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Barbed Functional Expansion Pharyngoplasty

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Abstract

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The role of lateral pharyngeal wall in the pathogenesis of obstructive sleep apnea has been demonstrated by DISE. The evolution regarding the techniques of pharyngoplasty has been focused on the concept of obtaining the expansion and stabilization of the pharyngeal airspace through the treatment of lateral pharyngeal wall collapse. The use of knotless barbed sutures has been recently described in oropharyngeal surgery to improve the biomechanical effect of sutures on tissue collapse with positive surgical outcomes. The BFEP technique is a technical update of classic FEP characterized by easier learning curve, less operation time, and AQ1 rare complications due to a better closure of tonsillar fossa.

Keywords

Lateral pharyngoplasty
Expansion pharyngoplasty
Obstructive sleep apnea
Outcome
Palato-pharyngeus muscle
Barbed sutures

32.1. Introduction

Obstructive sleep apnea (OSA) results AQ2 from the collapse of the pharyngeal airway during sleep. The etiology and

mechanism of collapse are multi-factorial but are mainly due to the interaction of an easily collapsible upper airway (UA) with the relaxation of the pharyngeal dilator muscles which happens during sleep [1,2]. Moreover, OSA can be related to anatomic abnormalities causing UA narrowing [3]. Drug-induced sleep endoscopy (DISE) has become popular worldwide as the preferred diagnostic tool to assess the UA while sleeping, revealing the key role of the lateral pharyngeal wall (LPW) collapse in the pathogenesis of OSA [4,5,6,7,8].

Accordingly, new surgical techniques in which the LPW is specifically addressed have been reported since 2003, when Cahali published first lateral pharyngoplasty technique based on sectioning of the superior pharyngeal constrictor muscle [9].

In 2007, Pang and T. Woodson [10] described an innovative technique (ESP) for creating tension in the LPW and widening retro-palatal diameters. The key point of this technique is the rotation and anchorage of the palate-pharyngeus muscle (PPM) to some steady holds such as the pterygoid hamulus (PH) and pterygo-mandibular raphe (PMR). These anatomical structures represent a stiff support which provides the high tensile strength required to suspend the PPM and to prevent collapse of the UA.

In 2012 [11], we described a modified ESP technique (Functional Expansion Pharyngoplasty—FEP) that represents a less aggressive and more “physiologic” approach to the LPW and soft palate to both increase pharyngeal airspace and decrease pharyngeal collapse, without undermining velum muscles, and in doing so avoiding scarring of the velum and uvulectomy.

To improve the biomechanical effect of sutures on tissue collapse, the use of knotless barbed sutures, extensively used in plastic surgery, has been recently described in sleep apnea surgery.

Several types of barbed threads are available commercially, each of which has unique feature and insertion technique. We first introduce the use of unidirectional barbed sutures for lateral pharyngoplasty [12]. This technique is a new simple variant of our FEP technique.

32.2. Surgical Technique

Surgery is performed under general anesthesia with oral endotracheal intubation. The patient is placed in a supine position with the head extended and a mouth gag is then used to adequately expose the oropharynx.

The first step is bilateral tonsillectomy with identification and meticulous sparing of the palato-pharyngeus muscles (PPM). The PPM is isolated from the mucosa and superior pharyngeus constrictor (SPC) muscle and transected in the midpoint of the tonsillar fossa, creating a muscle flap with superior and medial pedicle. The posterior surface of the cranial portion of the PPM is partially left attached to the SPC.

By means of unidirectional barbed sutures, the needle is introduced in the maxillary tuberosity turning around the pterygoid hamulus [13] (PH) (Fig. 32.1) and performing a U-shaped stitch engaging the terminal loop of the thread (Fig. 32.2). The needle is then inserted downwards and laterally to the pterygo-mandibular raphe (PMR). Once the needle reached the apex of the tonsillar fossa (Fig. 32.3), it was driven through the PPM flap (Fig. 32.4). This stitch is repeated at least three times by different directions. The needle is reinserted through the flap and directed laterally to the PMR (Fig. 32.5). Applying the right amount of tension to the wire pulls the flap upwards and laterally, increasing the oropharynx diameters as well as the soft palate stiffness. Afterwards, the needle is introduced laterally to the PMR piercing through the posterior tonsillar pillar (Fig. 32.6). Finally, the suture grasps and suspends the posterior pillar and returns back in a point laterally to the PMR (Fig. 32.7). Based on appropriate tension of the suture, complete or partial closure of the tonsillar fossa can be obtained minimizing the risk of bleeding and wound dehiscence. In the last step, the thread is locked around the maxillary tuberosity periosteum (Fig. 32.8). The barbed wire is pulled and cut close to the mucosa without the need for any knot.

Fig. 32.1

The needle is introduced in the maxillary tuberosity turning around the pterygoid hamulus

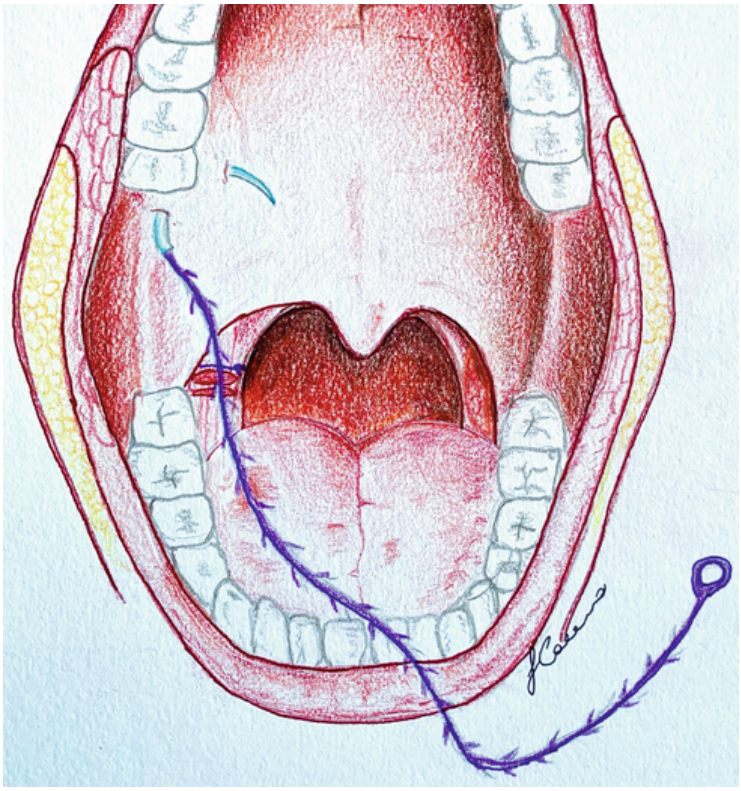


Fig. 32.2

The needle performs a U-shaped stitch engaging the terminal loop of the thread

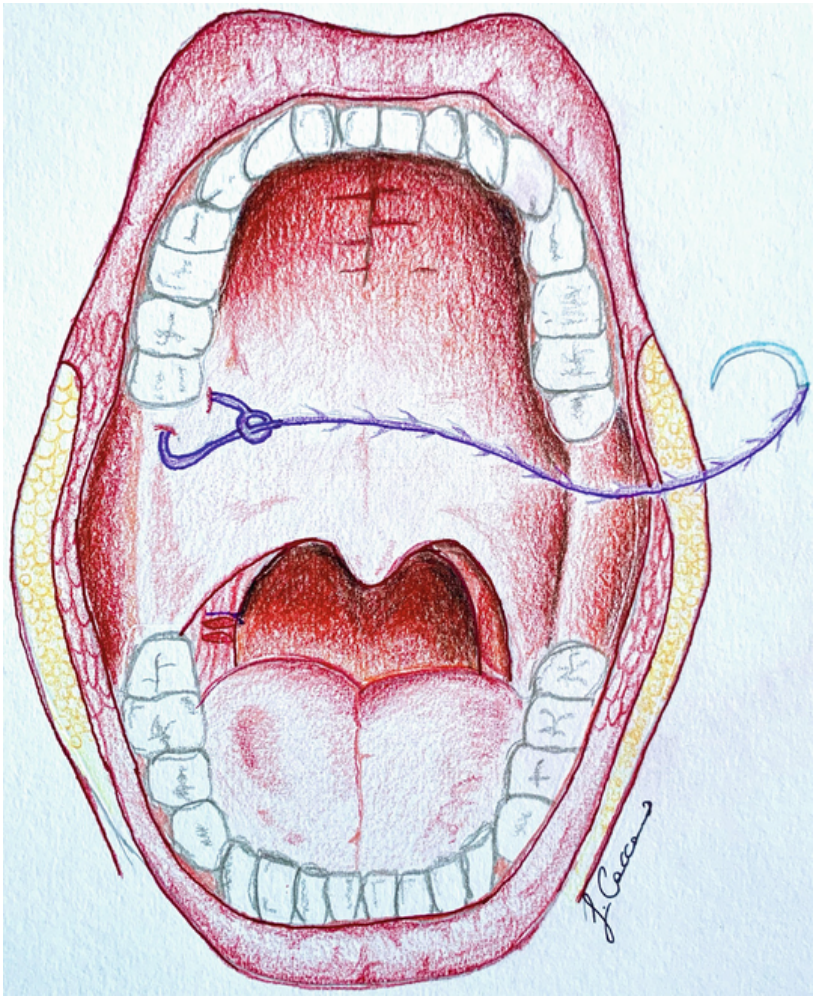


Fig. 32.3

The needle is inserted downwards and laterally to the pterygomandibular raphe reaching the apex of the tonsillar fossa

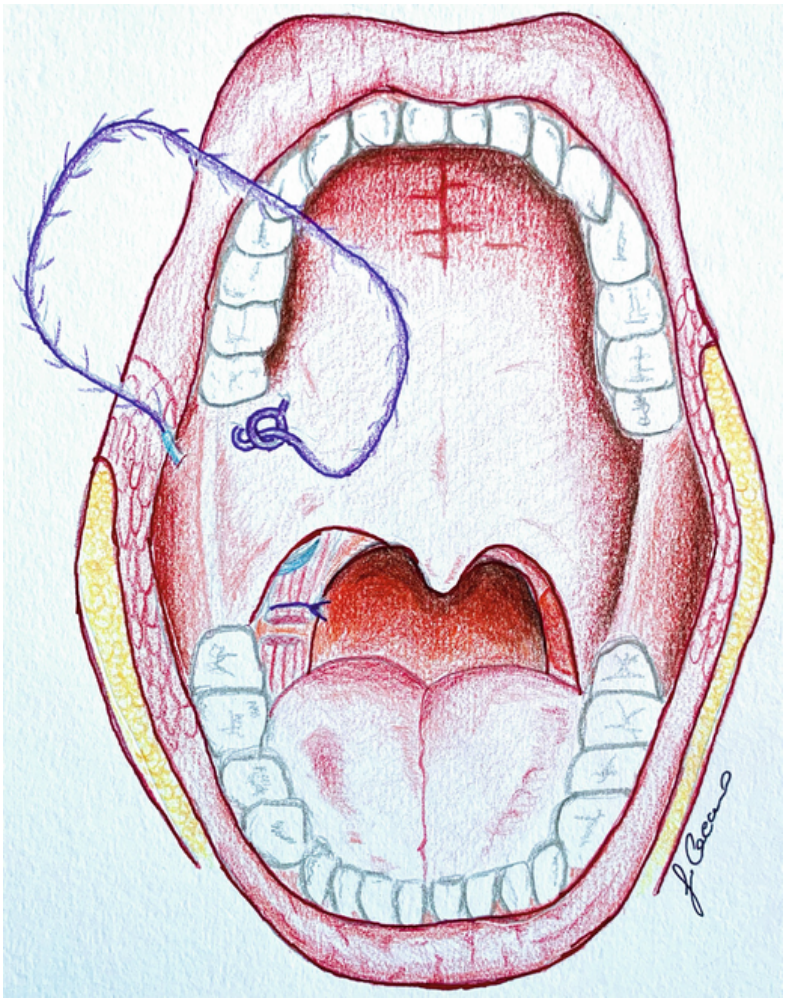
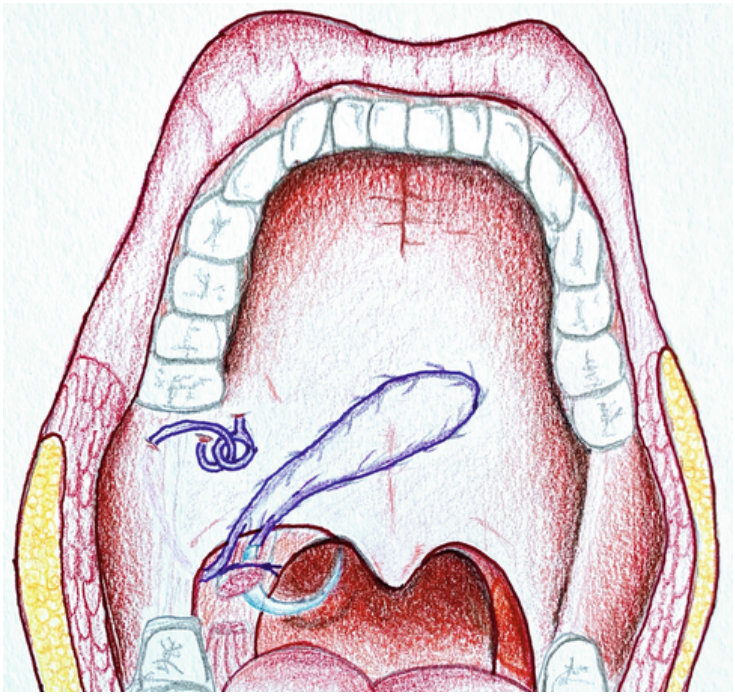


Fig. 32.4

The PPM flap is engaged by the needle for three times in different directions



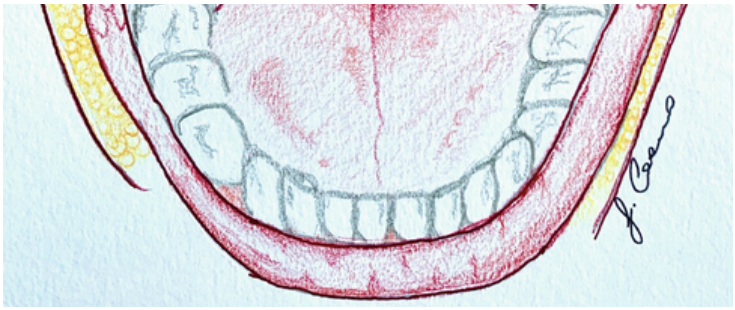


Fig. 32.5

The needle is reinserted through the flap and directed laterally to the pterygomandibular raphe

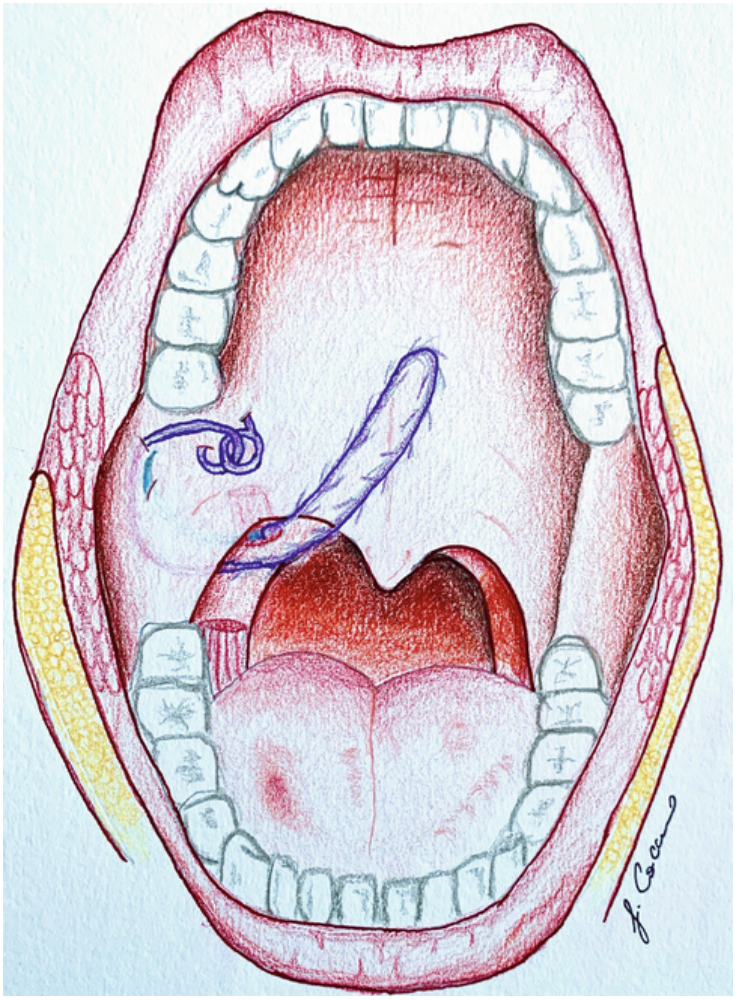
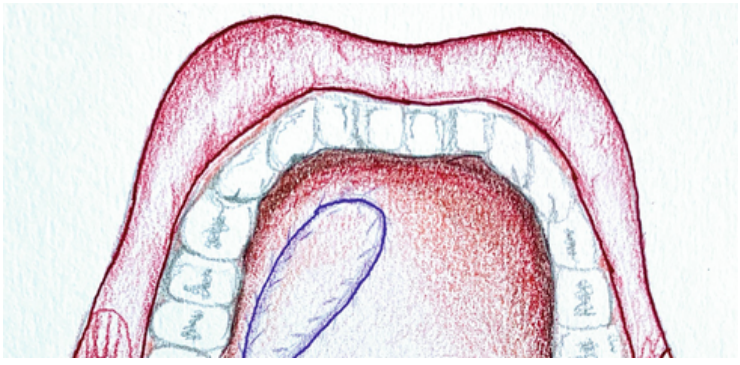


Fig. 32.6

The needle is reintroduced laterally to the pterygomandibular raphe reaching the apex of the tonsillar fossa



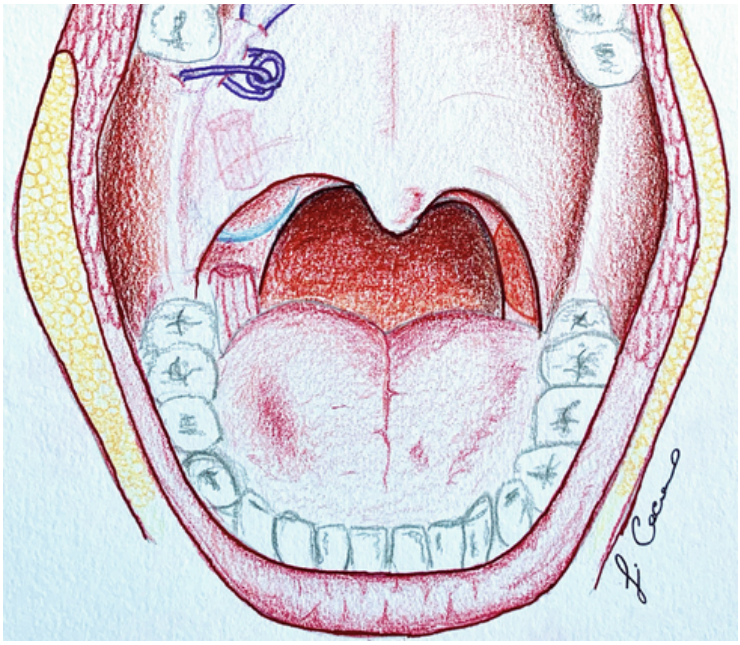


Fig. 32.7

The needle with a U-shaped stich grasps and suspends the posterior pillar and returns back

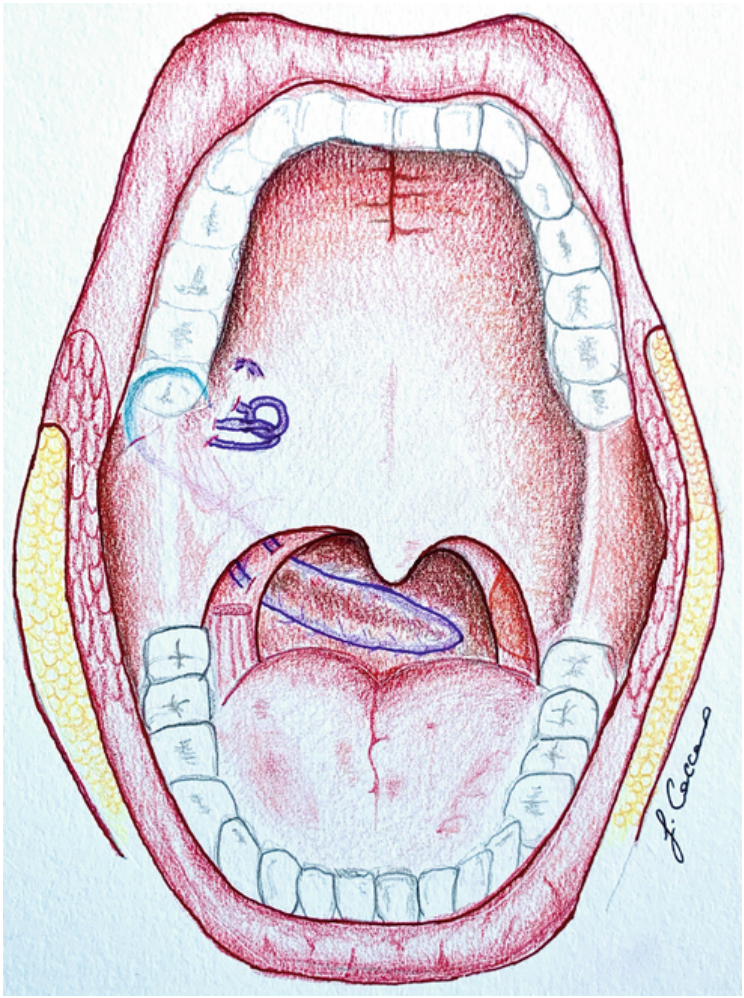
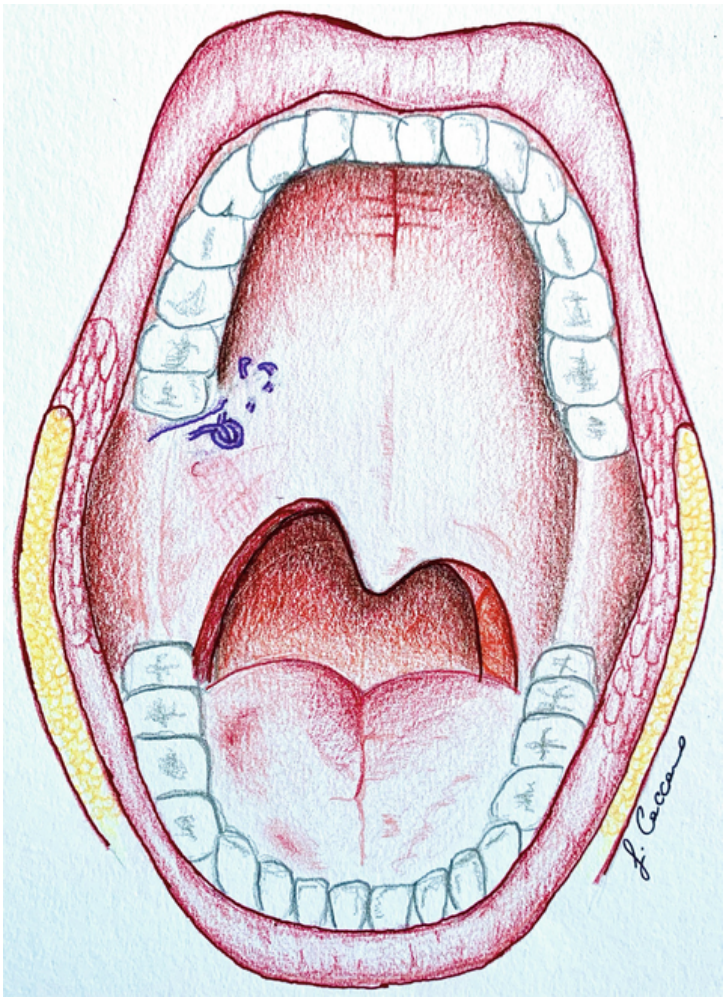


Fig. 32.8

The thread is locked around the pterygoid hamulus with a supero-lateral widening of oropharyngeal space and closure of the tonsillar fossa



Operation time is about 40 min.

Several types of barbed threads are available commercially, each of which has unique feature and insertion technique.

For this technique we use a unidirectional barbed absorbable suture with a terminal loop (V-Loc™ 90 2.0, Covidien Healthcare, Mansfield, MA). The V-Loc suture is characterized by unidirectional shallow barbs with circumferential distribution. Its dual angle barbs allow stronger anchoring force and higher maximum load compared to other barbed sutures and the shallow cut-depth preserves the integrity of the strand's strength over time. This thread generally undergoes complete absorption 90–110 days after surgery.

32.3. Indications

In our protocol, the surgery originates from a diagnostic workup completed by DISE. We currently see an indication for barbed FEP in case of single clinically significant (>75%) oropharyngeal airway obstruction related to lateral wall collapse as assessed by sleep endoscopy, no craniofacial anomalies and morbid obesity (BMI > 40).

32.4. Postoperative Care

The patients can start a soft oral diet on the first postoperative day and a normal diet after 10–15 days. Postoperative paracetamol plus codeine may be useful for analgesia after surgery.

To prevent infections, we recommend antibiotic therapy for 5–7 days (i.e., amoxicillin clavulanate). In some cases, corticosteroids are needed to reduce postoperative swelling.

32.5. Complications

We did not observe serious complications related to this surgery. No cases of suture dehiscence were observed. No dysphagia or swallowing disturbances were referred at long-term follow-up.

Some patients reported dry mouth and globus sensation, but those complaints had subsided by 1 month. Postoperative bleeding was rare (2.2%).

32.6. Surgical Outcomes

We treated 90 patients (male-female ratio: 84–6) with a mean age of 46.9 (range: 20.0–71.0) years and mean body mass index of 28.5 (range 22.6–35.0) Kg/m^2. Twenty-six (28.9%) patients had moderate OSAS and 64 (71.1%) had severe OSAS, while 80% of patients had small tonsils (grade 1 or 2 according to Brodsky score). In all cases, the site and pattern of collapse was assessed by DISE and scored using the VOTE classification.

Success criteria were defined as 50% reduction in apnea–hypopnea index (AHI) and an AHI less than 20/h [14]. A total of 68 patients (75.6%) met the surgical success criteria. The mean AHI decreased significantly from 42.6/h (± 19.2) to 11.6/h (± 10.4)—(mean difference, 31.1; 95% CI, 27.3–34.8; $p < 0.001$). Also, the PSG oximetry parameters improved significantly. The mean lowest O_2 saturation ($LsatO_2$) increased from 79.0% to 86.2% (mean difference, −7.1; 95% CI, −8.8/−5.4; $p < 0.001$) while the mean time with oxygen saturation <90% decreases from 12.8% to 2.9% (mean difference, 9.9; 95% CI 6.7–13.0; $p < 0.001$). Excessive daytime somnolence also improved after surgery, with ESS decreased from 9.9 to 4.7 (mean difference, 4.7; 95% CI 3.8–5.5; $p < 0.001$).

To determine predictors of surgical success clinical parameters (BMI, neck circumference, MPH, ESS), DISE findings and polysomnographic data were analyzed.

Multivariate analysis showed that lateral pharyngeal wall collapse, as assessed by DISE, was the only significant predictor of positive response to surgery ($p < 0.001$). Considering patients with isolated velo-oropharyngeal obstruction, the success rates grow up from 75.6% to 89.5%. In contrast, retro-palatal complete concentric obstruction and multilevel collapse was associated with poor outcome ($p < 0.001$) and only 50% of patients meet booth success criteria. All other parameters have no predictive value, although we noticed that lower MPH value had a positive trend associated with a good surgical success without achieving statistical significance ($p < 0.07$). In conclusion, DISE is a useful tool for predicting success rate of pharyngeal surgery and to select patient's candidate to combined treatment.

32.7. Concluding Remarks

This technique is a new simple variant of FEP described in 2012. The operation consists of barbed sutures inserted through the fibromuscular soft palate tissue in such a way that they lift and stiffen the excessively collapsing structures [15]. The threads are suspended to specific fibro-osseous anchor points which provide the high tensile strength required to suspend the soft tissue and to prevent collapse [16, 17]. After gradual resorption of the barbed threads, collagen synthesis is continuously stimulated, leading to the formation of scar tissue that will further contribute to the retraction and maintenance of the soft palate tissue in the desired position. Furthermore, considering that in palate surgery completeness of suturing is very important to reduce the risk of dehiscence, barbed sutures offer reduction of bulk at the repair sites without redundant knots as a potential weak point. The minimal required manipulations and the knotless technique mean that, for the inexperienced surgeon, this is a technique that is easy to learn, and that can be performed quickly and safely. The use of barbed suture threads also leads to a complete closure of the tonsil fossa which makes postoperative hemorrhage a rare occurrence. Another benefit is that barbed sutures permit adoption of an individualized tailored approach in each patient.

The surgical outcomes obtained so far present an excellent success rate associated with an improvement in subjective symptomatology.

The DISE represents an important diagnostic tool that allows to select and distinguish patients who have an isolated lateral oropharyngeal collapse, which when recognized is associated an elevated surgery success rate, from those that present multilevel collapse or retro-palatal complete concentric obstruction which have poor surgical results and should be candidates for combinates AQ3 treatments.

Acknowledgments

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