Research Article

Third Generation Veloplasty: Elongation of the Soft Palate, A New Concept and Technique

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Abstract

Background: Adequate reconstruction of the soft palate to achieve quality of phonation is one of the main objectives of cleft palate repair. Even with adequate repair, the soft palate may remain short, leading to Velopharyngeal Insufficiency. In such cases lengthening is achieved by sacrificing other important anatomical structures.

Objective: We present a new technique in the reconstruction of the soft palate that elongates it in an efficient way providing adequate sufficiency and uvular competence, without sacrificing other palatal structures.

Methods: During a five-year period, this technique was applied to a total of 731 patients, 437 in primary repairs and 294 in secondary or revision cases. All patients were subjected to a quantitative analysis with the "Alvarez Scale" or Speech Score both before and after surgery.

Results: There was a notable improvement in our series in the prevention and treatment of Velopharyngeal insufficiency (VPI). There was a gain of one to two points (over fifteen) in improvement as compared to what the revision group had in their preoperative evaluation.

Conclusion: In our experience, the Third Generation Veloplasty (TGV) is more effective in improving the velopharyngeal function than the first generation Veloplasty (OR = 2.76)

Keywords | Velopharyngeal insufficiency (VPI), First Generation Veloplasty (FGV), Second Generation Veloplasty (SGV), Third Generation Veloplasty (TGV), Uvular insufficiency (UI), Uvular incompetence (UIc), Speech Score (SS)

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Introduction

From the beginning of palatal reconstruction, surgeons sought the three-layered anatomical reconstruction of the congenital defect between the oral and nasal cavities.[1,2] This fundamental principle in the repair of the cleft palate has not changed since Bernard von Langenbeck.

With respect to the bony palate, the reconstruction has evolved in the form of wide dissection techniques, such as Veau-Wardill and Bardach. Current methods also include conservative techniques with minimal incisions that have taught us to temper surgical procedures by dissecting what is strictly necessary to achieve repair of the defect with minimal scars. We have described these as the Surgical Philosophy of the Palate, or cut as you go.[3,4,5] These methods have shown encouraging results, however, they have a long learning curve.

Despite adequate closure of the palatal cleft, speech disorders are quite common in these patients. Hence, there is a need to look for reconstructive alternatives in order to improve functional results.[6,7,8]

To understand the cleft palate malformation, it is important to relate the pathology with anatomical

basis of the cleft. Lack of complete fusion of the medial palatal processes of the first pharyngeal arch is the origin of the hard palate cleft. This results in a communication between the oral and nasal cavities. Defects at the osseous level will result more in food leakage and less in speech problems. The repair of this bone segment has structural purposes.[8,9,10] An adequate repair will alleviate the symptoms of food leakage into nasal cavity.

The structures comprising the soft palate have a different purpose. The tensor muscles of the palate are important in swallowing, and sphincter control of the Eustachian tube. The elevator muscle of the palate has a major role in phonation. Finally, the intrinsic muscle of the uvula, the estafilino Uranus, completes the last elevation phase of the palatal veil until its complete posterior closure. For these reasons the repair of the soft palate has more functional than structural purposes. The aim here is to reconstruct the integrity of the fissured muscles.

Subsequent to the original description of cleft palate repair, modifications and different techniques were added. These techniques sought to improve speech results in the cleft palate patient. Here it is pertinent to add that there is no universal system that classifies the various veloplasty techniques. Therefore, we have grouped them in the following system for purely educational purposes, and to be better able to describe the novel technique used in this study.

First generation veloplasty: Since its original description of by Bernard von Langenbeck (1810-1887), the aim of veloplasty is repair of the palatal veil elevator with the Intravelar Veloplasty technique,[3,11] This undoubtedly provides the solution to velopharyngeal Incompetence. Results demonstrate that this technique leads to a secondary problem due to scar contracture: a functional but short palate. A short palate in itself is a cause of Velopharyngeal insufficiency (VPI). In summary, the Intravelar Veloplasty resolves the Incompetence of the cleft, but not the VPI.

Second generation veloplasty; This is an evolution of the previous one, with the additional purpose of lengthening the palate, while still repairing the muscular sling. Second generation techniques include the Push-back procedure, Furlow's double-opposing Z-plasty (figure 1) and the Sannvenero-Roselli technique(figure 2).

This generation of veloplasty techniques managed to repair the muscular sling AND gain adequate palatal length, but always sacrificed some structural anatomical component. For instance, the Push Back technique increases the anterior Dental palatine fistula rate. The Furlow technique affects the competence of the estafilino Uranus muscle, and in the Sannvenero-

Fig 1: Marking for Furlow's double-opposing Z-plasty

Fig 2: Sannvenero-Roselli technique

Third generation veloplasty: In order to achieve the objectives of muscular competence and adequate palate length without compromising structural anatomy, we propose the '3rd generation veloplasty'. It recovers ideal palate intrinsic muscle positions of tensor and levator veli palatini, and the Uranus estafilino muscle. Imaging and histopathological studies show that the Uranus estafilino muscle intervenes in the third and last phase of the soft palatal lift process, concluding the sphincter constriction. For this reason, we think it is necessary to preserve and reconstruct the uvula using both halves and not discard any part thereof.

Methods

The study was conducted over a five-year period in Ecuador and simultaneously over a two-year period in Peru, Paraguay, Nicaragua and Egypt within the Operation Smile Foundation of each country. Approval was obtained from the respective medical directors. The Third Generation Veloplasty (described below) was routinely applied in all cleft palate patients, including both primary cases, as well as previously operated patients who were candidates for a re-do palatoplasty.

Speech samples were recorded for all patients pro-operatively, as well as post-operatively. Speech assessment was done using the Alvarez score. The primary cases had at least a 3-year follow-up, and the secondary cases had a one-year follow-up. The results of this technique were compared to that of a 'control group', comprising of patients who underwent first generation veloplasty (intravelar veloplasty method), before we started implementing the current technique

The relative risk was calculated, for development of VPI with first generation technique versus third generation technique. The odds ratio for improvement of VPI with third generation technique was also calculated.

Surgical Technique

With the patient in Rose's position and a Dingmann mouthpiece in place, the soft palate was infiltrated with a solution containing 0.25 mg of bupivacaine and epinephrine 1: 100,000. After waiting for a latency period of seven to ten minutes, de-epithelialization along the medial border of the cleft uvula was done on both sides, as shown in figure 3.

Fig 3: *De-Epithelialization Along the Medial Edges of the cleft uvula*

Figure 4: *A full thickness, 1 cm Long Cut made Parallel to the Posterior Border of the Uvula*

Once this step is done, fibers of the Uranus estafilino muscle can be clearly seen from the base of the uvula. After that a full thickness cut that involves the oral mucosa, uvular muscle and nasal mucosa has to be made; the path and direction of this cut will be parallel to the posterior border of the uvula no further than one centimeter as shown in Fig. 4.

Once this cut is made on both sides, that is to say on each palate hemi-veil, the remaining uvulas are pushed towards the posterior pharyngeal wall forming a rhombus. This defect is closed in the midline with absorbable vicryl 6/0 sutures.

With consequent suturing of this rhombus, there are two effects: firstly the contact surface of the elevator and Uranus estafilino muscles increases, ensuring adequate competence. Secondly, through the Rose-Thompson effect there is elongation of the soft palate. (Figure 5 and 6)

Figure 5: *Creation of Rhomboid Defect*

Results

A total of 731 patients were treated with the third generation veloplasty technique. The control group included a total of 484 cases, treated with Intravelar Veloplasty technique (First Generation Veloplasty). The details of both these groups are elaborated in Table 1. The phono-audiological follow-up during three post-operative years in primary cases and one postope-rative year in secondary review cases detected a two-point improvement in the Alvarez speech score (Table 2).

The odds ratio analysis shows that the Third Gene-

rationVeloplasty (TGV) is 2.76 times more effective in improving the velopharyngeal function than the first generation Veloplasty (Table 3). Our results also demonstrate that patients are 4.93 times more likely to develop VPI using First Generation Veloplasty as compared to third generation (table 4).

OR = 4.5 / 1.63OR = 2.76

Figure 6 *a: Prior to Suturing of the Rhomboid Defect, and*
b: Rose-Thompson Effect Demonstrated 2 Months Post-Operatively)

Discussion

Repair of the cleft palate has continued to evolve over the last century, with techniques aimed at restoration of the structure as well as function of the palate to resemble the norm as closely as possible.

Earlier (first generation) techniques, restored the muscular sling but resulted in a short palate[3]. To overcome this problem techniques were developed to simultaneous lengthen the palate and restore the muscle sling. However, most of these sacrificed some crucial anatomical structure. This left room for an 'ideal' technique that would meet the objectives of repair, namely, muscle repositioning, adequate palatal length, while not compromising on integral palatal structures.

Table 1: *Comparison of Demographics of the 3rd and 1st Generation Veloplasty Groups*

	3rd generation veloplasty group	1st generation veloplasty group
Total patients	731	484
Primary cases	437	484
Male	57% (249)	39% (189)
Female	43% (188)	61% (295)
Unilateral	61% (267)	72% (349)
bilateral	39% (170)	28% (135)
Secondary cases	294	NA
Male	36% (112)	
Female	62% (182)	

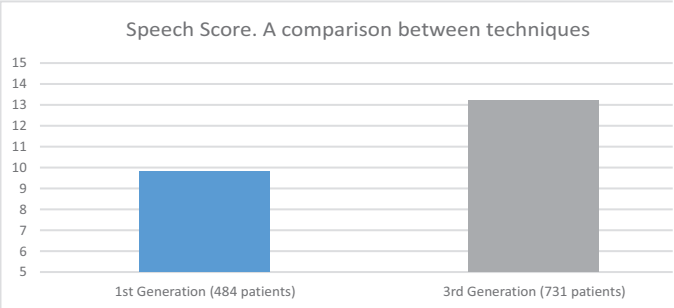

Figure 7: Comaprison of Speech Scores between the two groups.

Table 2: *(odds ratio analysis): Third Generation Veloplasty (TGV) is 2.76 times more Effective in Improving the Velopharyngeal function than the First Generation Veloplasty.*
RR=0.69/0.14; RR=4.93

	Improved Speech	Did not Improve Speech
3rd Generation Veloplasty	598	133
1st Generation Veloplasty	300	184

Intelligible speech production is one of the most important goals of cleft palate repair. Innovations in existing surgical repair techniques aim towards improving quality of speech. With advances in objective speech assessment tools, one is able to attribute particular aspects of a surgical technique to improved speech outcomes. This study successfully demonstrated the advantageous effect on speech of the "3rd generation veloplasty'. Results of this study demonstrate that patients are 4.9 times more likely to develop VPI if undergoing first generation techniques versus the 3rd generation veloplasty technique

Table 3: *Relative Risk:Patients are 4.93 times more likely to Develop VPI using First Generation Velo-plasty as Compared to third Generation.*

VPI DEVELOPED GENERATION	YES	NO	TOTAL
First	334	150	484
Third	105	626	731
TOTAL	439	776	1215

This technique is partcularly useful as it can be incorporated into pre-existing palatal repair techniques,

without any added morbidity as it does not sacrifice other anatomically important structures of the palate where important modulations of sounds for speech are made.

Conclusions

The Third Generation Veloplasty concept has allowed us to teach our residents the logical objectives of Soft Palate repair, which are adequate length and motor capacity. This also highlighted the importance of the estafilano uranus muscle in the final part of the palatal lift process.

The Speech Scale proposed by us serves as an auxiliary mechanism to evaluate the effect of the muscular repairing technique.

This technique has provided us with a new way of performing Veloplasty, which can be integrated to any other previous technique. Nevertheless, larger multicentric studies to further evaluate the results of this technique are required.

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