



MUTATIONAL FALSETTO: A PANORAMIC CONSIDERATION

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ABSTRACT:

This article is intended to present everything that is known about puberphonia in a comprehensive yet concise manner. The evolution of the approach and attitude to its treatment from ancient concepts to recent trends is highlighted.

INTRODUCTION:

“If the eyes are the mirror of the human soul, then the voice is the barometer of human emotion.”

So important is the quality of voice to a human being. Hence I feel that it wouldn't be out of place, to point out the psychosocial impact puberphonia has, at the very outset of this article. While what exactly is the technical handicap of the puberphonia patient is one thing, what the patient perceives it to be, is an entirely different thing. The unfortunate teenage boy who struggle with this disorder at puberty will have many woeful stories to tell, if only someone could lend a sympathetic ear to him without themselves mocking at him, while he relates his misery. They end up being the butt of many jokes among his peers and classmates. This ultimately results in his self-esteem and confidence taking a beating, and he ends up going into a shell. The teenage girls aren't completely left out from this scenario. A similar condition presenting in a teenage girl, though less prevalent and less obvious, is called “Juvenile Resonance Disorder” or “little Girl's Voice”.

An objective tool to assess the perceived handicap of the patient is the Voice Handicap Index (VHI). VHI has 3 parts with an overall score of 120 and individual subset has score of 40 each. VOICE HANDICAP INDEX: as developed and validated by Barbara H. Jacobson et al.

This index is a way to assess how a person would describe the way he/she uses his/her voice. It also allows him/her to explain as to how his/her voice affects his/her life.

The undertaker is expected to answer the questions that follow subsequently with one of the following responses:

- 0=Never
- 1=Almost never
- 2=Sometimes
- 3=Almost always
- 4=Always

Part I

- 1) My voice makes it difficult for people to hear me
- 2) People have difficulty understanding me in a noisy room
- 3) My family has difficulty hearing me when I call them through the house
- 4) I use the phone less often than I would like to
- 5) I tend to avoid groups of people because of my voice
- 6) I speak with friends, neighbors, or relatives less often because of my voice
- 7) People ask me to repeat myself when speaking in person
- 8) My voice difficulties restrict personal and social life
- 9) I feel left out of conversations because of my voice
- 10) My voice problem causes me to lose income

Part II

- 1) I run out of air when I talk
- 2) The sound of my voice varies throughout the day
- 3) People ask, "What's wrong with your voice?"
- 4) My voice sounds creaky and dry
- 5) I feel as though I have to strain to produce voice
- 6) The clarity of my voice is unpredictable
- 7) I try to change my voice to sound different
- 8) I use a great deal of effort to speak
- 9) My voice is worse in the evening
- 10) My voice "gives out" on me in the middle of speaking

Part III

- 1) I am tense when talking to others because of my voice
- 2) People seem irritated with my voice
- 3) I find other people don't understand my voice problem
- 4) My voice problem upsets me
- 5) I am less outgoing because of my voice problem
- 6) My voice makes me feel handicapped
- 7) I feel annoyed when people ask me to repeat
- 8) I feel embarrassed when people ask me to repeat
- 9) My voice makes me feel incompetent
- 10) I am ashamed of my voice problem

Other popular scales for voice assessment:

Grade, Roughness, Breathiness, Aesthenia, Strain (GRBAS) scale is a subjective measure of voice based on perceptual evaluation.

While the Multi-Dimensional Voice Program (MDVP) scale is an objective measure of voice based on acoustic analysis.

DEFINITION:

The persistence of adolescent voice even after puberty in the absence of organic cause is known as Puberphonia.

According to the modified diagnostic classification systems, puberphonia is classified under Functional Voice disorders, and more specifically as a Psychogenic Voice Disorder.

Functional voice disorder (FVD) refers to an aphonia or dysphonia where there is no organic pathology, or, if there is, it is either insufficient to account for the nature and severity of the voice disorder, or considered secondary to the functional problem.

Psychogenic voice disorder (PVD) refers to an aphonia or dysphonia that occurs as a result of disturbed psychological processes where there is a sudden or intermittent loss of volitional control over the initiation and maintenance of phonation in the absence of structural or neurological pathology sufficient to account for the dysphonia. Symptom incongruity and reversibility may be demonstrated, and psycho-social factors are often linked to onset. Whilst muscle tension patterns may be inferred or observed, such patterns are secondary to the psychological processes operating. Psycho-social factors will frequently be linked with onset. This may take the form of stressful life events and difficulties, even traumatic experiences, or as a result of difficulties in communication in significant relationships. It is also common that no stressful situations are identified at least in the short term and, in some cases, even after successful resolution.

The identification of psychological stress is generally possible, but it is not necessarily a prerequisite to diagnosis. Symptoms are inconsistent with the normal appearance of the larynx, and symptom reversibility may be demonstrated. The symptom incongruity will be the more obvious at initial assessment.

Normal or improved phonation cannot be voluntarily produced, but may be inadvertently leaked by the speaker in rare unconscious moments or when deliberately facilitated through reflex activities such as laugh or cough.

Puberphonia is classified as Psychogenic Voice Disorder type 4.

THE PHYSIOLOGICAL VOICE CHANGE AT PUBERTY:

The laryngotracheal complex which lies at a higher level in an infant, gradually descends in position as age advances. At puberty this descent is rapid and there is a sudden laryngeal growth spurt due to a sudden increase in testosterone levels, and that is when the boy's voice "breaks", as we call it. This technically translates to a drop in the fundamental speaking frequency of the boy's voice. In a study conducted by Harrier et al, Ultrasound measurements of the vocal folds were taken for a number of boys passing through puberty. The boys were grouped according to their pubertal stage as defined by Tanner. A gradual increase in the length of the vocal folds was observed as puberty progressed. The fundamental frequency of the boys' speaking voice was recorded via laryngography

and a good correlation between the length of the vocal folds and the frequency of the voice was seen. However the sudden drop in frequency seen between Tanner stages 3 and 4 did not correlate with similar changes in the length of the vocal folds. Stroboscopy done at this juncture revealed changes in the mass and structure of the vocal folds at this time of maximum frequency change.

The voice of a typical adult male has a frequency range of 85-180Hz.

INCIDENCE OF PUBERPHONIA:

According to a study conducted by Banerjee, the incidence of puberphonia in India is 1 in 900,000. Adolescent males are the most commonly affected. Although this condition is not that prevalent among adolescent girls, since the laryngeal growth spurt is not so dramatic in them, a similar condition presenting in a young girl is known as “Juvenile Resonance Disorder” or “Little Girl’s Voice”.

ETIOLOGY OF PUBERPHONIA:

- Embarrassment of the “new” voice
- Failure of the adolescent male to accept his adult role
- Over identification of a male child with his mother
- Hero worship of older boy/sibling
- Social Immaturity
- Desire to maintain soprano singing voice
- Muscle incoordination/dysfunction
- Emotional stress/ psychogenic
- Non-fusion of thyroid laminae
- Delayed development of secondary sexual characters
- Current researchers however feel that the more likely cause is an attempt to control unstable pitch and quality characteristics

PATHOPHYSIOLOGY OF PUBERPHONIA:

When the adolescent child is not able to adapt to the newer lower-pitched voice that develops at puberty following the rapid descent of the larynx, the problem of mutational falsetto manifests. Since the brain is more accustomed to the higher pitched voice of the infant, it refuses to accept the pitch lowering that is taking place naturally. The high pitched voice characteristic of puberphonia is caused by increased tension and contraction of the muscles in the larynx causing it to elevate. But the fact of the matter is that the laryngeal capability to produce normal low pitched voice is present. Hence the origin of the problem is mainly psychogenic and behavioural.

MANIFEST MUTATIONAL FALSETTO:

1. Unusual high pitched voice persisting beyond puberty. In a study conducted by Satish Chandra et al, the mean pitch of boys affected with puberphonia was found to be 224Hz. The pitch is in fact variable with the normal low pitched voice expected for the person’s age manifesting itself suddenly, especially when the patient’s voice is used for non-verbal tasks such as laughing or coughing.
2. Hoarseness of voice
3. Breathy, weak, thin voice
4. Inability to shout or compete with background noise.

5. Vocal fatigue
6. inadequate resonance of voice

EVALUATION OF A PUBERPHONIA PATIENT:

1. Videolaryngoscopy
2. Stroboscopy
3. Psychological assessment
4. Tests to rule out hypogonadism and assessment of secondary sexual characters
5. Electrolaryngography- it provides immediate visual feedback to the speaker about his voice in waveform.
6. Gutzmann pressure test (external downward pressure on the thyroid cartilage will bring out the normal low pitched of adulthood which is prevented from emerging in puberphonia) and a clinical examination of the laryngeal framework.

MANAGEMENT:

THE SHIFT FROM OLDER CONCEPTS TO CURRENT TRENDS..:

In recent times, there has been a dramatic change in the approach to the treatment of this condition. While older concepts were almost synonymous with voice therapy and spoke about nothing else, recent trends are inclined towards surgical correction. The seventh edition of Scott Brown's textbook of Otorhinolaryngology and Head and Neck Surgery in fact states that laryngeal framework surgery is contraindicated in the treatment of puberphonia. However surgical correction of puberphonia has now been successfully done through many studies and case reports across the globe.

GOALS OF PUBERPHONIA TREATMENT:

To put things in perspective for ourselves and the patient, we need to first be clear about what are our goals of puberphonia treatment:

- ⊘ The patient should be taught to phonate at a low pitch. ⊘ He should be made to understand and accept the fact that the "new low-pitched voice" is normal. It should be ensured that he is comfortable with his new voice. He will need to be encouraged to use it in different situations.
- ⊘ he must be taught to use his respiratory and phonatory muscles to their maximum capacity
- ⊘ any underlying psychological issues should be addressed.

THE DIFFERENT TREATMENT MODALITIES AVAILABLE:

- ⊘ voice therapy
- ⊘ laryngeal manipulation
- ⊘ surgery

VOICE THERAPY:

Voice therapy is a behavioral method for changing the manner of voice production. Furthermore, the therapeutic techniques used in voice therapy may enhance wound healing following vocal fold injury. Voice therapy is an effective and appropriate method of treatment either as sole therapy for voice disorders or in conjunction with other treatment modalities (eg, surgery, medications).

Voice therapy has traditionally been divided into 2 categories, direct and indirect. Literature indicates that a voice therapy program that combines direct and indirect approaches is most effective. Indirect voice therapy.

Historically, indirect voice therapy involved voice rest. For many patients, this treatment option is not feasible. For example, 4 weeks of voice rest for an elementary school teacher is often unreasonable. If an inefficient or traumatic manner of speaking is the cause of the voice problem, most voices improve temporarily following voice rest. However, the dysphonia typically returns upon resumption of voice use. In addition, teachers and others who use their voices professionally may suffer serious job-related consequences as a result of being placed on long-term voice rest. Hence Voice rest alone may not provide a long-term solution for the voice problem. Indirect voice therapy also consists of educating the patient about the dangers of poor voice use and vocal hygiene.

The patient needs to be educated on the following:

Normal vocal anatomy and physiology

- Voice care/vocal hygiene
- Minimize shouting/yelling.
- Minimize whispering.
- Minimize caffeine and alcohol, as they are diuretics.
- Minimize coughing and throat clearing.
- Minimize grunting or vocalization during exercise.
- Do not compete vocally with noisy environments.
- Eliminate tobacco use and exposure to second-hand smoke.
- Rest voice during periods of excessive fatigue and stress. • Eat a well-balanced diet.
- Keep hydrated by drinking at least 8 glasses of water per day and 1 additional glass for every serving of caffeine or alcohol consumed. Additional hydration may be needed to combat environmental dryness.
- Increase awareness of potentially abusive vocal behaviours, and adopt a lifestyle plan that minimizes the same.
- Minimize gastroesophageal reflux through behaviour and dietary modifications.

Direct Voice Therapy:

Direct voice therapy involves alteration of a patient's speaking technique in an attempt to increase vocal efficiency and improve voice quality. Voice therapy typically requires 1-2 therapy sessions per week for approximately 6-8 weeks. Exceptions exist, including voice therapy prior to phonosurgery, which is usually limited to several sessions before surgery and resumption of therapy approximately 1-2 weeks after surgery.

The direct voice therapy options available specifically for puberphonia are as follows:

Cough: Patient is taught to cough with pressure over the Adams apple. This maneuver shortens the length of the vocal cord thereby reducing its vibrating pitch. The patient is advised to perform this exercise at home. This will enable the patient to get used to a lower basic speech frequency.

Speech range masking: This procedure is known to improve the quality of voice. It has been established that speaking in a noisy background has profound effects on how an individual speaks. It can alter the quality of speech of an individual. This procedure also makes the voice clearer and louder. For this purpose an instrument known as the facilitator is used. The masking bandwidth is between 100 - 8000 Hz. The advantage of using this frequency is that it covers the speech range and masking is possible at much lower sound levels when compared to a white or pink noise which are commonly used for purposes of masking. A tape recording of the voice of the patient during and after masking is provided to the patient and the patient should try to match the voice generated during masking on a consistent basis.

Glottal attack before a vowel: Vowel is a very important sound in speech. It is also easily amenable to therapy / change. Glottal attack involves bringing both vocal cords into close approximation. The patient is asked to breathe in and build air pressure in the subglottic area. This causes increased muscular tension in the laryngeal area. The vowel is uttered as the air is breathed out. This procedure enables a patient with puberphonia to settle down to their basic fundamental frequency of voice.

Relaxation techniques to relax laryngeal musculature:

Laryngeal muscles can be relaxed using the following procedures:

Yawn technique: The patient is advised to practise yawning, followed by generation of a sighing sound. This procedure reduces the tension on the vocal folds.

Chewing technique: First the act of chewing in an exaggerated manner is practised. Then gradually random sounds, words and sentences are added to this task. This act reduces the tension of the laryngeal muscles. **'M' warm up:** To warm up the vocal cords the consonant M is spoken or sung before the words. This helps to produce a gentle air flow through the larynx as phonation begins.

Visipitch: This instrument is commonly used by speech pathologists to treat various speech disorders. This machine helps in extraction of critical speech and voice parameters and displays them in true real-time to help clients achieve therapy goals with visual feedback. This machine helps in training the patient in nuances of normal speech production.

Boone's technique of larynx lowering: This method is also known as "Yawn - sigh" method. The patient is asked to simulate a yawn and while yawning is in progress asked to sigh. This maneuver not only lowers the larynx, it also relaxes it.

Humming while sliding down the scale: In this exercise the patient is taught to hum in the highest pitch possible and the humming is continued by lowering the pitch. This exercise helps not only in tuning the vocal cords it also relaxes the laryngeal muscles.

McFarlane and Boone's Half swallow Boom technique: In this technique the patient is asked to swallow. While swallowing is in progress the patient is asked to say "Boom". Then the patient is asked to turn to one side and say "BOOM". The same exercise is repeated by turning the head to the opposite side.

The patient is then asked to lower the chin, and say Boom.

The patient is taught to add words to the BOOM.

The swallow procedure is known to maximise the closure of larynx. The sound Boom is produced by posterior pressure to the larynx. The patient gradually learns to lower the pitch of his voice.

CONTROVERSY:

Pannbacker(2001) finds Boone and McFarlane's half-swallow boom to be not so effective as it can be physiologically impossible to swallow and say "boom" at the same time. It can in fact induce vocal hyperfunction and damage to vocal folds which can increase the risk of worsening the voice problem. This might hence turn into an iatrogenic voice problem. He even says that there is no empirical evidence that this technique is effective. He believes that all effort closure techniques should be used in moderation because of the damage they can cause.

Antero posterior compression of thyroid cartilage:

Compression is applied to the Adam's apple area in the neck using the thumb and the patient is asked to speak. This procedure relaxes the vocal cord and lowers its basic pitch. The patient is instructed to repeat this exercise frequently while attempting to speak.

Overall voice therapy is very promising. Typically the puberphonic patient produces a functionally lower pitch during the first session itself. It is recommended to continue therapy until the patient's "new" voice is stabilized.

LARYNGEAL MANIPULATION:

This was first described by Dr. Sudhakar Vaidya in his study. The patients were asked to come nil by mouth for 6 hours prior to the procedure to the ENT OPD. They were examined under local anaesthesia using the anaesthesiologist's Macintosh intubation laryngoscope. The long blade of the laryngoscope was put in the vallecula and the patient was asked to phonate a long "EEE". Pressure in the vallecula stretched the vocal cords. Additional pressure applied over the anterior commissure with the laryngeal biopsy forceps and external digital pressure over the thyroid cartilage improved the voice quality. There was an immediate improvement in the patient's voice from child-like high pitch to the low-pitched adult male voice.

Digital laryngeal manipulation in which thyroid cartilage is compressed, and patient is asked to speak. The patient is instructed to repeat this procedure at home.

Botulinum toxin injection into the cricothyroid muscle could also be of help. Ideally 15 units of Botulinum toxin should be injected into each side.

SURGERY:

When all these conservative methods fail, surgery will have to be resorted to. The first case of surgically corrected puberphonia was reported by Pau and Murthy. They mobilized the hyoid bone by dissecting supra-hyoid musculature and upper half of thyroid cartilage, and reduced cricothyroid distance by apposing mobile hyoid to fixed cricoid cartilage by 2 non-absorbable figure of eight sutures.

Ishikki type III relaxation thyroplasty has shown promise in managing this condition. This surgical procedure lowered the pitch of voice in these patients by shortening the length of the vocal folds. In the classic Ishikki type III thyroplasty 2 – 3 mm vertical strips of thyroid cartilage were

excised on either side of midline. This caused retrusion of the middle portion of the thyroid cartilage resulting in a reduction in the length of the vocal folds.

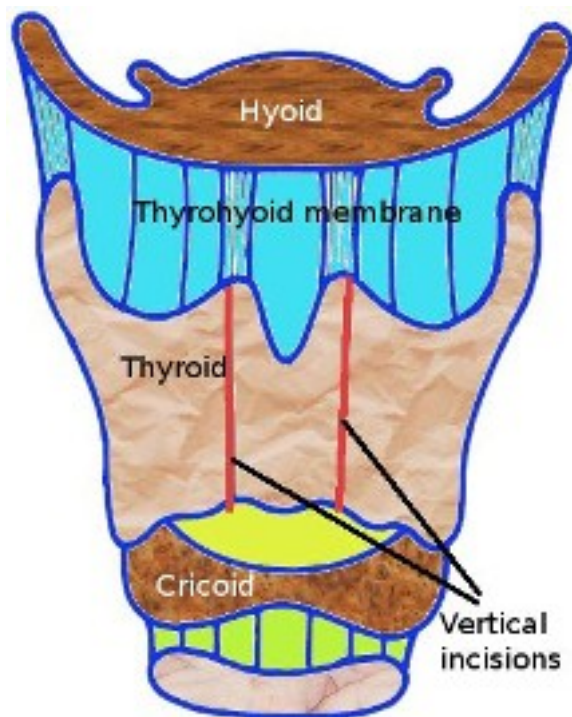


Diagram showing the two vertical incisions on either side of midline of thyroid cartilage (Ishikki type III thyroplasty)

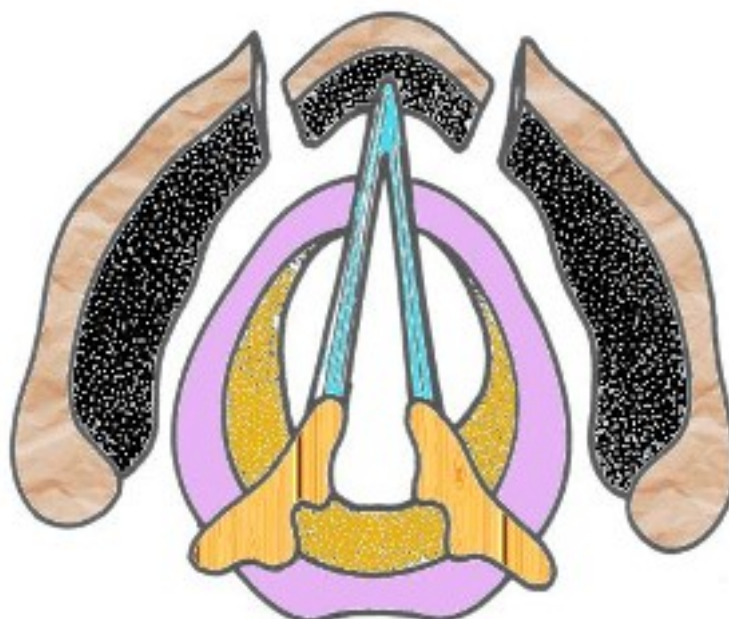


Figure showing the depressed anterior segment of the thyroid cartilage



Figure showing the anterior segment of thyroid cartilage which has been pushed behind and the free edges of thyroid cartilage reapproximated

Various modifications of Type III Ishikki thyroplasty have been proposed. These include:

Retrusion thyroplasty:

In this modified procedure the lamina of thyroid cartilage is incised bilaterally and its anterior segment is depressed.

Relaxation thyroplasty:

In this procedure a small window is created close to the anterior commissure tendon and the cartilage window created is pushed behind.

Tucker's procedure:

This is a less invasive procedure in which a superiorly based cartilage window is created at the level of anterior commissure and is pushed behind causing relaxation of the vocal folds.

CASE REPORT:

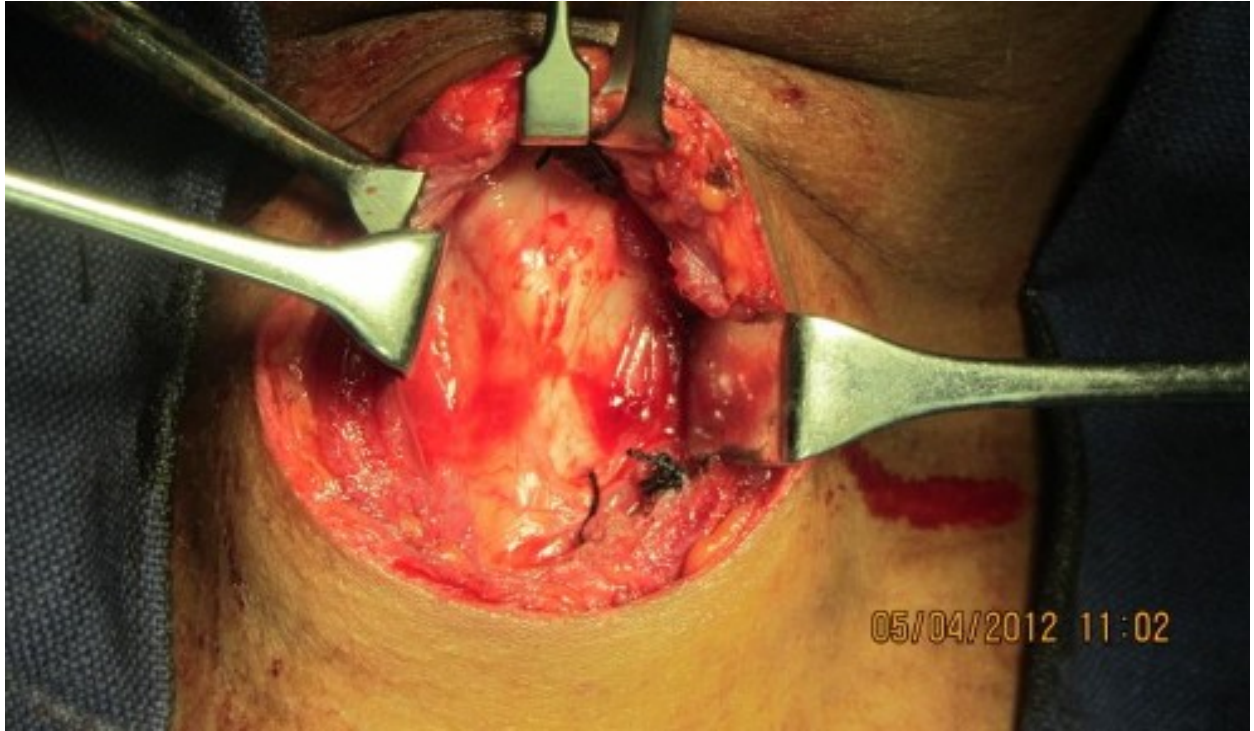
We, at the ENT department of Stanley Medical College treated a 23 years old male patient who presented to us with puberphonia with Relaxation Thyroplasty. The patient was kept in nil per oral for 6 hours and the procedure was done under local anesthesia.



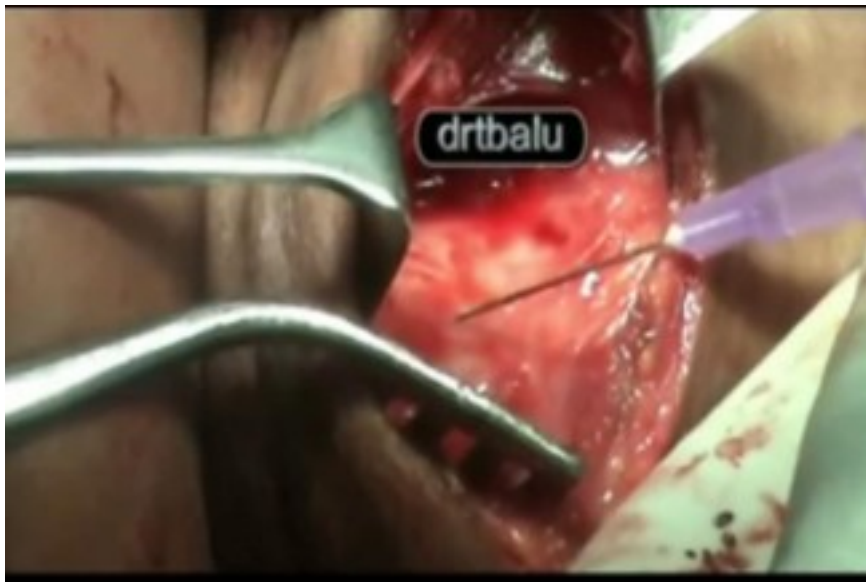
A horizontal incision was made at the lower border of the thyroid cartilage and layers separated.^{1,2}



Strap muscles identified and retracted.



Thyroid cartilage was exposed and skeletonised



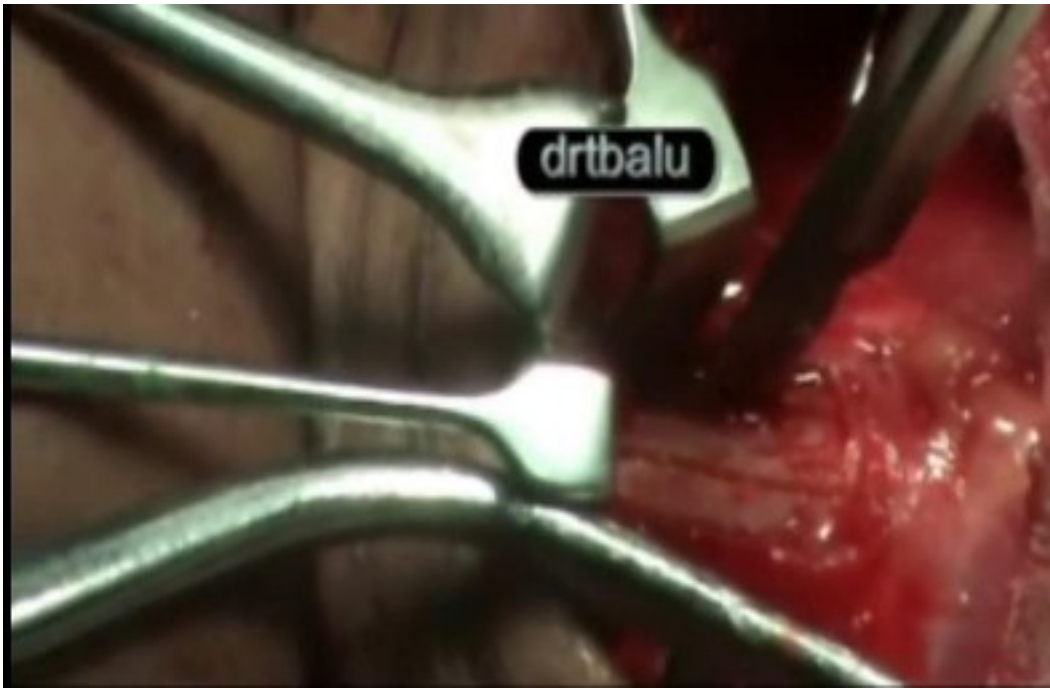
Perichondrium of the thyroid cartilage infiltrated with xylocaine.



Perichondrium of the thyroid cartilage incised in the midline vertically.



Perichondrium elevated from the thyroid cartilage.



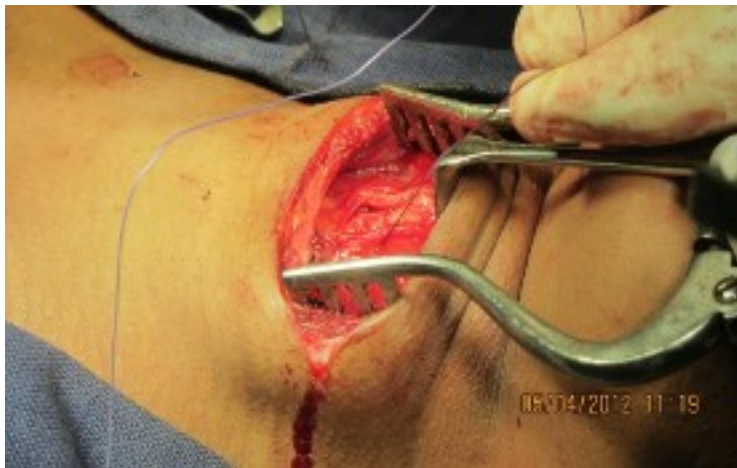
2 – 3 mm strips of the thyroid cartilage incised on either side of the midline with fissure burr and knife.



Cartilage strips being separated



Middle portion of thyroid cartilage is depressed



Free edges of thyroid cartilage being approximated



Figure showing thyroid cartilage free ends after approximation



Figure showing completion of skin suturing

CONCLUSION:

As pointed out at the very outset of this article, it is the psycho-social impact that puberphonia has that we need to keep in mind while we treat these boys. If it is going to benefit the patient, probably in terms of a quicker and more definite result, such changes in the approach to these patients are most acceptable and welcome. For it is such advances, that help our medical field develop, in order to serve the community better.

It must be remembered that, treatment of puberphonia, not only improves the quality of voice of the patient, but also the quality of his life.

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