Pitch Elevation in Trangendered Patients: Anterior Glottic Web Formation Assisted by Temporary Injection Augmentation

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Summary: Pitch elevation surgery is most often indicated to assist male-to-female transgendered individuals seeking a more feminine voice quality. Behavioral therapy is primary management but if the desired voice quality is not achieved, surgery is offered. Procedures described that raise vocal pitch alter one or more of the main parameters known to physiologically control pitch; vocal fold tension, length, and mass.

Objective. Web formation with injection augmentation significantly raises vocal pitch in male-to-female transgendered individuals.

Study Design. Retrospective cohort study.

This report describes the voice results after anterior web formation with injection augmentation to reduce vocal fold length in a series of 10 transgendered patients.

Methods. Retrospective review of male-to-female transgendered patients referred to St. Michaels Hospital Voice Clinic, Toronto, Canada for pitch elevation was carried out including demographic data, preoperative and postoperative acoustic data and videostroboscopic evaluation.

Results. Comparison between preoperative to postoperative acoustic measures demonstrated a mean increase in fundamental frequency of 110 Hz after web formation. Perturbation measures and pitch range were unchanged from before surgery to after surgery.

Conclusion. This novel modification for endoscopic anterior web formation has been shown to be a successful procedure for permanent elevation of pitch with little or no morbidity.

Key Words: Pitch elevation–Transsexual voice–Endoscopic laryngeal surgery.

INTRODUCTION

Elevating vocal pitch is an uncommon indication for surgery and has been done primarily for male-to-female transgendered individuals who desire their voice to be perceived as female, consistent with their psychological gender identity. Gender dysphoria or transgendered[1–4] is a state in which an individual is convinced that one's personal psychological gender is inconsistent with their phenotype or physical gender. The distress associated with this condition may cause an individual to seek medical or psychological intervention. Multidisciplinary care is the current practice standard[3] for these individuals who often require medical, surgical, and psychological treatment from a variety of specialists. Most of the male-to-female transgendered individuals receive hormone therapy (estrogen) however it has been shown to have little effect or no effect on voice quality.[4,5] A voice quality perceived as male conflicts with the psychological female identity in these individuals. Not infrequently, transgendered individuals will seek treatment from a laryngologist and/or a speech language pathologist to achieve agreement between their perceived gender (based on their voice) and their psychological identity.

Perceptual research on gender identification based on voice and speech characteristics have found that the primary cue in gender identification is "pitch".[5–9] Although there is overlap in the standard deviation of male and female average speaking fundamental frequency (SFF) range, Spencer[7] and Wolfe[10] found that an SFF of above 160 Hz were more likely to be identified as female and below 150 Hz subjects were more reliably identified as male speakers. Vowel formant frequencies (F2) have also been found to be higher in women[5,6,8,11] and in transgendered individuals identified as female.[7,12] Gelfer et al[6] also reported in their study of 15 male-to-female transgendered individuals that an SFF of 160 Hz was insufficient for female gender perception and a mean SFF of 187 Hz was observed in the transgendered subjects who were identified as female.

Resonance characteristics such as formant frequencies are not only higher in women[9,13] (20%) but are also a salient gender cue in connected speech particularly if the SFF of the individual is in the unclear zone between 145 and 165 Hz.[12,14] An individual can acquire the skills to modify their vocal resonance by altering vocal tract shape with intensive speech therapy. Therapy also addresses nonsegmental aspects of speech such as prosody, resonance focus and loudness[7,13,15–18] to achieve a feminine voice quality. The therapy is resource and time intensive and it has not been uniformly successful with considerable individual variation.[7,8,12,13,15–19] Also, patients report that a lower "male" voice emerges during nonspeech voice tasks like laughing/coughing and long-term maintenance of the "feminine" voice has been problematic.[12,15]

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At our tertiary voice center, transgendered individuals seeking a more female voice quality are offered speech therapy and surgery is reserved for unsatisfactory outcome or if an individual does not have access to these specialized services. This approach is consistent with the recently published Good Practice Guideline[3] for Gender Dysphoria published by the Royal College of Psychiatrists (2013).

Surgical options

The main parameters for physiological manipulation of pitch are surface tension (cover stiffness) and vocal fold mass and length[20] following the simplistic model of a vibrating string. One of the first procedures described by Isshiki[21] for pitch elevation was cricothyroid approximation (CTA) which increases tension by tilting the larynx inferiorly and suturing/plating the lower border of the thyroid ala to the upper border of the cricoid, reproducing the activation of the cricothyroid muscles. A series of 21 patients reported a median pitch elevation of >55 Hz after CTA[22] and other reports show similar results.[23,24] Although easy to perform and the procedure can be done under local anesthetic, the disadvantages include enhancing the prominence of the thyroid notch, potential reduced pitch range,[13,24] and initial pitch rise was not retained in some patients long term.[23,24]

Anterior glottic web formation has been performed by both external and endoscopic approaches to shorten the vibrating length of the vocal folds to raise pitch. The normal male adult vocal fold is roughly 1.5 times longer than a female and its cross sectional mass is also larger. Fundamental frequency varies inversely with vocal fold length[25] if all other parameters are constant and on this basis, reducing vocal fold length by one third should raise the F_0 into a female range. This is not the case in transgendered individuals and shortening the vocal fold length by one third may be insufficient to accomplish a "female" voice given the phenotypic male vocal tract and vocal fold mass.

External approaches have included laryngofissure and suturing of the anterior vocal folds[26,27] and more recently, "feminization laryngoplasty" which consists of excision of the anterior thyroid ala and vocal folds with reconstruction.[28,29] A large series of 76 patients who underwent feminization laryngoplasty reported an increase in SFF of more than 50 Hz (6 semitones ST). However, revision surgery was required because of unequal tension or patient dissatisfaction in 27%.

Other endoscopic approaches to reduce muscle mass using muscle excision or laser[30–32] have had less promising results. Technical issues in endoscopic procedures to shorten the vocal folds by web formation[26,33] have been hampered by suture dehiscence, anterior commissure blunting, and insufficient reduction in vocal fold web length.

The ideal surgical procedure for raising vocal pitch should be reliable with little or no morbidity and permit the individual to use a normal intent and effort when speaking with a F_0 higher than 165 Hz to be perceived as female.

This report is a case series of voice results in male-to-female transgendered individuals after web formation surgery. The technique is based on a previously described novel technique of anterior glottic web formation.[34] However, the technique has been modified and simplified by altering the augmentation material from Gelfoam powder (Pfizer, Kalamazoo, MI) to Radiesse Voice Gel (Merz Pharma, Frankfurt, Germany). This report demonstrates that anterior web formation with injection augmentation is an effective, endoscopic method of dramatically raising pitch with no statistical difference in pitch range and perturbation measures after web surgery.

METHODS

A retrospective chart review of male-to-female transgendered individuals referred for pitch elevation to the Voice Clinic at St. Michaels Hospital (between January 1, 2000 and June 30, 2012) a tertiary referral laryngology center was carried out. All subjects were offered primary behavioral therapy. If patients continued to express dissatisfaction with their voice quality after therapy, then endoscopic web formation was offered as surgical treatment. One patient could not attend therapy sessions because of travel distance. A detailed questionnaire was collected including demographic data, medical history, and past treatment for their voice.

All subjects met the following inclusion criteria:

1. Age between 22 and 65 years
2. Currently in a formal program for gender dysphoria or attending a specialty clinic
3. Female hormone replacement therapy and living full time as a woman for more than 3 years
4. No other laryngeal pathology other than prior pitch elevation procedures or laryngeal shave
5. No history of speech, language, or hearing problem
6. Nonsmoker

Subjects were excluded if they had other laryngeal pathology, were medically unfit for surgery, or did not consent.

Videostroboscopic examination by the principal investigator and voice recording for acoustic data were carried out by a speech language pathologist in a sound treated room.

Postoperative evaluation was done at 6 months with annual follow-up when possible.

Data collection preoperatively and postoperatively included the following:

1. Videostroboscopy
2. Acoustic Recording including
   a. Vowel tokens (three trials)
   b. Pitch Range (best of three trials)
   c. Reading task (Rainbow passage)

Videostroboscopic examination

Videostroboscopy was carried out to screen for other laryngeal pathology and as standard of practice for voice evaluation. Whenever possible, rigid laryngoscopy was done with a 70° Storz (Karl Storz, Tuttlingen, Germany) scope with a c-clamp triple chip CCD Toshiba camera (Toshiba Corporation, Kawasaki, Japan). Files were stored on the KayPENTAX 9400 videostroboscopic computer system (KayPENTAX, Lincoln Park, NJ). If poorly tolerated, a flexible endoscope