

## เสียงคนสูงอายุ

เบญจมาศ พรธานี

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## The Senile Voice

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The voice is a fingerprint or mirror of the personality. The human voice and speech pattern are amazingly distinctive. Hearing a few sentences spoken on the telephone by someone you know or a friend or family member talking in another room, is all that is needed to identify the speaker. The voice also sends other messages such as emotions or feelings to others. People seek to maintain effective oral communication as long as possible so good communication skills are important to the elderly and may be one of their most important and remaining avenues of socialization. Those who are employed, especially in professional or supervisory posts, may be forced to retire early if they experience diminished vocal effectiveness.

A large number of elderly persons complain of vocal difficulty such as "I can't sing as well as I used to", "I have a soft voice and get tired after long periods of talking", "My voice is dry", or "I have to clear my throat a lot whenever I use my voice". The terms "presbylaryngitis" or "presbyphonia" are commonly used in the professional literature. It is important to distinguish voice changes that accompany normal aging from those precipitated by physical or emotional abnormalities. Hence, clinicians should know what is within normal limits so that an elderly speaker can be properly counselled after expressing concern about his/her voice. Such knowledge requires normative data that describe how nonpathological aging processes affect the human voice and which aspects of the voice profile fall within normal limits and which do not.

### The development of larynx

By the third month of fetal life, the larynx has recognizable features. At birth, the larynx gradually descends in the neck and continues to do so throughout life. The soft cartilaginous framework of the neonatal larynx becomes ossified over time, a process that is usually complete by about the age of 65. The length of the vocal cords increases from 6-9 mm in infancy to 12-15 mm by adulthood<sup>(1)</sup>. During puberty, rapid changes in the

size of laryngeal structures (increases in the length, weight, height and width of the thyroid and cricoid cartilage) produce varying vocal effects. The male vocal folds undergo more than twice the growth of female folds 11.6 mm versus 4.2 mm, respectively. This represents an increase in vocal fold length of 63% from prepuberty to puberty in men and of 34% in women<sup>(2)</sup>. The increase is due to an increase of serum testosterone, which causes growth of pubic hair as well as the mutation of the voice in males<sup>(3)</sup>. Because the growth of the male vocal cord is rapid, boys experience temporary hoarseness, occasional pitch break and unsteadiness of the voice with a slight decrease in pitch<sup>(4)</sup>. There are three phases during this mutational period<sup>(5)</sup>:

**1. Premutation.** The first signs of mutational change of voice occur around the age of 9-10 years in boys, when the voice becomes somewhat weaker, and the upper limit of the vocal range slowly decreases.

**2. Mutation.** A rough, hoarse voice quality and successive decreases in pitch over a relatively short period characterize this phase which lasts from a few months to one year. The decrease in pitch makes the adolescent uncertain and this instability appears in voice breaks, which in some adolescents are quite pronounced. The peak of the mutational phase usually takes place around the age of 13-15 years of age.

**3. Stabilization.** By 17 years, boys experience a lowering of the their fundamental frequencies by about one octave, whereas girls experience a lowering of about two to three notes<sup>(4)</sup>. By adulthood the length of the vocal cords increases to between 17-23 mm in men and 12-17 mm in women. This morphological development precipitates acoustic changes affecting the three major attributes of the human voice : pitch, loudness, and quality<sup>(1)</sup>.

The vocal pitch, commonly expressed through measures of fundamental frequency (Fo), gradually lowers from infancy to early adulthood, stabilizes throughout the period of middle life, and then, depending on gender, declines or increases during old age.

Newborns, regardless of gender, have an Fo of approximately 500 Hz, which drops after puberty to about 130 Hz in males and 220 Hz in female. Finally, the Fo stabilizes at a slightly lower frequency throughout most of adult life, at approximately 100 to 110 Hz in men and 200 to 210 Hz in women. Changes in laryngeal anatomy and physiology, as well as in the balance of the respiratory/supraglottal systems, cause this gradual decline in pitch<sup>(1)</sup>. A clear, developmental sequence does not occur for the other two attributes of voice : loudness and quality. Loudness depends on subglottal pressure, which in turn is determined by the efficiency of the respiratory power supply and by laryngeal valving. If socially appropriate and functionally adequate, it is seldom a clinical issue in normal individuals of any age. Quality is the perceptual correlation of the complexity of the laryngeal tone produced, which is modified by cavity resonance. Again, as long as voice quality does not displease the ears of listeners, it is of no particular clinical concern.

### The senile voice

The literature pertaining to the effects of aging on the larynx focuses on various structural and functional components, including the cartilaginous skeleton, intrinsic laryngeal muscles, vocal cords, and nerve and blood supply

#### Structure changes

##### Laryngeal cartilages

The cartilaginous framework of the larynx undergoes changes from birth into old age - mainly calcification and ossification<sup>(6-8)</sup>. These changes occur in both genders, although they are manifested somewhat earlier in males. Some of the age-related changes in the cricoarythenoid joints may affect vocal cord approximation and, subsequently, glottal efficiency.

#### Nerve and blood supply

Although the possibility of decreased neuromuscular control of the larynx as a function of age has been suggested<sup>(9,10)</sup>, the functional significance of these changes is yet to be determined.

#### Laryngeal glands

The glands that secrete the vocal cord mucous undergo involutional changes that could result in the dehydration of the epithelial lining of the cords<sup>(11)</sup>. This could affect the integrity of vocal cord tissue and subsequently its function and may also be responsible for the dry voice and excessive throat-clearing experienced by many elderly speakers.

#### Vocal cords

The larynxes of older people exhibit bowing and

sulcus of the vocal cords, as well as what is described as "arrowhead" configuration of the glottis. The changes in the larynxes of older men are most likely caused by muscle atrophy, which produces a general decline in the efficiency of the glottal valve<sup>(12-15)</sup>. Some studies report involution of the lamina propria<sup>(12-14,16)</sup>

Multiple physical changes of the larynx and its components occur with age. Further research into these is needed.

#### Functional changes

##### Maximum phonation time

Maximum phonation time (MPT) is determined by measuring the maximum sustained phonation time using a single, deep inhalation. MPT then reflects both respiratory support and the efficiency of glottal valving, but does not distinguish between the two variables<sup>(17)</sup>. There is a considerable variability of maximum phonation time in performance tests. It varies between 20-30 seconds within the median speaking range<sup>(18)</sup>, between 19-30 seconds in males and between 16-24 seconds in females during sustained phonation<sup>(1,18,19)</sup>. Maximum phonation time in aging is between 13 to 18 seconds for males and 10 to 15 seconds for females<sup>(20,21,22)</sup>. The data indicate that maximum phonation time in elderly men and women is lower than in younger persons, which may be linked to declines in respiratory function that accompany age.

##### Voice quality

Changes in vocal cord tissues may introduce vibratory irregularities that contribute to deviations in the voice quality<sup>(8)</sup>. There are several terms that clinicians use to explain voice quality in elderly persons such as: breathy, strained, tense, hoarse, tremulous, shaky, squeaky, and weak.

##### Vocal jitter and shimmer

Jitter refers to the small cycle-to-cycle variation in the vocal cord's vibratory frequency and shimmer refers to the cycle-to-cycle amplitude perturbations. Previous studies show that jitter and shimmer increase in elderly person<sup>(9,23,24)</sup>.

##### Spectral noise

Levels of spectral noise in voices can be measured by determining their harmonic-to-noise(H/N) ratio. Normal voices have low levels of noise, whereas abnormal voices show greater noise levels<sup>(25)</sup>. Older speakers in poor physical condition have greater spectral noise (lower H/N ratios) than do older speakers in good physical health or younger speakers regardless of their physical condition. Hoarseness is prevalent in the voice of the elderly, so perhaps a common characteristic of many senescent voices is a lower H/N ratio<sup>(1)</sup>.

## Fundamental Frequency (Fo)

Studies of fundamental frequency (Fo) in the elderly show different results. Boone<sup>(26)</sup> concludes that there is a lowering of pitch in both young adult males and females but a slight increase of pitch in the late stage of elderly men and a decrease of pitch in elderly women. Perhaps the biggest hormonal influence on the female voice comes during and after menopause. Less estrogen is available, while at the same time, there is some increase in testosterone, causing increased thickness of the membranes covering the vocal cords. There may also be some atrophy of the muscles of the larynx, and perhaps some calcification of the laryngeal cartilage. The post-menopausal woman also carries her larynx lower in the neck. All of these physical changes seem to contribute to a continual lowering of pitch as people age<sup>(26)</sup> (Figure 1).

The majority of men aged from 20 to 50 years have clear normal voices though the pitch drops a note or two by the age of 50. Around 70, the hormonal balance between estrogen and testosterone begins to change in men. Consequently, the male begins to lose some vocal cord tissue, which results in a slight increase in pitch. There can also be some increased hoarseness<sup>(26)</sup> (Figure 2).

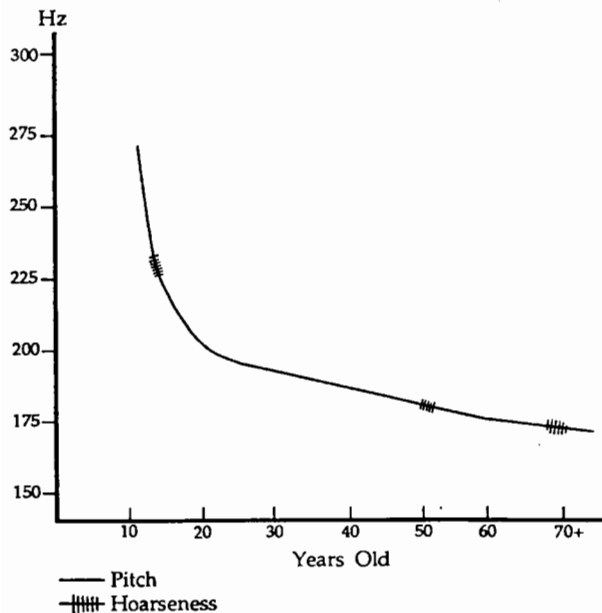


Figure 1. Female voice changes over time.

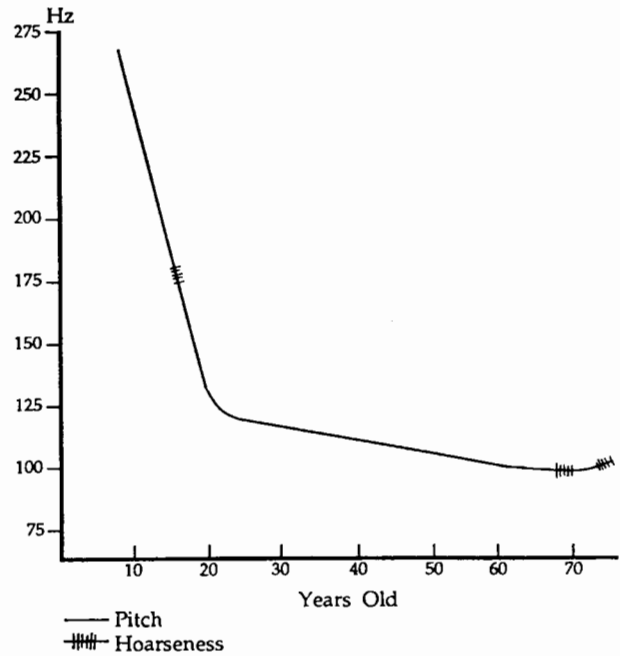


Figure 2. Male voice changes over time.

In people older than 90, the voice pitches of men and women are similar.

## Speaking rate

The speed of talking decreases with increasing age in both males and females. It takes older people longer to say the same thing than it does younger people. This slowing is perhaps caused by diminished breathing due to lower lung volumes and reduced air pressures. This means the older person must breathe more often. Older people also tend to prolong vowel sounds as they speak which also contributes to fewer words spoken per minute.

In summary, there is no precise age at which the senescent voice becomes a universal phenomenon. Heterogeneity in aging is reflected in the great range of voice quality among the elderly<sup>(1)</sup>. The major acoustic attributes of the voice - pitch, loudness, and quality - do not change in elderly persons who are in good physical health. However, there is strong evidence that in some elderly people, laryngeal structures and their functions are affected by advancing age. Table 1 summarizes the major structural and functional changes commonly associated with the senescent voice<sup>(1)</sup>.

**Table 1** Age-Related Structural and Functional Changes in the Laryngeal Mechanism and Phonation

Structure/Function	Senescent Change	Comments
Laryngeal cartilage	Increased ossification and calcification	Similar for both genders
Nerve and blood supply	Decrease in neuromuscular control and blood supply	Available data are inconclusive
Laryngeal glands	Decrease in output	Thickening of mucous, dehydration
Vocal cords	Atrophy Edema	In males In females
Respiratory support	Decreased	Both genders
Vocal quality	Hoarseness	Both genders
Pitch	Increased Decreased	In males In females
Loudness	Reduced(?)	Both genders
Jitter/shimmer	Increased	Both genders
MPD*	Reduced	Both genders
H/N ratio*	Decreased	Both genders

MPD = Maximum phonation duration or time

H/N ratio = Harmonic-to-noise ratio

### Clinical implications

#### Evaluation

A thorough and collaborative (ENT/speech-language pathology) evaluation is necessary to distinguish voice problems related to normal aging from those caused by vocal abuse or pathology. Thus when making a diagnosis it is essential to take a detailed history and carry out auditory testing, a laryngological examination, and acoustic/perceptual analyses.

#### Treatment

A thorough differential diagnosis, selective pharmacological treatment, sensible vocal rest, vocal hygiene counseling, and optimal voice usage are the mainstays of treatment, with some surgical advances, such as tightening of the vocal ligament<sup>(27)</sup>, offers promise for the future.

The availability of clinical services provided by speech-language pathologists is somewhat limited. Specific therapeutic approaches include: counselling, pushing exercises, relaxation, ear training, digital manipulation of the larynx<sup>(1)</sup>, breathing exercises and pitch ascending.

Counselling is the least invasive treatment and should be given to patients early in treatment. If the patient can follow the advice given, the voice may improve. Boone<sup>(26)</sup> suggests ten easy steps for maintaining natural voice:

1. Cut down on throat clearing and coughing. Don't yell.
2. Develop a soft, legato like voice. It is a lot easier on the vocal cords and on the ears of our listeners.
3. Use a pitch level that is natural for you.
4. Focus the voice. A good, natural voice sounds as if it is focused right on the top of the tongue and in the middle of the mouth.
5. Pause and renew your breath more often.
6. Reduce the demands on your voice. Don't do all the talking
7. Develop an open vocal tract. While you listen to someone else, or when you read or watch television, make a deliberate effort to keep your mouth slightly open
8. Avoid talking in loud settings.
9. Avoid smoking and alcohol.
10. Drink enough water. Excessive dryness can irritate the membranes covering the vocal cords and cause swelling. Such irritation often is eliminated completely by drinking more fluids. Some medications such as antihistamines, diuretics can cause dryness of throat and larynx. People who take such medications should check with their doctors or pharmacists to see if the drug causes throat dryness. If dryness is a problem, sometimes another medication can be substituted.

The ideal humidity for the voice is between 40-50%.

Humidity under 20% dries out the air passage in the vocal tract. Humidity over 50% may add too much moisture to our airways, which may result in continual throat clearing. These conditions may require a change the moisture levels in the environment.

Exercises to strengthen the laryngeal value: Mueller<sup>(28)</sup> suggested that pushing exercises utilized to improve glottal closure in cases of aging voice and vocal cord paralysis. Ringel and Chodzko-Zaiko<sup>(29)</sup> found that some age-related changes may be subject to modification and that function need not decline at a uniform rate. Healthy lifestyles - including good nutrition, exercise and recreational activity may modify certain age-related changes since physiologically healthy individuals exhibit better laryngeal control than those who are less healthy<sup>(1,26,29,30)</sup>.

However, people who have had voice problems in aging should consult an otolaryngologist and speech-language pathologist for early treatment.

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