

Literature Review**Management of Presbyphonia****Fauziah Fardizza*, Mirta Hedyati Reksodiputro****

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Jakarta**ABSTRACT**

Background: The proportion of individuals over 65 years of age in developed countries is increasing rapidly, due in large part to current and projected increases in life expectancy. Within the aging population, the incidence of vocal disorders is estimated to be between 12%-35%. **Literature Review:** Presbyphonia, or age-related dysphonia, is a diagnosis of exclusion. Patients' other comorbidities must be evaluated completely. The complexity of presbyphonia involves the changes in the diverse tissues of the true vocal folds, musculature, and cartilage. Patients would get benefit from treatment of voice therapy or surgical laryngeal augmentation procedures. **Purpose:** The aim of this literature review is to describe presbyphonia and several kinds of its management. The primary treatment goal is to enhance glottal closure either by voice therapy or surgical interventions (phonosurgery) such as injection augmentation (IA) and bilateral thyroplasty surgery (BTS). Holistic physical evaluation had to be done to reach complete medical therapy. **Conclusion:** The best therapy for presbyphonia are voice therapy, or surgery followed by voice therapy and voice hygiene.

Keywords: vocal disorder, presbyphonia, voice therapy, phonosurgery, management

ABSTRAK

Latar belakang: Prevalensi individu yang berusia diatas 65 tahun di negara maju semakin meningkat dengan cepat seiring dengan meningkatnya usia harapan hidup. Dalam populasi lanjut usia, angka kejadian gangguan fonasi diperkirakan antara 12%-35%. **Tinjauan Pustaka:** Presbifonia, atau disfonia terkait usia lanjut, membutuhkan evaluasi faktor komorbid secara lengkap. Kerumitan dari presbifonia adalah karena melibatkan perubahan jaringan, otot, dan tulang rawan di sekitar pita suara. Tatalaksana yang dilakukan adalah perawatan terapi suara dan prosedur bedah augmentasi pita suara. **Tujuan:** Untuk menggambarkan presbifonia serta berbagai jenis tatalaksananya. Keberhasilan utama penatalaksanaan presbifonia adalah meningkatnya penutupan glotis, baik dengan terapi suara atau intervensi bedah (phonosurgery) seperti injeksi augmentasi dan bedah tiroplasti bilateral. Dibutuhkan evaluasi fisik secara holistik untuk mencapai hasil terapi medis yang baik. **Kesimpulan:** Penatalaksanaan terbaik untuk presbifonia adalah terapi suara, atau pembedahan diikuti dengan terapi suara dan higiene suara.

Kata kunci: gangguan fonasi, presbifonia, terapi suara, phonosurgery, tatalaksana

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INTRODUCTION

Presbyphonia is voice disorders associated with aging process. Presbyphonia are common in the elderly and have a significant impact on communication and quality of life.¹

The proportion of individuals over 65 years of age in developed countries is increasing rapidly, due in large part to current and projected increases in life expectancy.² Within the aging population, the incidence of vocal disorders is estimated to be between 12% and 35%.^{3,4} Davids⁵ study reported 25% of patients over age 65 years who came with voice complaint were found to have vocal fold atrophy (presbylaryngis), where the hallmark physical signs are vocal fold bowing with an increased glottic gap and prominent vocal processes. Presbyphonia, or age-related dysphonia, is a diagnosis of exclusion, and other comorbidities must be considered in a complete evaluation of elderly patients with dysphonia.^{4,6} The complexity of presbyphonia involves the changes in the diverse tissues of the true vocal folds, musculature, and cartilage. Patients benefit from treatment of voice therapy or surgical laryngeal augmentation procedures.⁴

The purpose of this article is to describe presbyphonia and its management. The primary treatment goal is to enhance glottal closure either by voice therapy or surgical interventions.

LITERATURE REVIEW

In the broad sense, voice refers to the sound we produce to communicate meaning, ideas, opinions, etc. In the narrow sense, voice, refers to sounds produced by vocal fold vibration, or voiced sounds. For voiced sound production, vocal fold vibration modulates airflow through the glottis and produces sound (the voice source).

The vocal folds are layered structures, consisting of an inner muscular layer (the thyroarytenoid muscle) with muscle fibers aligned primarily along the anterior-posterior direction, a soft tissue layer of the lamina propria, and an outmost epithelium layer. The thyroarytenoid (TA) muscle is sometimes divided into a medial and a lateral bundle, with each bundle responsible for a certain vocal fold posturing function.⁷

Prevalence of voice impairments in older people

Generally, presbyphonia, or age-related dysphonia, is regarded as a diagnosis of exclusion after completion of a full medical and vocal evaluation.⁴ It is estimated that 5% to 30% of all those older than 65 years will endorse dysphonia. Dysphonia has many causes, but one possible contributor common in the elderly population is that of presbylaryngis, or an aging larynx. The prevalence of presbylaryngis is unknown.⁸ A retrospective review by Davids et al.⁵ towards 6360 patients with a range of otolaryngological complaints, demonstrated that 58% of those aged over 65 years had voice complaints. Prospective studies have yielded lower prevalence rates. Golub et al.⁶ discovered that 20% of 107 elderly residents of an independent living facility reported voice difficulties.

The nature of voice impairments in older people

Voice impairments in older people may arise as a result of normal structural and neurogenic aging processes affecting the vocal mechanism and/or as a result of pathological processes related to vocal misuse, vocal loading, and physical and psychosocial health. Those pathological processes may be unrelated to aging (e.g., patterns of vocal misuse developed earlier in life, preexisting

vulnerability to psychosocial stress), but could equally be associated with the increased risk of chronic medical conditions that occurs with older age (e.g., stroke, Parkinson's disease, chronic obstructive airways disease, or depression).²

Management of presbyphonia

The goal of therapy is based on a causal model that suggests targeting the biological basis of the condition—degenerative respiratory and laryngeal changes—as a result of sarcopenia. Specifically, the voice therapy protocol should capitalize on high-intensity phonatory exercises to overload the respiratory and laryngeal system and improve vocal loudness, reduce vocal effort, and increase voice-related quality of life (VRQoL).³

The vocal therapy for the elderly program is effective for treating voice presbyphonia.⁹ The primary treatment goal is to enhance glottal closure either by voice therapy or surgical interventions such as injection augmentation (IA) and bilateral thyroplasty surgery (BTS).¹⁰

Voice Therapy

Behavioral voice therapy guided by a speech-language pathologist (SLP) is often the recommended primary approach for treating voice disorders and, when not the primary approach, it is recommended in addition to a medical or surgical treatment. Voice therapy is often categorized as direct, focusing on the physiological components of the disorder, or indirect, focusing on the actions and the environmental factors that may contribute to the disorder.¹¹

Van Stan et al.¹² had recently developed a taxonomy of voice therapy that further subdivides direct and indirect treatment into more specific elements. Direct intervention is divided into five categories: auditory,

somatosensory, musculoskeletal, respiratory, and vocal function. The indirect intervention consists of pedagogy and counseling sections.

Recommended direct intervention techniques include vocal function exercises (VFE),¹³ phonation resistance training exercise (PhoRTE),¹⁴ Lessac–Madsen resonant voice therapy,^{2,13,15} and other resonance enhancement techniques such as Lee Silverman voice treatment (LSVT), breath control and respiratory muscle strengthening exercises, head and neck muscle relaxation, glottal onset training, laryngeal manual therapy, vocal glides and arpeggios, and singing/acting voice training. Recommended indirect methods include general physical/aerobic conditioning and voice care education/vocal hygiene training.^{12,16}

Surgical intervention

Consists of injection laryngoplasty, collagen injection, autologous fat injection, autologous microlobular fat and platelet rich fibrin (PRF) injection, and medialization thyroplasty (MT).

- Injection laryngoplasty

Injection laryngoplasty (IL) initially developed for restoration of glottic competence in vocal fold paralysis, has also been increasingly used in treatment of the aging voice. A number of materials have been used over the years including Teflon, silicone, fat, Gelfoam, collagen, hyaluronic acid, carboxymethylcellulose, and calcium hydroxyapatite. Some of these are limited by safety or efficacy concerns, and some of them are not long lasting. With the growing use of in-office IL, the ease of use has made this technique more popular because of the ability to avoid general anesthesia in a sometimes already frail patient population.³ Davids et al.⁵ also examined changes in VRQoL scores for patients undergoing IL and demonstrated a significant improvement pre- and post-therapy (34.8 vs. 22, $p < 0.0001$).

Table 1. Voice therapy⁹

	Exercise	Desired effects
Tongue or lip trills	Tongue or lip trills with continuous phonation	It improves mucosal vibration of vocal folds and assists in normotensive vocal production.
Nasal sound technique	Nasal sound “m” continuously or “m” not continuously	It facilitates vocal production with less effort, decreases roughness and balances resonance.
Vocal glide technique	Ascending and descending vocal glissandos, associated with facilitating sounds, such as trills, nasal, or fricative “z”	It increases vocal flexibility and improves glottic closure.
Maximum phonation time technique	Phonation of sustained vowels at maximum phonation time, louder than usual, maintaining adequate mouth opening, without excessive muscular effort, controlling the vocal quality throughout the phonation	It increases sound pressure levels, improves glottic closure, and increases resistance to expiratory air passage, helping to improve phonatory stability. It is highly effective in situations of vocal hypophonia, in which case, the exercise should be performed louder than usual.
Semi-occluded vocal tract–Lax Vox technique	Sustained “u” or “v” sound phonation in a silicone tube (Lax Vox) 35 cm long and 9–12 mm in diameter placed in the mouth, between or in front of the incisor teeth and above the tongue, which should be relaxed and may lightly touch the tube without occluding it. The other end is dipped into a plastic water bottle with a capacity of about 500 mL of liquid and filled with about 2/ 3 of water. The tube should be immersed in the liquid at a depth of 1–2 cm	It enlarges the vocal tract and reduces the collision force between the vocal folds.
Semi occluded vocal tract—Lax Vox—“deep bubbling technique”	Sustained “u” or “v” short phonation in a silicone tube (Lax Vox) as described above, although the tube should be immersed in the liquid at a depth of 10 cm	It activates the laryngeal musculature and compensates as a strength exercise aiding in glottic closure.

Table 2. Injection materials used in injection laryngoplasty¹⁷

Short term	Longer lasting
Gelfoam™	Calcium Hydroxyapatite
Radiesse Voice Gel™	Fat
Collagen – Cymetra, Zyplast, Zyderm	Fascia
Hyaluronic Acid - Restylane	Polydimethylsiloxane - Bioplastique™

- Collagen injection

Collagen injection is one possible method for treating a vocal fold scar by medialization of one or both of the scarred vocal folds. Collagen injection laryngoplasty is presently the treatment of choice for presbyphonia if speech therapy is insufficient. Collagen injection for Parkinson-related dysphonia is an effective temporary method of subjectively improving voice and speech in selected patients. Laryngeal collagen injection can also permit further medialization of one or both vocal folds after medialization thyroplasty.

The original form of solubilized collagen was produced from bovine species. Afterwards bovine collagen was used for the correction of different defects affecting voice production and swallowing. The most widely used collagen was the bovine GAX collagen (Zyplast; Collagen Corporation, Palo Alto, California, USA), which is collagen cross-linked with glutaraldehyde to increase its physiochemical stability. Noncross-linked soluble bovine collagen could be subject to early resorption and can be recommended for temporary augmentation.¹⁸

- Autologous fat injection

Autologous fat injection has a longer lasting effect compared to other materials. It has been shown to provide long term improvement of voice function comparable to thyroplasty. Its effect has been shown to last 26 months and more. However, the actual duration is variable as the rate of resorption is unpredictable. Fat tissues are harvested in operating theatre, typically excised from subcutaneous tissues in the abdominal wall, then cut into small pieces to get only the fat cells without the stroma. It is called microlobular fat. Afterwards it is put into 10ml syringe, so that it can be injected into the target organ, in this case into the vocal fold. If the fat is harvested by syringe aspiration, the procedure will ruin extracellular matrix which contains mesenchymal stem cells (MSC).

Its autologous nature makes it biocompatible and safe for use. It is also one of the materials that maintain the viscoelasticity of the vocal fold post injection. The disadvantage of fat injection is the prolonged harvest time and variability in its results due to unpredictable fat survival. Complication rate is low, although there have been reports of donor site hematoma, poor voice quality due to over-injection, and fat extrusion. In addition, patients will have to undergo general anesthesia. Patients also tend to suffer prolonged postoperative dysphonia up to a few weeks, owing to the necessary over-injection. There has been a recent development in using autologous fat in combination with autologous platelets fibrin for injection laryngoplasty.¹⁹



Picture 1. Harvesting microlobular fat graft.²⁰

- Autologous microlobular fat and platelet rich fibrin (PRF) injection

Microlobular fat injection would fill the stroma and made vocal cord medialization. The combination of microlobular fat with autologous platelet biological product will enhance the fat viability.^{19,21-24} The autologous platelet biological product such as Platelet Rich Plasma (PRP), Platelet Rich Fibrin (PRF), and Platelet Rich Fibrin Matrix (PRFM) are source of autologous growth factors.^{20,21} Combination of microlobular fat graft and PRF was proven to have a significant result of microlobular fat graft stability in vocal cord. It could be analyzed from the quality of the voice one month after injection.²⁰

PRF is an autologous platelet biological product, which contain plasma, and fibrin, that could be injected in semi liquid consistency. It possesses several growth factors such as platelet-derived growth factor-AB (PDGF-AB), transforming growth factor β 1 (TGF- β 1), platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and epidermal growth factor (EGF), that can help maintain fat viability.²³⁻²⁶ These factors can stimulate cell and matrix proliferation as well as angiogenesis. In fat tissue, PRF stimulates angiogenesis, which is necessary to maintain viability.²⁷⁻³⁰ Angiogenesis, immunity, and epithelial cover are the three important phenomena for healing and soft tissue maturation. PRF can simultaneously support the development of these three phenomena. VEGF, which is present in PRF, has several functions, and it acts as an endothelial cell mitogen, chemotactic agent, and inducer of vascular permeability. VEGF is considered as a unique growth factor because it has an effect on the wound healing cascade, including angiogenesis, epithelialization, and collagen deposition.²⁴ Reksodiputro et al.²⁴ study had emphasized that autologous microlobular fat combined with PRF is associated with good fat graft viability (growth factors expression).

Koento et al.²³ had analyzed the comparison of fat survival among microlobular fat, centrifuged fat, microlobular fat with PRF, and centrifuged fat with PRF. The result of this study was that the microlobular fat with PRF group had the largest number of adipocytes (mean = 1.932) compared to that in the centrifuged fat, microlobular fat, and centrifuged fat with PRF groups. Reksodiputro et al.²⁴ study showed that a combination of microlobular fat and PRF increased angiogenesis, and VEGF expression could improve graft viability. PRF was found to be associated with increased VEGF expression, whereas microlobular fat was found to be associated with good angiogenesis. Thus, microlobular

fat combined with PRF is recommended as an autologous graft.^{20,23,24}



Picture 2. Combination of microlobular fat graft and PRF.²⁰

- **Medialization thyroplasty (MT)**

Medialization thyroplasty (MT) is a procedure in which one or both of the vocal folds is/are augmented by placing an implant into the vocal fold. It is a permanent technique for addressing the glottal insufficiency found in the aging larynx. In the same fashion as IL, the technique developed as a way to address the paralytic vocal fold and could use either Silastic or Gore-Tex implants.¹⁷ Postma cited by Bradley et al.³ observed the benefit of bilateral MT with Silastic implants in a heterogenous group of patients including presbylaryngis, bilateral fold paresis, unilateral paralysis with contralateral bowing, and other neurologic diseases, and discovered complete glottal closure in 83% of patients, with 85% of patients indicating that they would have the surgery again.

DISCUSSION

As the primary means of communication, voice plays an important role in daily life. Voice also conveys personal information such as social status, personal traits, and the emotional state of the speaker. Mechanically, voice production involves complex fluid-structure interaction within the glottis and its control by laryngeal muscle activation. For voiced sound production, vocal fold vibration modulates airflow through the glottis and produces sound (the voice source), which propagates through the vocal tract and is selectively amplified or attenuated at different frequencies. In order to be heard over noise, such harmonic energy also has to

be reasonably above the noise level within this frequency range, unless a breathy voice quality is desired. Vocal fold tension is regulated by elongating or shortening the vocal folds, so changing vocal fold lengths also leads to changes in vocal fold stiffness. The voice source also contains important information of the pitch, loudness, prosody, and voice quality, which convey meaning.⁷

Presbyphonia is voice disorders associated with aging process, which are common in the elderly and have a significant impact on communication and quality of life.¹

Presbyphonia is a diagnosis of exclusion, which means a diagnosis made by excluding all other known diseases, or it is a diagnosis of a medical condition reached by a process of elimination, which may be necessary if presence cannot be established with complete confidence from history, examination or testing.⁴

There is a high prevalence of voice problems in older people, with a large proportion having significantly impaired quality of life related to their dysphonia. General health measure do not reflect voice-related quality-of-life (VRQoL), and many individuals may wrongly attribute dysphonia to age-related changes alone.⁶

Within the aging population, the incidence of vocal disorders is estimated to be between 12% and 35%.³ The primary treatment goal is to enhance glottal closure either by voice therapy or surgical interventions such as injection augmentation (IA) and bilateral thyroplasty surgery (BTS).¹⁰ Voice therapy is a useful tool in the treatment of presbyphonia and improves VRQoL.³

Injection laryngoplasty (IL) initially developed for restoration of glottic competence in vocal fold paralysis, has also been increasingly used in treatment of the aging voice. With the growing use of in-office IL, the ease of use has made this technique more popular because of the ability to avoid

general anesthesia in a sometimes already frail patient population. A number of materials have been used over the years including Teflon, silicone, fat, Gelfoam, collagen, hyaluronic acid, carboxymethylcellulose, and calcium hydroxyapatite.³ According to Remacle et al.¹⁸ collagen injection laryngoplasty is presently the treatment of choice for presbyphonia if speech therapy is insufficient. Meanwhile, autologous fat injection has a longer lasting effect compared to other materials. It has been shown to provide long term improvement of voice function comparable to thyroplasty. Its autologous nature makes it biocompatible and safe for use. The best autologous fat for vocal fold repairment is the microlobular fat, which was harvested by excision and cut into small pieces, and put into a 10ml syringe to be injected to the vocal fold afterwards.¹⁹

There has been a recent development in using autologous fat in combination with autologous platelets rich fibrin (PRF) for injection laryngoplasty.¹⁹ The combination of microlobular fat, with autologous platelet biological product will enhance the fat viability.^{19,21-24} The microlobular fat combined with PRF is recommended as an autologous graft.^{20, 23, 24}

Sachs et al.¹⁰ stated that the primary treatment goal of presbyphonia is to enhance glottal closure either by voice therapy or by surgical interventions such as injection augmentation (IA) and bilateral thyroplasty surgery (BTS). While behavioral voice therapy guided by a speech-language pathologist (SLP) is often the recommended primary approach for treating voice disorders and, when not the primary approach, is recommended in addition to a medical or surgical treatment.¹¹

Presbyphonia is a voice disorder associated with aging process. It is common in the elderly and has a significant impact on communication and quality of life. It needs complete examination including evaluation of comorbid diseases. The goal

of the therapy is for reaching the best glottal closure. It could be achieved with voice therapy by a speech-language pathologist (SLP), or depending upon the condition of the elderly, a laryngoplasty could be performed, followed by voice therapy and vocal hygiene afterwards.

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