

# Autologous Fat Injection Laryngoplasty for Unilateral Vocal Palsy

Subjects: Otorhinolaryngology

Contributor: Yung-An Tsou

Unilateral vocal palsy (UVFP) affects the voice and swallowing function and could be treated by various materials to achieve improved mucosal wave and better closure during phonation. Injection laryngoplasty is considered an exemplary method for these patients and could be injected as early as possible. We conducted a systematic review and meta-analysis for the subjective and objective outcomes of autologous fat injection laryngoplasty (AFIL) and assessed the effects for patients with UVFP.

Keywords: autologous fat injection laryngoplasty ; unilateral vocal fold paralysis

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## 1. Introduction

Quality of life is compromised in speech and swallowing in patients with unilateral vocal fold paralysis (UVFP). Because of recurrent laryngeal nerve neuropathy, inadequate glottic closure is frequently found because of idiopathic, neoplasm, or iatrogenic causes <sup>[1]</sup>. The surgical treatment includes injection laryngoplasty, laryngeal framework surgery, recurrent laryngeal nerve (RLN) re-innervation, and laryngeal pacing <sup>[2]</sup>. The voice outcomes are similar between injection laryngoplasty and medialization thyroplasty <sup>[3]</sup>. Surgery is considered after conservation therapy. However, recent laryngology consensus considers early injection laryngoplasty as a prior treatment strategy for patients with UVFP in various etiologies. Injection laryngoplasty offered a better approximation of vocal folds and improved the recovery of mucosa waves by creating better vocal fold contact. Because of better approximation and recovering vocal mucosa waves, there was a decreased laryngeal framework rate after injection laryngoplasty <sup>[4]</sup>. Other surgical methods, including RLN re-anastomosis and laryngeal framework surgery, could be applied for poor recovery or compensation after voice therapy, or for patients who need repeated laryngoplasty injection <sup>[5]</sup>. In addition, laryngeal reinnervation could not recover the movement of paralyzed vocal cords, but maintained the vocal tension and vocal fold resistance during phonation. However, it takes four to six months to get a stable voice outcome. It often needs medialization thyroplasty to better refine voice quality and consider a salvage for UVFP after the failure of injection laryngoplasty <sup>[6]</sup>. Thus, injection laryngoplasty aims to decrease the glottic gap and offer better glottal closure, shortening the voice handicapped condition and leading to quicker restoration of speech vocal quality.

Injection laryngoplasty is considered a conserved, safe, and less invasive temporary surgery that helps recover paralyzed vocal folds compared to laryngeal framework surgery. This management was first presented by Brunings <sup>[7]</sup>. After time gone by, various kinds of materials, including xenograft (silicon, Teflon, calcium hydroxylapatite, buffy coat), homograft (dermis, facial), autograft (autologous fat), and synthetic materials (collagen, geofoms, hyaluronic acid (HA), dermalogen, teflon, calcium hydroxylapatite) have been used for injection laryngoplasty <sup>[8]</sup>. Autologous fat injection laryngoplasty (AFIL) was first presented in 1998. It is autologous and has almost no tissue rejection reaction after undergoing injection laryngoplasty <sup>[9]</sup>. Few studies have compared fat to other materials for sustained voice outcome improvement. However, some laryngologists considered fat injection laryngoplasty a permanent effect because of adipose stem cells contained in the autologous fat during its harvesting <sup>[10]</sup>. The quality of fat is affected by harvesting technology, characteristic differences of individual fat, and tissue reaction of autologous fat to the surrounding laryngeal tissues. In clinical practice, the injection technique, assessments, and outcomes related to AFIL vary.

## 2. Autologous Fat Injection Laryngoplasty for Unilateral Vocal Palsy

To sum up, AFIL improved (VHI and GRBAS) and objective voice outcomes (MPT and jitter) for at least 12 months. However, there were no changes in F0 and NHR by AFIL. Thus we conclude that the AFIL is not changing the vibration rate of bilateral vocal folds, there is no obvious noise reduction component measured by MDVP, and the noise harmonic ratio is not significantly changed after AFIL. However, we consider it is a good treatment choice for patients with UVFP.

The etiology of UVFP is complex and is of inflammation, neoplastic, traumatic, idiopathic, iatrogenic, and neurogenic cause [11]. The recent prior etiologies of UVFP were post-thyroid surgery, idiopathic, and thoracic surgery [12]. There were often mixed etiologies causing the vocal gap and decreased mucosa wave during phonation. Not only does vocal quality affect the patient's communication function, but it also affects the swallowing function and causing a reduced quality of life [13]. Injection laryngoplasty is considered an exemplary method for these patients, and it could be injected as early as possible [14]. However, many materials could be injected into the vocal area to decrease the vocal gap or slit during phonation to increase the mucosa wave [15]. However, the voice quality and sustainable effect are considered by AFIL. Regardless, the vocal quality and the impact of vocal function and durability of fat are not clear. The sustained voice outcome could be reached up to 12 months [16][17][18][19][20][21] but might decrease after that time [20][22].

The history of injection laryngoplasty was first presented by Dr. Brunings in 1911, more than a century ago [23][24]. Multiple kinds of materials could be injected into the vocal fold thyroarytenoid muscle area presented since 1911. Short-term temporal material for injection laryngoplasty includes bovine gelatin collagen-based products (i.e., Cymetra, Zyplast, Gelfoam, Surgifoam, and Cosmoplast/Cosmoderm) [25], hyaluronic acid (Restylane, and Hylaform), and carboxymethylcellulose (Radiesse Voice Gel) [26]. Ricci et al. indicated that AFIL had no complication during the injection procedure because the material was autologous fat, which caused less inflammation [17]. The AFIL is safe and with good efficacy for UVFP. The materials that had a longer duration with permanent (long-lasting) effects in the body include autologous fat, calcium hydroxylapatite (Radiesse), ArteSense, and particulate silicone [27]. Autologous fat is safe and widely accepted with fewer adverse effects such as umbilical herniation [28]. There were few complications after injection laryngoplasty by collagen, hyaluronic acid, and calcium hydroxylapatite, micronized AlloDerm including infection, laryngeal abscess formation [29][30][31][32], and acute dyspnea by polydimethylsiloxane (PDMS) [33]. Therefore, autologous fat injection laryngoplasty was still considered a proper long-lasting treatment with a fewer complication for patients with UVFP. Because of reports of 50% (45% failure rate after four years) reabsorption after fat injection laryngoplasty after longer run [22]. Therefore, AFIL is preferred over injection, but sometimes contributes to persistent vocal strain and poor voice quality in the initial two to three weeks after AFIL.

In harvesting fat, preventing long-term air exposure is warranted, and better to remove the emissary fat after waiting for 10 min for precipitation after configuration to separate the plasma and liquid oil before injection laryngoplasty [17][18][34][19]. The configuration speed should not be so high, and it is suggested to not exceed over 3000 mph in order to prevent injury to fat cells [34][19]. The centrifuged autologous fat could contain stem cells to increase new adipocytes [17], which may cause long-term effects on perceptual, acoustic analysis, and quality of life in UVFP patients. Sometimes, insulin saturation is applied to autologous fat to increase the survival rate of fat because of the simulation of insulin growth factor in the fat cells [35]. There were also combined materials to mix with fat to improve the survival of fat like PRP that is helpful to the decreased absorption rate of fat. The adipose stem cells could be harvested during harvesting fat; however, the percentage of adipose stem cell (ASC) is not predictable. The younger patients might have a higher concentration of ASC than older patients. Future studies of bone marrow harvesting mesenchymal stem cells or using the growth factors mixtures with fat are warranted.

AFIL could be a permanent procedure because of harvesting viable adipose stem cells. There were still laryngologists believing that AFIL may be a permanent procedure for UVFP because of higher ASC harvested [36]. That is also a possible explanation as to why AFIL markedly decreased the need for laryngeal framework surgery [37]. In addition, autologous fat material is considered the ideal material. The ideal material is considered to meet the criteria of not causing tissue reactions such as tissue rejection or tissue inflammation. The sustained function to fill the tissue defects. Easy to harvest with reliable to use. In the literature review, the AFIL was widely accepted and the voice outcome is good [16][18][34][19][35][20][21]. The results of our reviewed articles supported that AFIL is a suitable phonosurgical treatment for UVFP. Our meta-analysis results revealed that MPT and jitter were significantly improved in short- and long-term effects after AFIL. The improvement in shimmer was only noted in the short-term result. However, no significant differences in F0 and NHR were found in short- and long-term results. Elbadan et al. thought that AFIL could reduce the glottal gap size, reducing the flow rate and subglottic pressure [18]. Jitter is presented as the measurable frequency perturbation and an important parameter to assess the improvement in voice quality [16]. Shimmer, F0, and NHR also could reflect the vocal abnormalities and are the indicators of voice quality improvement [16]. This review answers which improvement is gained in subjective and objective voice quality after AFIL and the average duration of the effective outcomes for patients with UVFP. We conclude that AFIL helps with subjective and objective voice quality in short and long-term follow-up with no F0 and NHR changes.

### **3. Summary**

AFIL significantly improved subjective voice outcome measures by VHI and GRBAS and resulted in prolonged MPT and better jitter in the short and long term. However, there was only improved shimmer after surgery and for six months after,

as the effect was not sustained for 12 months. The NHR was not improved by AFIL. There were a few complications and this could be widely considered in patients with UVFP.

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