateral complete secondary cleft plate	11	11	
	Incomplete cleft palate	9	9	
	Unilateral complete cleft palate	1	2	

IVV intravelar veloplasty

10]. Other methods (e.g., the Furlow method) increase length of the palate. However, an additional increased length of palate can be used when the muscles are effectively dissected. The main problem in this method is the non-anatomic movement of the levator muscle. Another important issue has been raised in this regard; the Furlow palate is thin, and the main concern in this connection is likely to be the appearance of a fistula in the future [11]. Moving the levator veli palatini muscle during the palatoplasty is an acceptable way to achieve the normal speech.

Although the palatal length is an important factor in cleft palate surgery outcome, it is likely that a multiple factors influence the success of a cleft palate repair with respect to speech and other outcomes. Some factors including gender, age, and cleft width should be considered as predictors in velopharyngeal dysfunction [12, 13]. On the other hand, age of surgery, palatal muscles dissection, and gentle tissue handling should be considered [14–16]; therefore, palatal length may not be a good guide for velopharyngeal insufficiency, alone.

Surgeons emphasize that levator muscle dysfunction with an abnormal position should be carefully performed to provide a proper pull of the levator muscle. This surgery is also challenging, but the wide dissection and overlapping of the levator muscle provides better functional outcomes for velopharyngeal and otological function [11]. In this study, we have also used a technique in which the oral and nasal layers are brought together by Z-plasty, which results in

higher soft palate length to uvula. In other words, the addition of Z-plasty method could significantly increase the length of palate. Ravishanker et al. [17] evaluated increased length of palate in both Furlow and Veau Kilner Wardill (VKW) methods, and they observed that increased length of palate was predicted in all patients under Furlow surgery, but in the VKW method in 30% of patients with long palates did not reach the predicted level, and stated that the Furlow method is a very suitable method for increasing the length of the palate. Guneren et al. [18] performed Furlow double-opposing Z-plasty. The increased lengths of palate during and after surgery were 16.11 mm (69.55%), 47.7 mm (55.47%), respectively. Pet et al. [19] increased postoperative palate length by 19–20%. Isik et al. [20] observed the total length, the length of hard palate, and the length of the soft palate were 5.7 mm, 1 mm, and 4.9 mm by technique of rotation palatoplasty, respectively. Atik et al. [21] found that high length of palate in the V-Y pushback palatoplasty method was not significant. Bae et al. [22] showed that the length of incomplete cleft palate in the two-flap palatoplasty method was greater than V-Y pushback method. In the complete cleft palate, the length of the palate length in the Furlow technique was significantly higher than the V-Y pushback. Unlike the Furlow method, our method does not produce Z-plasty muscle, but only Z-plasty is performed in the mucosal layer, thus decreasing the amount of scarring and tissue tension and increasing the length of the palate.

Table 2 The comparison of soft palate length in two methods group before and after surgery

Soft palate length	Two-flap palatoplasty with IVV	Two-flap palatoplasty with IVV plus Z-plasty	P value
Before surgery (mm)	17.56 ± 2.05	17.68 ± 1.88	0.561
After surgery (mm)	20.56 ± 2.42	22.43 ± 2.73	0.032
Change (mm)	3.09 ± 1.05	5.75 ± 2.04	<0.001

In this study, two complications, which were fistulae of soft palate in the group under the technique of two-flap and Z-plasty technique, were observed that these two patients considered hygiene as the cause of this. Nagy et al. [11]’s oral mucosal prosthesis with IVV method reported that there was no complication after operation, such as site-operated hemorrhage and site inflammation. Another study by Gongorjav et al. [23] that compared 4 techniques of surgery and the complications of these four methods showed that complete repair of the wound without complications was observed in 76.9% of the patients with a two-flap technique, 57.7% in patients undergoing Furlow surgery, 62.5% of patients were operated by two-stage palatoplasty, and 93.9% using the Mongolian method. Another study performed by Muzaffar et al. (11) by two-stage palatal method found that the incidence of fistula was 7.8%, and in the follow-up 4.9 years, the incidence was 33%. In a study by Mommaerts et al. (12) in which two-staged palatal Furlow Z-plasty was investigated, 13.3% of the patients had wound open after surgery, which the whole thickness was in the anterior part of the muscle sling and was corrected surgically. In a study by Aboul-Wafa [24], the cleft palate of the infants corrected with the islandized mucoperiosteal flap, none of the 36 neonates treated with any of the major complications, including the opening of the surgical site and the fistula. In this study, the incidence of complications was acceptable; in other words, only 6.6% of the patients infected had fistulae formation, which was also due to a lack of observance of the health status, which was acceptable compared with complications of other studies.

This study had some limitations. Soft tissue swelling has made the measurements difficult at the end of the operation but it is common in these surgeries. Also, we measured the cleft length immediately after operation and the swelling in this condition is lower.

Conclusion

The results of this study showed that the two-flap palatoplasty plus Z-plasty technique is a suitable method with low complication to increase the palatal length in infants with cleft palate. Similar studies including an extended patient group with substratification of the patient groups and clinical follow-up with respect to velopharyngeal competency would be considered in the future studies.

Compliance with ethical standards

This study was approved by Medical Ethics Committee of Tabriz University of Medical Sciences (approval code: IR.TBZMED.REC.1396.252). Before the inclusion of infants to the intervention, informed consent was obtained from their parents.

Conflict of interest The authors declare that they have no conflict of interest.

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