Egyptian Journal of Medical Research

Print ISSN: 2682-4396 / Online ISSN: 2682-440X

# Posterior Pharyngeal Wall Augmentation with Fat Graft in Patients having Mild Velopharyngeal Insufficiency

**Mahmoud Hassaan Khalefa [1], Ramez Reda Botros [1], Nora Maher Farah [2]*, Ahmed Ali Abdelmonem [3]**

[1] *Otorhinolaryngology department, Faculty of Medicine, Beni-Suef University, Beni-Suef 62511, Egypt*

[2] *Otorhinolaryngology department, Beni-Suef Specialized hospital, Beni-Suef 62511, Egypt*

[3] *Phoniatrics department, Faculty of Medicine, Beni-Suef University, Beni-Suef 62511, Egypt*

**Article Info**

***Corresponding Author:***
Nora Maher Farah
noramaher43@gmail.com

***Keywords***
Posterior Pharyngeal Wall
Velopharyngeal
Insufficiency
Dermal Fat Graft.

**Abstract**

***Background:*** The velopharynx functional and structural integrity is essential for the production of normal speech resonance. The velopharynx is a dynamic and intricate structure that serves as a barrier between the oral and nasal cavities through the production of sound. Hyper-nasality, nasal escape, and compensatory errors are all consequences of anatomical abnormalities of the velopharyngeal (VP) valve (VP in-sufficiency = VPI), which collectively diminish speech intelligibility. ***Aim of the Work:*** To assess the outcome and the posterior pharyngeal wall augmentation complications the with fat graft in patients having mild VP insufficiency. ***Patients and Methods:*** A single-arm clinical trial was conducted on 20 patients with mild VPI. They were treated with the posterior pharyngeal wall augmentation with autologous fat injection at a tertiary hospital. The study started from December 2022 till March 2024. ***Results:*** There was a significant development in the open nasality degree, consonants imprecision, audible nasal air emission, overall intelligibility, facial grimace, closure of the gap, distorted vowels, A/E and Cold Mirror

tests after the operation in seventeen patients, and three patients did not improve. All patients did not have any complications from the operation. ***Conclusion:*** Our study reported that augmenting the posterior pharyngeal wall with fat graft is effective in the management of hypernasality in mild VP gap patients. This method has a minimal complication rate due to autologous tissue application.

## 1. Introduction:

Inability to close the velopharyngeal (VP) sphincter through phonation and/or swallowing is referred to as VP insufficiency (VPI). This condition may be caused by a large VP gap and/or reduced velum and posterolateral pharyngeal walls muscular contraction. [1]

VPI may be caused by neurological, iatrogenic, or congenital factors. Additionally, VPI is associated with more than 400 recognized syndromes, and a preoperative diagnosis that is accurate is essential for a proper clinical orientation. [2]

VPI is most frequently caused by submucous cleft, cleft palate, velar hemiparesis, velar hypoplasia, post-adenoidectomy, velar paresis or paralysis, and the velar resection results for cancer. [3]

Speech therapy is the initial treatment option for mild VPI; however, surgery may be necessary if there is insufficient improvement. In the literature, various surgical strategies are described, including palatal pushback, sphincter pharyngoplasty, posterior pharyngeal flap, velopharyngoplasty (VPP), and pharyngeal posterior wall augmentation with various fillers types. [2]

In carefully selected patients with VPI who have a small central VP gap, posterior pharyngeal wall augmentation is an effective technique. Various materials can be implanted to fill in the central deficiency, and posterior pharyngeal wall flaps can be used to create a bulk in this region. [4]

Implant materials are available in both autologous and non-autologous varieties. They can be inserted into the posterior pharyngeal wall through an incision or directly injected. Cartilage, fascia, silicone, acellular dermis, fat, polytetrafluoroethylene, and calcium hydroxyapatite have all been previously identified as materials suitable for implantation. [5]

In this study, fat graft was injected in patients of mild VPI aiming to augment the posterior pharyngeal wall and to discuss this augmentation value.

## 2. Patients and Methods:

A single-arm clinical trial was conducted on 20 patients with mild VPI. They were treated with

the posterior pharyngeal wall augmentation with autologous fat injection at a tertiary hospital. The study started from December 2022 till March 2024.

**Ethical considerations:**

Approval of research ethics committee, Faculty of Medicine (approval code: FMBSUREC/ 06112022/Farah). Written consent from the parents of the patient was done. The patients had the right to withdraw from the study at any time.

**Study Population:**

***Inclusion Criteria:***

- Patients having mild degree of VP incompetence, diagnosed by flexible nasopharyngeal examination.
- Long-term speech therapy (at least 1 year) with poor response.
- Age of patients: from 4 to 18 years old.
- VP gap cases ≤25% with a Borel–Maisonny score between ½ and 2/1.

***Exclusion Criteria:***

Patients with the subsequent:

- Contraindication to general anesthesia.
- Mental retardation (IQ < 70).
- Functional nasality.
- Large velo-pharyngeal gap.
- Moderate to severe degree of open nasality.

**Borel–Maisonny score:**

French reading is taught through the Borel-Maisonny phonetic and gestural method, which employs a multisensory approach. It concentrates on the integration of auditory, visual, articulatory, and kinesthetic memories. It was initially created by one of the pioneers of speech therapy in France. The concept is to link each sound with a specific gesture that will facilitate memorization and serve as a connection between the sound and its graphic representation. Six The Borel–Maisonny score was employed to evaluate hypernasality (Table 1). [2]

**Table (1):** Borel–Maisonny score [2]

| Score | Definition |
|---|---|
| 1 | Normal phonation, no nasal air emission |
| 1/2 | Good phonation, intermittent nasal air emission, good intelligibility |
| 2/1 | Phonation with partially corrected nasal air emission |
| 2b | Phonation with continuous nasal emission but good intelligibility and no social discomfort |
| 2m | Phonation with continuous nasal emission and poor intelligibility |
| 2/3 | Phonation with continuous nasal emission with compensatory articulation, poor intelligibility |
| 3 | Continuous compensatory articulation and bad intelligibility |

**Sampling Method:** Convenient.

**Sample Size:** This study included 20 patients with mild VPI

We use Steven K. Thompson equation to calculate the sample size, from the next formule[1]

Priori: Compute required sample size

**Input:** Tail(s) = One

**Tests -** Means: Difference from constant (one sample case)

**Analysis:** A **t** Effect size d = 0.58
α err prob = 0.05
Power (1-β err prob)= 0.80
**Output:**
Noncentrality parameter δ = 2.5938389
Critical t = 1.7291328
Df = 19
***Total sample size = 20***
Actual power = 0.8036942

**Study Tools:**

***All patients were underwent the following:***

- Full history taking.
- ***Complete ENT clinical examination:*** The clinical examination of speech and the video-nasopharyngoscopy. A Phoniatrician conducted the auditory perceptual evaluation of the speech, evaluating spontaneous speech, repetition of sentences, and phonemes to evaluate resonance, audible nasal air escape, turbulence, and articulation defects with intra-rater reliability.

***Auditory perceptual speech assessment:*** Syllables, sentences, automatic speech, and single words comprised the speech sample. It was recorded in high-fidelity audio and subsequently investigated as subsequent:

- Initially, the open nasality degree (graded from 0 to 4, with 0 denoting no hypernasality and 4 denoting the highest degree of hypernasality).
- Secondly, the consonants imprecision (graded from 0 to 4, with 0 representing no consonants imprecision and 4 representing the maximum consonants imprecisions).
- Third, compensatory glottal articulation which means compensatory behaviors secondary to VPI (Graded from 0 to 4, where 0 indicates no glottal articulation and 4 represents the maximum glottal articulation);
- Fourth, fricatives pharyngealization which is defined as an improper articulation whereby a set of consonants is produced with the tongue backing towards the pharyngeal wall. (graded from 0 to 4, where 0 indicates no pharyngealization and 4 represents the maximum pharyngealization);
- Fifth, the audible nasal air emission (graded from 0 to 4, with 0 indicating no audible nasal air emission and 4 indicating the maximum audible nasal air emission);
- Sixth, overall intelligibility (graded from 0 to 4, where 0 represents the lowest intelligibility and 4 represents the highest speech intelligibility); and Seventh, facial grimace (graded from 0 to 4, where 0 represents absence of facial grimace and 4 represents the maximum facial grimace). Simple clinical tests include Gutzman's (A/I) test and Czermark's (cold mirror) test.
- The videonasopharyngoscopy was conducted on all patients using a flexible endoscope. The Karl-Storz 1101RP flexible naso-laryngoscope was employed in younger patients, with a working length of 30 cm and a distal end outer diameter of 3.5 mm. Patients were requwsted to produce the phoneme ‘i’ several times, also (3nnber, Cocacola).
- The following parameters were documented: velar morphology, velar mobility, lateral

pharyngeal wall mobility, type of closure& the gap.

**Grading of velar mobility during phonation:**

- If the velum shows no mobility at all, it will be graded 0.
- It the velar mobility during phonation was less than 50% of VP valve size during respiration, it will be graded I/IV.
- It the velum mobility during phonation was 50% of VP valve size during respiration, it will be graded II/IV.
- It the mobility was more than 50%, it will be graded III/IV.
- If the VP valve was competent during phonation, it will be graded IV/IV.

The same grading was applied to lateral pharyngeal walls mobility.

- The post-operative evaluation was done after 6 months after surgery.

**Surgical treatment:**

- The method was conducted under general anesthesia. Fat was extracted from the abdomen or, in the case of thin patients, from the thigh and gluteal region, following local infiltration with a 2% lidocaine with epinephrine solution.
- A multiple-hole infiltration cannula was employed to infiltrate the anesthetic solution, and a 2mm skin incision was made with an 11-blade (Figure 1).
- A 3mm, fat harvest cannula was utilized to harvest the fat (Figure 2).
- A 5/0 nylon suture was used to close the skin incision. The donor area was covered with surgical dressing.
- Conversion of macro fat to micro fat by using specialized filters (3-way cannula) (Figure 3) which permits having benefits of both fat globules and adipose derived stem cells.
- In order to inject the fat into the posterior pharyngeal wall, which is superficial to the pre-vertebral fascia, the patient was placed in a supine position with the neck hyperextended (Figure 4). A Dingman mouth gag was used to achieve this.
- When it comes to the fat injection into the pharyngeal wall, a fat injection cannula was employed (Figure 5).
- The total injected fat amount ranges from (5 -15ml) until the posterior pharyngeal wall closes the soft palate (we considered that 20% of injected fat will resorb)
- One day following the surgery, all patients were discharged. In each instance, prophylactic antibiotic treatment was implemented (amoxicillin/clavulanic acid, contingent upon the patient's weight).

**Figure (1):** Multiple-hole infiltration cannula for infiltrating the anesthetic solution.

**A**


**B**

**C**

**Figure (2):** Fat harvest technique by using the liposuction cannula.

**Figure (3):** 3-way cannula used for conversion of macro fat to micro fat.

**A**

**B**

**Figure (4):** Fat injection technique (a: Patient in supine position with hyperextended neck, b: fat was injected into the posterior pharyngeal wall).

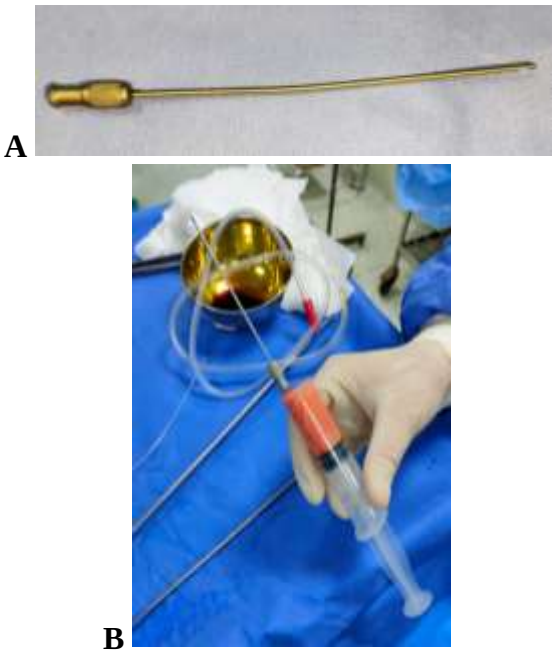

**Figure (5):** a: Fat injection cannula, b: total amount of injected fat).

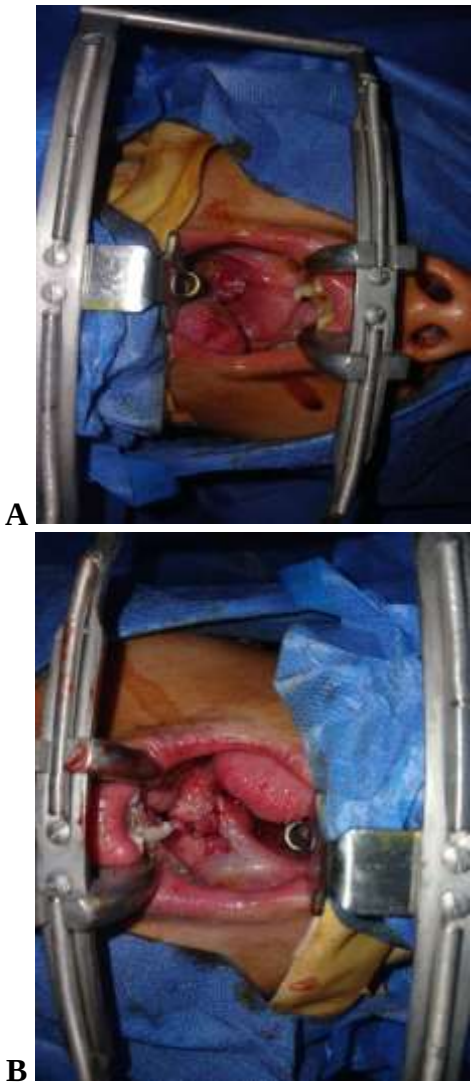

**Figure (6):** A) Pre and B) post-operative injection.

**Statistical Analysis**

All data were revised and validated, and subsequently described and analyzed on an IBM-compatible PC using the SPSS (Statistical Package for the Social Sciences) program version 24.0.0, Microsoft Office Excel 2019, and GraphPad Prism version 6.

All parameters examined in the study group were subjected to descriptive statistics, which were presented as percentages and numbers.

Following up the categorical data was performed using Mc-Nemar/Cochran test when possible.

The following probability (P) values were used to determine the significance level:

- Nonsignificant (NS) is denoted by P>0.05.
- Significance (S) is defined as P < 0.05.
- Highly significant (HS) is indicated by a P-value of < 0.001.

## 3. Results:

The objective of this investigation was to assess the complications and the posterior pharyngeal wall augmentation outcome with dermal fat graft in 20 mild VPI cases.

**Table (2):** Age and sex distribution in the studied patients.

| Items | Values (no=20)<br>No. (%) |
|---|---|
| **Age** | |
| **Mean ± SD** | 9.9 ± 4.5 |
| **Median (min-max)** | 9.5 (4-18) |
| **Sex** | |
| **Females** | 9 (45.0%) |
| **Males** | 11 (55.0%) |

**Table (2)** showed that the mean age of the studied patients was 9.9 years and ranged from 4 to 18 years. 45% of the studied patients were females and 55% were males.

**Table (3):** Nasopharyngeal examination among the studied patients

| Nasopharyngeal examination | Values (no=20)<br>No. (%) |
|---|---|
| **Velar morphology** | |
| **Concave** | 7 (35.0%) |
| **Concave and bifid** | 2 (10.0%) |
| **Convex** | 5 (25.0%) |
| **Flat** | 4 (20.0%) |
| **Short** | 2 (10.0%) |
| **Velar mobility** | |
| **I** | 0 (0.0%) |
| **II** | 8 (40.0%) |
| **III** | 10 (50.0%) |
| **IV** | 2 (10.0%) |
| **Lateral Pharyngeal wall mobility** | |
| **I** | 11 (55.0%) |
| **II** | 8 (40.0%) |
| **III** | 1 (5.0%) |
| **IV** | 0 (0.0%) |
| **Adenoid hypertrophy** | 14 (70.0%) |

Table (3) discussed the velar morphology and showed that 35% of patients were concave, 10% of patients were concave and bifid, 25% of them were convex, and 20% of them were flat. The velar mobility was grade II in 40% of cases, grade III in 50% of cases, and grade IV in 10% of cases. The pharyngeal wall mobility was grade I in 55% of cases, grade II in 40% of cases, and grade III in 5% of cases. There were 70% of cases with adenoid hypertrophy, 57% of them with moderate hypertrophic adenoid and 43% of them with mild hypertrophic adenoid.

**Table (4):** Pattern of closure among the studied patients

| Item | Values (no=20) No. (%) |
|---|---|
| **Velar closure** | |
| **Circular** | 9 (45.0%) |
| **Coronal** | 11 (55.0%) |
| **Sagittal** | 0 (0.0%) |
| **Circular with passavant's ridge** | 0 (0.0%) |

Table (4) showed that the pattern of closure was circular in 45% of cases and coronal in 55% of cases.

**Table (5):** Following up the degree of open nasality among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **Degree of open nasality** | | | |
| **0** | 0 (0.0%) | 10 (50.0%) | < 0.001* |
| **1** | 11 (55.0%) | 8 (40.0%) | |
| **2** | 9 (45.0%) | 2 (10.0%) | |
| **3** | 0 (0.0%) | 0 (0.0%) | |
| **4** | 0 (0.0%) | 0 (0.0%) | |
| **Change of open nasality** | | | |
| **No change** | 3 (15.0%) | | |
| **2 to 1** | 7 (35.0%) | | |
| **1 to 0** | 10 (50.0%) | | |

**P-value is highly significant NB: 4/4 is the worst*

Table (5) indicated a significant enhancement in the open nasality degree after the operation. At baseline, there were 11 patients (55%) with grade 1 and 9 patients (45%) with grade 2. After the operation, ten out of eleven grade 1 patients improved to grade 0 and one patient didn't improve. And seven out of nine grade 2 patients improved to grade 1 and two patients didn't improve.

**Table (6):** Following up the imprecision of consonants among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **Imprecision of consonants** | | | |
| **0** | 6 (30.0%) | 15 (75.0%) | < 0.001* |
| **1** | 10 (50.0%) | 3 (15.0%) | |
| **2** | 4 (20.0%) | 2 (10.0%) | |
| **Change of grades** | | | |
| **No change** | 9 (45.0%) | | |
| **2 to 1** | 2 (10.0%) | | |
| **1 to 0** | 9 (45.0%) | | |

**P-value is highly significant NB: 4/4 is the worst*

Table (6) indicated that there was a significant improvement in the consonants imprecision after the operation. At baseline, there were six patients (30%) with grade 0, ten (50%) patients with grade 1 and four (20%) with grade 2. After the operation, patients with grade 0 (six patients) remained in grade 0. Nine out of ten patients with grade 1 upgraded to grade 0 and 1 patient didn't improve. Two out of four patients with grade 2 upgraded to grade1 and two cases didn't improve.

**N.B:** All cases had no compensatory glottal articulations and pharyngealization of fricatives before and after the operation

**Table (7):** Following up the audible nasal air emission among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **Audible nasal air emission** | | | |
| **0** | 0 (0.0%) | 12 (60.0%) | < 0.001* |
| **1** | 13 (65.0%) | 6 (30.0%) | |
| **2** | 7 (35.0%) | 2 (10.0%) | |
| **Change of grades** | | | |
| **No change** | 3 (15.0%) | | |
| **2 to 1** | 5 (25.0%) | | |
| **1 to 0** | 12 (60.0%) | | |

**P-value is highly significant NB: 4/4 is the worst*

Table (7) showed a significant enhancement in audible nasal air emission after the operation. At baseline, there were thirteen (65%) patients with grade 1. And seven (30%) patients had grade 2. After the operation, twelve out of thirteen patients with grade 1 upgraded to grade 0 and 1 patient didn't improve. Five out of seven patients with grade 2 upgraded to grade 1 and 2 patients didn't improve.

**Table (8):** Following up the overall speech intelligibility among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **Overall intelligibility** | | | |
| **0** | 0 (0.0%) | 0 (0.0%) | < 0.001* |
| **1** | 0 (0.0%) | 0 (0.0%) | |
| **2** | 8 (40.0%) | 2 (10.0%) | |
| **3** | 12 (60.0%) | 7 (35.0%) | |
| **4** | 0 (0.0%) | 11 (55.0%) | |
| **Change of grades** | | | |
| **No change** | 3 (15.0%) | | |
| **2 to 3** | 6 (30.0%) | | |
| **3 to 4** | 11 (55.0%) | | |

**P-value is highly significant NB: 4/4 is the best*

Table (8) indicated that there was a significant improvement in overall intelligibility of speech after the operation. At baseline, there were eight patients (40%) with grade 2 and twelve patients (60%) with grade 3. After the operation, six out of eight patients with grade 2 upgraded to grade 3 and two cases didn't improve. Eleven out of twelve patients with grade 3 upgraded to grade 4 and one didn't improve.

**Table (9):** Following up the facial grimace among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **Facial grimace** | | | |
| **0** | 14 (70.0%) | 18 (90.0%) | 0.125 |
| **1** | 6 (30.0%) | 2 (10.0%) | |
| **Change of grades** | | | |
| **1 to 0** | 6 (30.0%) | | |
| **No changes** | 14 (70.0%) | | |

***NB:*** *4/4 is the worst *P-value is non-significant*

Table (9) indicated statistically insignificant improvement in facial grimace after the operation. At baseline, there were fourteen patients (70%) with grade 0 remained in grade 0 after the operation, six patients (30%) with grade 1 improved into grade 0 after the operation.

**Table (10):** Following up the gap shape among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **Gap shape** | | | |
| **Competent** | 0 (0.0%) | 17 (85.0%) | < 0.001* |
| **Central** | 20 (100.0%) | 3 (15.0%) | |
| **Peripheral** | 0 (0.0%) | 0 (0.0%) | |
| **Gap shape follow up** | | | |
| **Competent velopharyngeal valve** | 17 (85.0%) | | |
| **Small central gap** | 3 (15.0%) | | |

**P-value is highly significant*

Table (10) indicated a significant closure of the gap as in most of cases, the gap disappeared (85%) and in the other cases (15%), the gap was still central but smaller in size (Figure 7).

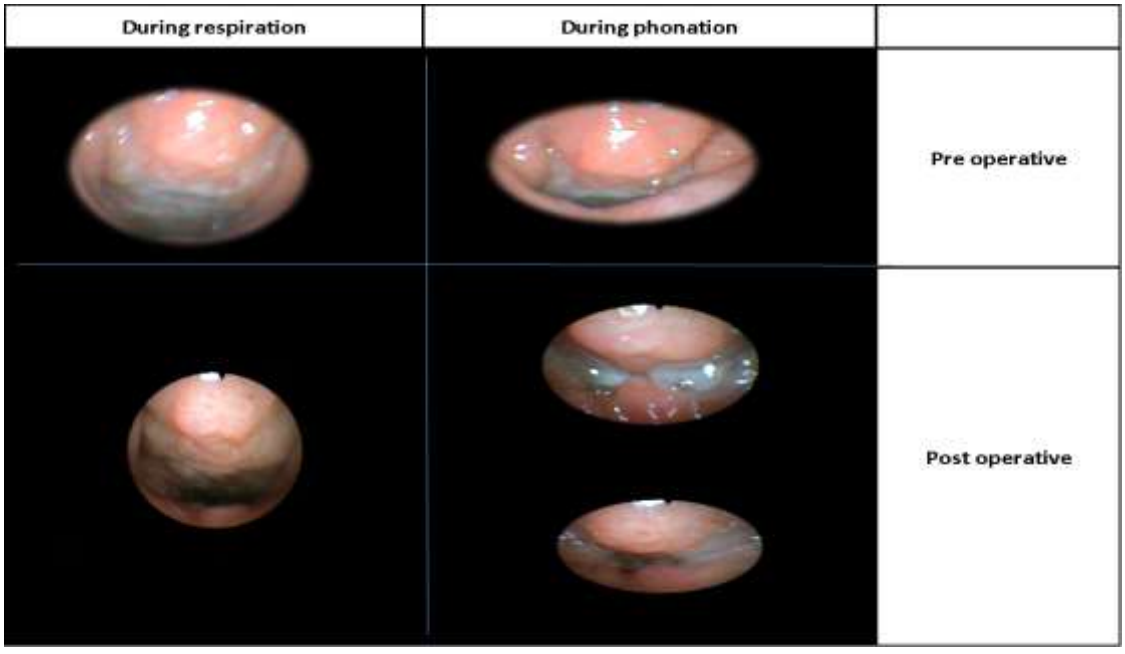


**Figure (7):** Pre and post-operative during respiration and phonation.

**Table (11):** Following up the distorted vowels among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **Distorted vowels** | | | |
| **0** | 0 (0.0%) | 10 (50.0%) | < 0.001* |
| **1** | 11 (55.0%) | 8 (40.0%) | |
| **2** | 9 (45.0%) | 2 (20.0%) | |
| **3** | 0 (0.0%) | 0 (0.0%) | |
| **4** | 0 (0.0%) | 0 (0.0%) | |
| **Change of grades** | | | |
| **No change** | 3 (15.0%) | | |
| **1 to 0** | 10 (50.0%) | | |
| **2 to 1** | 7 (35.0%) | | |

**P-value is highly significant*

Table (11) indicated a significant improvement in distorted vowels after the operation, as ten patients (50%) returned normal, seven patients (35%) improved from grade 2 to grade 1 and only 3 patients remained in grade 1 or 2.

**Table (12):** Following up the A/E and Cold Mirror tests among the studied patients

| Items (no=20) | Pre operative No. (%) | Post operative No. (%) | P-value |
|---|---|---|---|
| **A/E and Cold Mirror** | | | |
| **-ve** | 0 (0.0%) | 17 (85.0%) | < 0.001* |
| **+ve** | 20 (100%) | 3 (15.0%) | |

**P-value is highly significant*

Table (12) indicated a significant improvement in A/E and Cold Mirror tests as all cases were positive before the operation and 17 cases became -ve after the operation.

Finally, all patients did not have any complications from the operation. Seventeen of the patients improved and three of them did not improve, they may need speech therapy for better satisfactory results.

## 4. Discussion:

VPI refers to the velum inability to close completely against the posterior pharyngeal wall through speech. This inability to close completely the VP port could ultimately lead to abnormal resonance, hyper nasal speech, and decreased intelligibility. The degree of hypernasality depends on the VP gap size. VPI remains a common problem in cleft palate patients and other related conditions are be able to persist following primary cleft palate repair. [7]

In the past, VPI treatment has consisted of surgical methods that either extend the soft palate to a more posterior position or bring the posterior pharyngeal wall closer to the palate. This can be accomplished through a variety of techniques, such as palatal pushback procedures, sphincter pharyngoplasty, and pharyngeal flap.

While these surgical methods generally have favorable results in terms of dropping hypernasality and enhancing articulation and resonance, they are invasive and can be associated with risks such as significant bleeding, middle ear disorders, airway compromise, and obstructive sleep apnea. [8]

Injectable or implants materials have been employed as an alternative to more invasive surgical methods for posterior pharyngeal wall augmentation. A variety of artificial and biological materials, including Teflon, petrolatum, paraffin, silicone, Goretex, Proplast porous polyethylene, and calcium hydroxyapatite, have been employed. The implant's propensity to extrude, migrate, or induce a foreign body reaction and generate a granuloma is a significant concern with these alloplastic materials. [2]

Other biologic materials, such as micronized acellular hyaluronan and, dermal matrix have been studied in animal models for posterior pharyngeal augmentation in response to these concerns. The utilization of autologous cartilage can mitigate the complications associated with alloplastic materials; however, it may necessitate costochondral harvest and result in variable resorption. Fat injection has become an increasingly appealing method for enhancing the VP structures as a result of the autologous fat harvest techniques introduction, as assessed by Coleman. [7, 9, 10]

The objective of this investigation was to enhance the posterior pharyngeal wall and to evaluate the efficacy of dermal fat graft injection in VPI patients. The objective of this investigation was to assess the complications and the posterior pharyngeal wall augmentation outcome with dermal fat graft in mild VPI patients.

Twenty patients with mild VPI were involved in this study after the speech therapy failed and the patients showed no response to treatment. Prior to surgery, all patients had a preoperative assessment. The failure of speech therapy can be attributed to a combination of factors, including anatomical defects, structural abnormalities, and neurophysiological disorders. In some cases, the insufficient closure of the velopharynx could be due to a short or abnormal velum, which may not be amenable to correction through speech therapy alone.

In the present study, it was found that the studied patients mean age was 9.9 years and ranged from 4 to 18 years. Less than half of the studied patients were females (45%) and the other were males (55%).

**Abdali and Yaribakht [8]** conducted a pilot study during which 24 patients underwent posterior pharyngeal wall augmentation with dermal fat graft harvested from the low crease abdominal region. The aim of this investigation was to underscore the significance of employing a material that is known for its durability, minimal

complications, and maximum recovery in the correction of VPI. In addition, we implemented evaluative adjuncts, including videofluoroscopy and nasoendoscopy, to assess the surgical results. The results indicated that 41.7% (10 patients) of the 24 patients were male and 58.3% (14 patients) were female. Participants in the investigation were aged 13 to 41, with an average age of 23.4±6.3 years.

A previous study by **Khafagy et al.** [7] evaluated the autologous tragal cartilage graft use for posterior pharyngeal wall augmentation in VPI patients following a simple palatoplasty for cleft palate. In this investigation, approximately eighteen patients (Seven female and 11 male) were diagnosed with VPI subsequent to cleft palate repair. Following surgery, all patients experienced a smooth recovery. Their ages varied from five to fourteen years (mean: 8.61 years).

**Lau et al.** [9] conducted an additional study that involved that three (27%) of the 11 patients included in the study were male and eight (73%) were female. Six patients had never undergone secondary speech surgery, four patients had undergone dynamic sphincter pharyngoplasty (DSP), and one patient had undergone a revision. The prior secondary speech surgery incidence was 46% in patients who underwent palatoplasty prior to fat grafting. The mental ability and hearing of all 11 patients were adequate for their age, and no child necessitated special education.

As mentioned previously, the average patients age f ranges from 4 to 18 years, and this age was preferable as the patients were more cooperative in follow up and evaluation before and after operations.

Our study revealed that about 35% of patients had concave velum shape, 10% of patients were concave bifid, 25% of them were convex, and 20% of them were flat. The velar mobility was grade II in 40% of cases, grade III in 50% of cases, and grade IV in 10% of cases. The pharyngeal wall mobility was grade I in 55% of cases, grade II in 40% of cases, and grade III in 5% of cases. There were 70% of cases with adenoid. Regarding the pattern of closure, about 45% of cases were circular and coronal in 55% of cases.

To achieve satisfactory outcomes, it is essential to exercise caution when selecting patients. The anatomic VP port structures are only slightly enhanced by VP fat injections, which is why severe VPI patients are not eligible for this correction type.

In our study we applied autologous fat injection to the posterior pharyngeal wall, which is a less invasive option for treating VPI, with potential benefits such as simplicity, reduced operation time, and minimal fat site changes. However, the technique may be associated with fat resorption, necessitating potential repeated injections, and the choice of injection site can impact outcomes and complications. Autologous fat transfer has been shown to

improve speech resonance and reduce nasal air escape in VPI, offering an alternative to more invasive procedures like VPP for mild cases.

A 111 patients' retrospective analysis who underwent posterior pharyngeal augmentation over a 40-year period was conducted by **Lypka et al.** [10], which is the largest study to date. They implemented a variety of implants, including Gore Tex blocks and textured silicone pillows. Only one patient received rib cartilage. They determined that posterior pharyngeal augmentation is an effective and safe treatment for VPI patients. They reported that all implants were well-tolerated and that speech had significantly developed. **Denny et al.** [11] indicated an 80% development in speech intelligibility in twenty children who underwent autologous costal cartilage implantation. They detected that cartilage was not squeeze out when costal cartilage was employed to augment the posterior pharyngeal wall in children.

In our study, the total injected fat amount ranged from 5 to 15 mL until the posterior pharyngeal wall closes the soft palate (we considered that 45% of injected fats will resorb) Meanwhile, an average of 13.1 mL of autologous fat was injected in **Lau et al.** [9] study with range 5-22 mL. Additionally, **Panizza et al.** [2] injected about 6 cc – 12 cc of fats. The amount of injected fat depends on the anatomic individual patient condition.

In the present study we followed our patients for at least 6 months by repeating flexible video-naso-endoscopy 2 weeks, 6 months. **Abdali and Yaribakht** [8] followed their patients' sixth-month visit. **Denny et al.** [11] followed their patients for two months. **Trigos et al.** [12] followed up his patients for one year.

It's worth noting that postoperative follow up for a period of at least 6 months is important to ensure that there's no migration of the injected fat, keeping in mind that 45% of the injected fat usually absorbed during first three months (mainly during first month) upon healing of fat graft. In the present study, it was found that there was a significant improvement in the open nasality degree, consonants imprecision, audible nasal air emission, overall intelligibility, nasal grimace, closure of the gap as in seventeen out of twenty patients, distorted vowels, A/E and Cold Mirror tests.

**Abdali and Yaribakht** [8] emphasized that the mean preoperative VP gap sizes were 8.38±1.84 mm at rest and 4.08±0.93 mm during activity (phonation). A statistically significant difference was indicated between postoperative and preoperative values (Gap size at rest and activity and VP closure ratio; $p < 0.0001$) as idetified by the Wilcoxon signed rank test. Nasality degree, nasal emission, and nasal grimace were the categories into which the speech evaluation data was divided. Hyponasality was not observed in any of the patients prior to or following the surgery. In a previous study, hypernasality severity was rated on a scale of 2 to 5, with 2 denoting no hypernasality, 3 denoting mild

hypernasality, 4 denoting moderate hypernasality, and 5 denoting severe hypernasality. Nasal emission was rated on a scale of 1 to 3, with 1 denoting absence, 2 denoting occasionality, and 3 denoting frequentity. Nasal grimace was classified as either absent (=0) or present (=1). The statistical significance of nasal emission and nasality was determined using the Wilcoxon signed rank test, while the McNemar test was employed to assess nasal grimace data.

**Khafagy et al. [7]** discovered that one patient had grade III, twelve had grade II, and ten patients had grade I VP valve closure during preoperative assessment with fiberoptic nasopharynx-goscopy. Postoperatively, four patients (40%) with preoperative grade I changed to grade II, one patient (25%) upgraded by two degrees to grade III, and five patients (50%) did not progress. Five patients (41.7%) were upgraded to grade III, and three (25%), to grade IV, in relation to patients with grade II VPI. Additionally, the patient with grade III VPI experienced an improvement to grade IV. These statistically significant changes in the VP valve closure degree following surgery (P-value 0.009). In preoperative speech intelligibility terms, thirteen had poor speech, nine patients had unintelligible speech, and one had fair speech. Speech therapy was administered to all patients subsequent to posterior wall augmentation with tragal cartilage. Next, the speech intelligibility test indicated that five had good speech intelligibility, four patients had fair speech intelligibility, and two had excellent speech intelligibility. Regrettably, two patients continued to exhibit speech that was unintelligible. The statistical significance of the postoperative enhancement in speech intelligibility was high (P<0.005%).

**Khafagy et al. [7]** discovered that 13 patients had grades 2 and five had grades 3 VPI when the VP valve closure degree was assessed preoperatively with fiberoptic nasopharynx-goscopy. The grades of three patients with grade 2 and two patients with grade 3 remained unchanged. Preoperatively, sixteen of the 18 patients exhibited poor speech intelligibility, while only one patient continued to experience poor intelligibility postoperatively. Statistically significant enhancement in speech intelligibility and grade of closure was observed postoperatively (P=0.001).

In the present study, it was found that all patients did not have any complications after the operation (obstructive sleep apnea and\ or bleeding) except for only having snoring due to postoperative edema which is temporary and disappears within 7 days. Seventeen of the patients improved and three of them did not improve. We did not observe any recurrent cases, or fat changes (loss or size change).

**Abdali and Yaribakht [8]** demonstrated that cases were assessed for early (acute) complications through the initial postoperative week. A single instance of minor bleeding

transpired four hours subsequent to the surgery. The bleeding ceased following the administration of humidified oxygen and pain control. One of their patients developed sleep apnea. They observed that the patient's neck circumference was 40 cm after reviewing the patient data. Two patients experienced severe pharyngeal pain at the surgery site (VAS scores: 7 and 8). One patient experienced the pain for 4-5 days, while the other patient experienced it for only 2 days. Upon examination of these two patients, they did not detect any apparent pharyngeal issues, including infection, wound dehiscence, or hematoma. Two patients experienced otalgia on the left side. Oral analgesics, decongestants, and hydration alleviated the otalgia, which persisted for approximately five days. Their examination of the tympanic membrane revealed hyperemic tympani.

They believed that otalgia was the inflammation and edema result that extended from the posterior pharyngeal incision site to the eustachian tube.. The most common complication in the first week following surgery was snoring. Snoring was observed in five patients, and it persisted for an average of three months. One patient continued to snore during the sixth month of the visit. [8] Especially when the velopharynx is manipulated or any constriction is applied in that region, snoring is a common occurrence during all pharyngeal surgeries. In two instances, they disclosed that dermal fat grafts were absorbed. Direct examination does not readily reveal graft absorption, as the incision and graft insertion sites are situated in the uppermost region of the posterior pharynx, mere millimeters below the adenoid site. Nevertheless, graft resorption was readily apparent during the nasoendoscopy evaluation. [8]

**Panizza et al.** [2] demonstrated that there were no significant complications, including embolism, infection, obstructive sleep apnea, and bleeding. The majority of patients reported mild pain in the neck region and at the fat harvesting site following the surgery. The pain was alleviated in all of these patients by administering acetaminophen intravenously in accordance with their weight. The harvesting site was uncomplicated, and there were no complaints about the scars.

Nevertheless, **Khafagy et al.** [7] did not report any clinically significant complications, including migration, displacement, or resorption. Obstructive sleep apnea is a substantial pharyngeal flaps technique complication, as detected by **Orr et al.** [13] and **Sirois et al.** [14] in 90% and 35% of cases, respectively. In addition, **Witt et al.** [15] determined that eight patients (13.9%) experienced postoperative airway dysfunction in 58 cases who underwent sphincter pharyngoplasty. In contrast, posterior wall augmentation was not frequently associated with this severe complication.

In the study conducted by **Williams et al.** [16], obstructive sleep apnea was only reported in one

patient (2.8%) who underwent posterior wall augmentation with Teflon injections.

Later, **Lypka et al.** [10] indicated only one patient (0.9%) with sleep apnea in a more extensive study that utilized five distinct implant materials. In posterior wall augmentation, the incidence of sleep apnea is low due to the physiological repair of VPI. The pharyngeal flaps increase static nasal airway obturation, and the velar muscle's function becomes less significant. It is important to note that none of the cases experienced postoperative airway obstruction or sleep apnea.

However, **Trigos et al.** [12] reported that VP closure was not impacted by minimal graft migration in cases after follow-up one year, despite the clinically other graft complications presence for example; displacement, resorption, or migration. From the studies above and comparing with our data there was an obvious improvement in most patients despite 3 of them did not improve There are several reasons for this phenomenon among those three patients such as fat resorption, displacement, migration, rapid absorption, or VP closure was influenced in spite of minimal graft migration in cases. The primary disadvantage of lipofilling is the resorption of fat. Fat resorption rates were reported in the literature to range from 50% to 90% for experimental evaluations and from 30% to 80% for clinical evaluations. [17]

Nevertheless, in patients with VPI, an overcorrection may be counterproductive and may result in obstructive sleep apnea. [18]

## 5. Conclusion and Recommendations:

***Conclusion:***

Our study reported that augmenting the posterior pharyngeal wall with fat graft is efficient in advancing hyper nasality in mild VP gap cases, and mild degree of open nasality. The application of autologous tissue results in a minimal complication rate for this method.

Limitations: the small number of patients, comparative group lack, and it was a single center one.

***Recommendations:***

- Provide a larger sample size with multicenter cooperation to validate our results.
- Provide a long follow up period.
- Dermal Fat Graft Posterior Pharyngeal Wall Augmentation is a promising and effective treatment for VPI.
- Speech therapy is recommended for patients who have not improved.

## 6. References:

1. Nam, M. (2018): Surgical treatment of velopharyngeal insufficiency. Archives of Craniofacial Surgery, 19(3), 163-178.
2. Panizza, R., Ghiglione, M., Zingarelli, M., Massa, M., Carlini, C., Arnoldi, R., Prato, P., Scarrone, S. & Vaccarella, F. (2018):

Autologous fat grafting in the treatment of velopharyngeal insufficiency: Clinical outcomes and treatment tolerability survey in a case series of 21 patients. Indian journal of plastic surgery: official publication of the Association of Plastic Surgeons of India, 51(2), 145–154.

3. Sweeney, M., Lanier, T., Purnell, A. & Gosain, K. (2015): Genetics of cleft palate and velopharyngeal insufficiency. Journal of pediatric genetics, 4(01), 9-16.
4. Perez, F. & Brigger, T. (2015): Posterior pharyngeal wall augmentation', in Surgery for Pediatric Velopharyngeal Insufficiency. Karger Publishers, 74-80.
5. Raposo-Amaral, A., Monte, M. & Raposo-Amaral, E. (2023): Treatment of Velopharyngeal Insufficiency via Bilateral Myomucosal Buccinator Flaps. Plastic and Reconstructive Surgery, 1084-1097.
6. Gardiol, S. (1984): The Problem of the Dyslexic Child in a Foreign Language Programme. The International Schools Journal, 1, 68-76.
7. Khafagy, G., Kassamy, H. & Mohamed, A. (2021): Augmentation of the posterior pharyngeal wall with autologous tragal cartilage for management of velopharyngeal valve insufficiency in adults. Auris Nasus Larynx, 48, 428-33.
8. Abdali, H. & Yaribakht, M. (2019): Assessment of outcomes and complications of posterior pharyngeal wall augmentation with dermal fat graft in patients with Velopharyngeal Insufficiency (VPI) after primary cleft palate repair: A pilot study. JPRAS open, 19, 6-18.
9. Lau, D., Oppenheimer, J., Buchman, R., Berger, M. & Kasten, J. (2013): Posterior pharyngeal fat grafting for velopharyngeal insufficiency. Cleft Palate Craniofac J, 50, 51-8.
10. Lypka, M., Bidros, R., Rizvi, M., Gaon, M., Rubenstein, A., Fox, D. & Cronin, E. (2010): Posterior pharyngeal augmentation in the treatment of velopharyngeal insufficiency: a 40-year experience. Annals of plastic surgery, 65(1), 48-51.
11. Denny, D., Marks, M. & Oliff-Carneol, S. (1993): Correction of velopharyngeal insufficiency by pharyngeal augmentation using autologous cartilage: a preliminary report. Cleft Palate Craniofac J, 30, 46-54.
12. Trigos, I., Ysunza, A., Gonzalez, A. & Vazquez, M. (1988): Surgical treatment of borderline velopharyngeal insufficiency using homologous cartilage implantation with videonasopharyngoscopic monitoring. Cleft Palate Craniofac J, 25, 167-70.
13. Orr, C., Levine, S. & Buchanan, T. (1987): Effect of cleft palate repair and pharyngeal flap surgery on upper airway obstruction

during sleep. Plast Reconst Surg, 80, 226-30.

14. Sirois, M., Caouette-Laberge, L., Spier, S., Larocque, Y. & Egerszegi, P. (1994): Sleep apnea following a pharyngeal flap: a feared complication. Plast Reconst Surg, 93, 943-7.
15. Witt, D. (2022): Sphincter Pharyngoplasty. In Surgical Atlas of Cleft Palate and Palatal Fistulae. Singapore: Springer Nature Singapore, 21, 393-401.
16. Williams, W., Eisenbach, C. & Bzoch, K. (1982): A long term study on treating velopharyngeal insufficiency by Teflon injection. Cleft Palate Craniofac J, 19, 47-56.
17. Quoc, H., Taupin, T., Guérin, N. & Delay, E. (2015): Volumetric evaluation of fat resorption after breast lipofilling. Annales de Chirurgie Plastique Esthétique. Elsevier, 495-499.
18. Teixeira, P., Reid, A. & Greensmith, A. (2011): Fatty hypertrophy cause obstructive sleep apnea after fat injection for velopharyngeal incompetence. The Cleft palate-craniofacial journal, 48, 473-477.