Egypt, J. Plast. Reconstr. Surg., Vol. 46, No. 3, July: 205-210, 2022

Optimizing Design and Mobility of Palatal Flaps in Repair of Wide Cleft Palate

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ABSTRACT

Background: Wide cleft palate is a problem faced by plastic surgeons. Many techniques have been described for cleft palate repair, but not all of them can be used in cases of wide cleft palate. The most common post-operative complication is palatal fistula. Oronasal fistulae causes several problems such as nasal food regurgitation, bad oral odor, hypernasal speech. This study was performed to evaluate two modifications of cleft palate repair techniques aiming to decrease the rate of post-operative fistulae.

Patients and Methods: In this series of cleft palate patients, we used the two flap palatoplasty technique combined with an anterior triangular flap based anteriorly at the cleft margin which is utilized as a turnover flap to decrease tension at the anterior nasal mucosal layer especially in wide clefts. Moreover, in wider clefts modifications such as greater palatine osteotomy and mobilization of the flap pedicles were used to provide more anterior and medial mobility of the flaps and thus decreasing the tension at the suture line in the midline.

Results: The study included 20 patients. Healing of the flap suture lines was uneventful. No complications were recorded.

Conclusion: The two modifications of cleft palate repair help to decrease tension during repair and thus decreasing the incidence of palatal fistulae.

Key Words: *Cleft palate – Fistula – Osteotomy – Greater palatine pedicle – Palatal flaps.*

Disclosures: The authors report there are no competing interests to declare, and no financial support was received by the authors.

INTRODUCTION

Wide cleft palate is a problem faced by plastic surgeons **[1]**. Many techniques have been described for cleft palate repair, but not all of them can be used in cases of wide cleft palate. The most feared problem in case of failure of repair is post-operative palatal fistula which occurs usually due to excessive tension on the repaired palatal tissues or due to other factors such as age of the patient, associated syndromes, operating surgeon experience, bleeding, and infection **[2]**. Although many techniques have been described to treat palatal fistula, but still it constitutes a difficult challenge to treat due to high recurrence rates, limited locally available tissues, fibrosis from the previous palatoplasty operation. Hence, prevention of fistula formation is an integral part of cleft palate management **[3-5]**. Wide cleft palate was defined by Bardach as cleft palate with a distance more than 15mm between the medial borders of palate. On the other hand extremely wide cleft palate means that the defect of the palate is more than 60% of the whole palatine width or if the combined width of both palatal shelves is less than the palatal defect width **[6]**. Oronasal fistulae causes several problems such as nasal food regurgitation, bad oral odor, hypernasal speech **[2]**. The rates of postoperative fistula after palate repair varies in the literature but generally ranges between 3% and 60% **[2,4,7]**. The most common site of oronasal fistulas is between the hard and soft palate and at the anterior part of the cleft. Recently, several modifications of cleft palate repair techniques were developed aiming to decrease the rate of fistulae. Modified Von Langenbeck technique with an anterior triangular oromucosal flap based anteriorly at the cleft margin which is utilized as a turnover flap to facilitate closure and decrease tension at the anterior nasal mucosal layer especially in wide clefts which cannot be closed by the standard Von Langenbeck technique **[7]**. Moreover, the two flap palatoplasty which was described by Bardach also helps to achieve tension free repair to avoid palatal fistulae with modifications such as greater palatine osteotomy and mobilization of the flap pedicles in wide clefts provides more anterior and medial mobility of the flaps and thus decreasing the tension at the suture line in the midline **[4,8]**. The concept

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of greater palatine osteotomy was described by Limberg in 1927. Later Oh and Wong in 2001 described a guarded osteotome to make a fracture of the greater palatine foramen to medialize the greater palatine pedicle and hence the oral mucoperiosteal flap **[1]**.

PATIENTS AND METHODS

Patients:

This study was registered and approved from our institutional medical ethics committee. Written informed consent was taken from all patients' parents included in the study. This study was performed in the period between 2018 and 2021. It included 20 Patients with wide cleft palate. The cases in this series were Veau class II and III. It was used whenever the configuration of the palate (classes II & III) allows the use of this technique.

Methods:

General anesthesia was used with an oral endotracheal tube. Dingman mouth retractor was applied. The patient was positioned supine with the neck fully extended by a head holder and a rolled gown below the child's shoulders. Injection of the palate was done by a solution of saline and epinephrine (1:100,000). Bardach two flap palatoplasty was performed **[6]**. The margin of the cleft was incised more on the oral side to add more tissue to the nasal mucosal layer. The mucoperiosteum at the anterior edge of the cleft palate was incised as a small triangular flap with its apex 5 to 10mm anterior to the anterior cleft margin (Figs. 1,2) **[7]**.

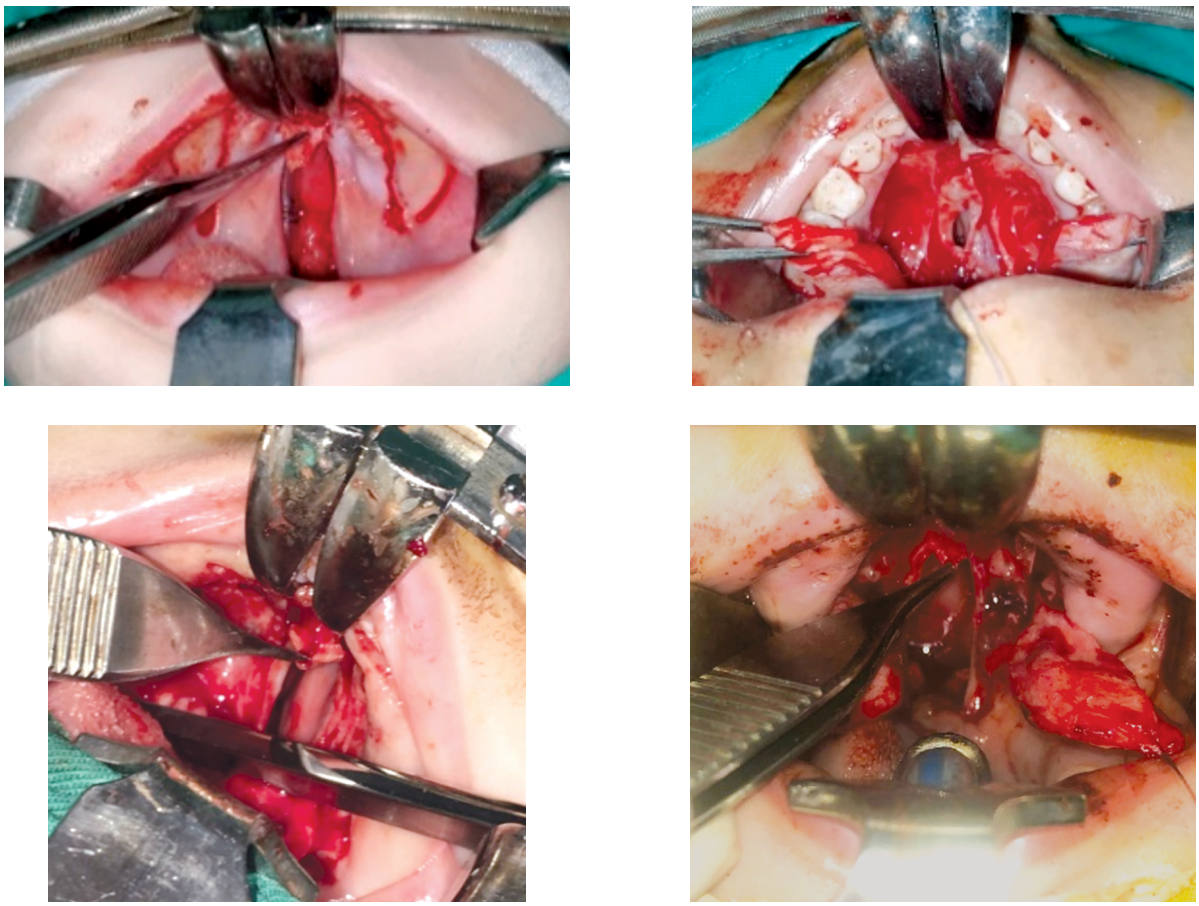

Fig. (1): Showing elevated anterior triangular flap. Upper left: In a 9-month-old cleft palate patient. Upper right: In a 12-month-old cleft palate patient. Lower left: In a 14- month-old cleft palate patient. Lower right: In a 10-month-old cleft palate patient.

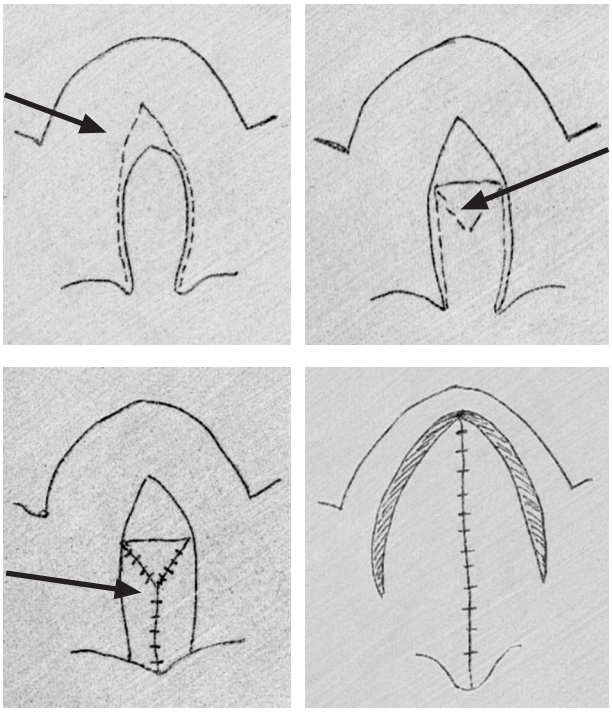

Fig. (2): Diagram of a cleft palate illustrating the steps of the anterior triangular flap technique. Upper left: The dotted line represents the incision on the oral mucosa with anterior extension to elevate the anterior triangular flap. Red arrow pointing at the oral mucosa. Upper right: Showing elevation of the anterior triangular flap as a turnover flap. The red arrow pointing to the reflected oral submucosa. Lower left: Showing suturing of the anterior triangular oromucosal flap to the nasal mucosa. The red arrow pointing to nasal mucosa. Lower right: Showing suturing of the oromucosa.

This flap was used as a turnover flap to achieve tension free closure of the most anterior part of the nasal mucosa which is subsequently covered by the oral mucoperiosteal flaps. The incision continues through the hard palate and soft palate till the uvula. The alveolar cleft margin is incised also till the bone commencing posteriorly behind the maxillary tuberosity and continuing anteriorly till the midline and then backwards till the tip of the triangular turnover flap, followed by elevation of the two oral mucoperiosteal flaps based on the greater palatine arteries. Dissection around the greater palatine pedicle to free them and convert them into flaps which adds to their mobility. Intravelar veloplasty was performed.

If the two oral flaps were not mobilized sufficiently to meet in the midline without tension, medial osteotomy of the canal for greater palatine artery was performed using a 2mm osteotome starting from the medial border of the greater palatine canal towards the cleft margin until the pedicle is medialized sufficiently to allow medialization of the two oral flaps (Fig. 3). The greater palatine foramen osteotomy was used in 60% of the series (12 cases).

Closure of the nasal mucosa layer was done using vicryl 5/0 inverted sutures. The anterior triangular flap was mobilized posteriorly to help decrease the tension anteriorly during nasal layer closure (Fig. 4).

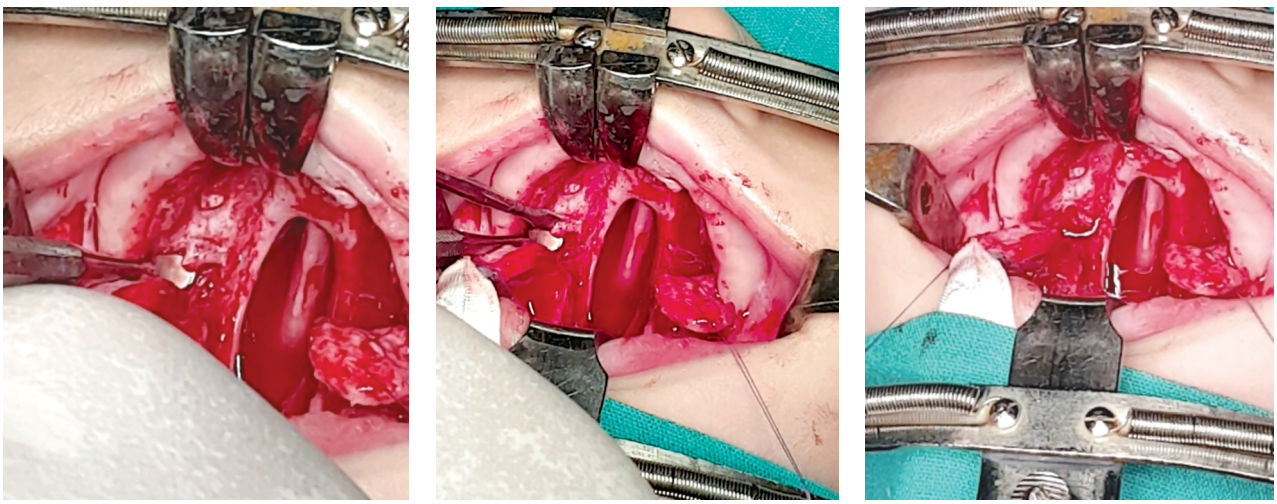

Fig. (3): Left: Showing protecting of the greater palatine pedicle, Middle: Showing osteotomy of the greater palatine canal, Right: Showing the greater palatine pedicle following osteotomy of the greater palatine canal and removal of the bony fragments.

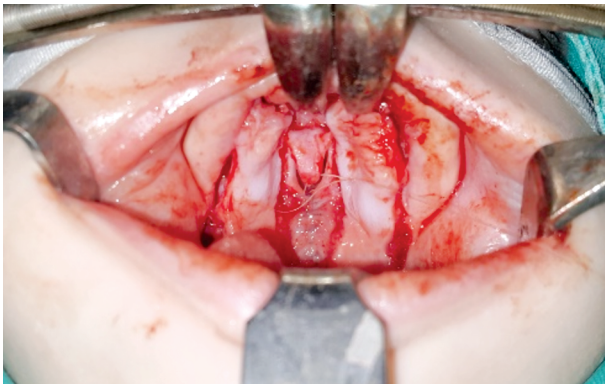

Fig. (4): Showing insetting of the anterior triangular flap.

After the nasal layer was completely closed, the palatine muscles were sutured using vicryl 4/0 simple sutures. Then the two halves of the uvula were sutured by vicryl 6/0 simple sutures followed by closure of the oral layer with vicryl 4/0 mattress sutures posteriorly and vicryl 5/0 simple sutures anteriorly. Tucking sutures by vicryl 6/0 were performed between the two oral flaps and the triangular flap. When feasible the two palatal flaps were sutured anteriorly to teeth mucosa by vicryl 4/0 to decrease the secondary defect after flap mobilization. Surgicel was packed into the lateral defect for hemostasis and to push the oral flaps more medially thus decreasing tension in the midline. Soft diet and fluids were advised in the first two weeks post-operatively with liberal water intake to wash food particles from the suture line.

Patients were assessed in the clinic postoperatively on a weekly basis for the first two months. Patients were followed-up clinically to assess velopharyngeal competence, speech development and to detect any post-operative fistulae for an average period of 12 months.

RESULTS

The study included 20 patients (10 males and 10 females). Their ages ranged from 9 months to 15 months with a mean of 12 months. The follow-up period ranged from 12 to 36 months (mean 15 months). Healing of the flap suture lines was uneventful. No complications were recorded (No fistulae occurred). As for speech outcomes, according to the universal parameters (hypernasality/hyponasality, voice disorders, consonant production errors, audible nasal air emission/turbulence) and global parameters (speech understandability / acceptability), reported by Henningsson et al., all patients showed normal parameters **[9]**.

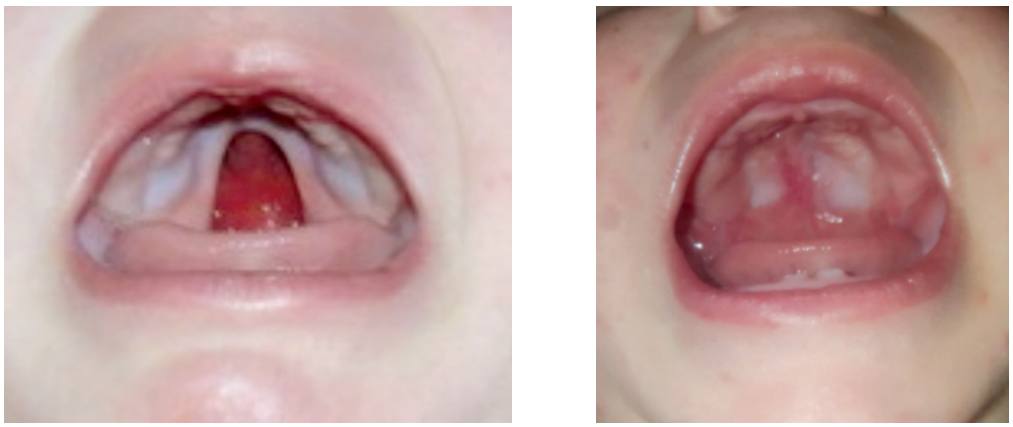

Fig. (5): Left: Showing a pre-operative 9-month-old case, Right: Showing the late post-operative result.

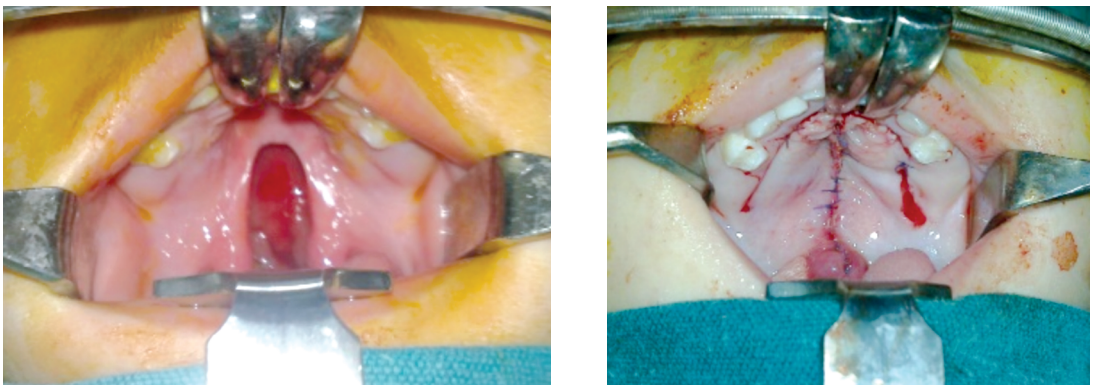

Fig. (6): Left: Showing a pre-operative 12-month-case, right: showing the immediate post-operative result.

Fig. (7): Left: Showing a pre-operative 10-month-case, Right: Showing the early post-operative result.

Fig. (8): Left: Showing a pre-operative 15-month-old case, Right: Showing the late post-operative result.

DISCUSSION

Wide cleft palates constitute a surgical challenge. The traditional techniques may not allow complete palatal closure or may allow closure but cause significant tension at the suture line which results in palatal fistula as a post-operative complication. Hence, a myriad of novel techniques and modifications were proposed to address this problem **[6]**. Oronasal fistulas negatively affects the child's speech and oral hygiene **[5]**. The two flap palatoplasty described by Bardach facilitates separation of the muscle layer accurately from both the oral and nasal layers and allows more medial movement of the oral mucoperiosteal flaps, thus helps in repair of cases of wide cleft palate with diminished fistula occurrence post-operatively **[10]**. This is a review of the Bardach approach with the addition of two steps to reduce initial complications and optimize the results.

Stewart et al., described a modification which specifically decreases the high reported incidence of anterior oronasal fistulae. They added an anterior triangular oral flap combined with the standard Von Langenbeck technique to decrease the tension anteriorly during closure of the nasal mucosal layer especially in wide clefts **[7]**. In this series we combined the Bardach 2 flap palatoplasty with the anterior triangular flap modification. This was sufficient in most of the cases to achieve tension free palatal closure, however in wider clefts we added greater palatine foramen osteotomy to mobilize the flap pedicle more medially and consequently resulting in more medialization of the oral flaps to relieve the tension **[11]**. In our hands and as a continuation of our previous series (900 cases), the technique of 2 flap palatoplasty provided good speech results **[12]**. We believe that the Bardach 2 flap palatoplasty technique is a physiological repair that doesn't transect the muscles, and thus doesn't change the vectors of muscle movement which allows physiological repair of the cleft palate to provide a good functional result.

The average cleft palate width in our series was 12mm (ranging from 9 to 16mm), but usually in cases of cleft palate, there are many variables not only the cleft gap width, but also the width (of the

palatal segments), palate configuration (arching). The combination of the steps can be used in all cases (wide, medium, or narrow defects) to optimize the results. There is diversity in the reporting of what is considered wide cleft palate, but it is logical that the wider the cleft, the more difficult the closure will be and the more will be the possibility of palatal fistula. In our opinion, there is interplay of other factors in addition to the cleft gap width which may affect the difficulty of the palate repair such as the arching and configuration of the palate and palatal width. Moreover, the use of these 2 techniques together with the 2 flap palatoplasty helps to increase the flap mobility whatever the cleft width or configuration of the palate.

Moreover, the anterior triangular flap other than decreasing tension, it helps to decrease fistula formation by providing two diagonal suture lines on the edges of the flap sutured with the nasal mucosa instead of a vertical midline suture line thus decreasing the overlapping of two opposing parallel suture lines (both nasal and oral mucosa) with the possible inflammation that may result from this overlapping. Similarly, it confers another advantage by allowing taking tucking sutures between the oral flaps and the triangular flap, this helps to eliminate dead space formation and thus decreasing fistula formation.

Conclusion:

This modification of the Bardach approach provides an anterior triangular flap which helps to close the nasal mucosal layer at the anterior part of the cleft and decreases the tension at the repair site, hence decreasing the chances of fistula formation especially in wide clefts **[7]**. The technique of greater palatine osteotomy similarly helps to decrease post-operative fistula by mobilizing the oral mucoperiosteal flaps more medially to allow closure without tension **[1]**.

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