ORIGINAL ARTICLE

Wendler Glottoplasty and Voice-Therapy in Male-to-Female Transsexuals: Results in Pre and Post-Surgery Assessment

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Abstract

Introduction: With the development of new ENT techniques, many male transsexuals who wish to become women usually request a surgical procedure to raise the fundamental frequency of the voice (feminization). The ENT specialist and the voice-therapist have to use an interdisciplinary approach to this growing social demand. The aim of this study was to show the results in a group of transsexual patients after Wendler’s anterior synechiae, with additional voice-therapy treatment.

Methods: Ten male transsexuals who wish to become women patients who had Wendler glottoplasty and voice-therapy were assessed. The surgical procedure consisted of a de-epithelialization of the anterior third of both vocal folds; this area was sutured and the surface of both vocal folds was vaporised with laser diode. Pre- and postsurgery voice assessment consisted of measuring fundamental frequency (Fo) and maximum phonation time, administering the transgender self-assessment questionnaire (TSEQ) and obtaining perceptual voice assessment by inter-rater agreement.

Results: All the male transsexuals who wish to become women patients significantly increased their Fo (106 Hz on average) after the treatment. Furthermore, significant improvements were shown in self-reported satisfaction and in the degree of voice feminization. No improvements in the maximum phonation time were observed.

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Conclusions: Wendler glotoplasty is a surgical procedure to contribute to feminising the voice, with good medium-term results and without noteworthy medical complications. The increase in vocal tone was observed using several pre- and post-surgery control measures and voice therapy.

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Introduction

The concept of transsexuality (which should not be confused with that of transvestism or that of homosexuality) is defined as the quality or condition of being transsexual. In turn, this is a person that possesses a sexual identity that makes him or her feel like the sex opposite to the one that corresponds anatomically or biologically. Transsexuality usually causes an insidious, permanent conflict in the individual that possesses it, a persistent discomfort with their own sex and a feeling of being inadequate in the social and biological role that include a constant desire to transform into the opposite sex, the one with which they identify psychologically. Most transsexuals (75%) are men wanting to become women (male-to-female transsexualism or simply MTF).2

Surgery has made it possible for transsexual patients to achieve many of their objective and “change into” men or women (depending on the case), in both external appearance and in the functional possibility of exercising their real sexuality. Notable aesthetic improvements are currently achieved in these individuals’ appearances, improvements barely contemplated 30 or 40 years ago. Facial feminization, for example, nowadays allows giving just the right touch to a masculine face to make it more feminine; thousands of transsexual patients go to specialised centres every day to improve their image and make it look like their sexual identity.2

Even after feminising their bodies and faces almost completely, there is still a “feature” left to modify, a last key to the apparent definitive well-being: the voice.1 This is usually the last step left, which many patients desire for finishing off the change wanted. That is why they go to speech therapists, Ear, Nose and Throat (ENT) specialists, voice professors, and other voice-related professionals to attempt to learn techniques and uses that manage to feminise them
as much as possible. Voice is known to be a secondary sexual characteristic, which can have a very important direct effect on the day-to-day life of transsexual patients. It often becomes a notable obstacle for being able to carry out totally a social, professional and even personal role as true women.¹

At first, from aesthetic speech therapy, voice feminization techniques were developed to help these patients to reach the desired degree of well-being, using minimally-intrusive or -invasive means. Vocal therapy includes the implementation of emission and modulation mechanisms designed to modify the fundamental spoken speech of these patients and which should be carried out by a speech therapist voice specialist.² The efficacy of this vocal therapy alone has not been completely demonstrated, because there are few studies on the matter.⁶ It is true that even when speech therapy has managed to feminise the voice significantly by changes in breathing, intonation, articulation, word choice and vocal inflection of the transsexual, the masculine voice (deeper tone) usually appears in day-to-day situations such as yawning, coughing or laughing.³

Given the limited success of these merely functional techniques in voice change intervention in transsexuals, other surgical intervention techniques have been described that attempt to increase vocal emission tone in this type of MTF transsexual patients. All the techniques have 3 main principles: (a) increase the vocal fold (VF) tension, (b) change the VF consistency and (c) reduce the VF mass. These 3 bases are achieved by: (1) cricothyroid approximation techniques, (2) anterior commissure advancement, (3) laser vaporisation of the VF surfaces, or (4) VF shortening using a synchiae or anterior attachment.

The most common surgical technique until a few years ago was probably the cricothyroid approximation, described by Ishikiki et al.⁸,⁹ and later modified by Lee¹⁰ and by Sataloff.¹¹,¹² Through a cervical incision, the cricoid cartilage is pushed backward and upward, and the thyroid cartilage, downward and forward. This brings the 2 cartilages closer together and the VF tension is increased.¹³

The anterior commissure advancement technique was developed by Lejeune¹⁴ in 1983 and then modified by Tucker¹⁵ in 1985. References about this technique are very limited, except for the good functional results gather by Tucker in his first 9 patients. However, mentioning it here is of interest given that, just like the cricothyroid approximation, it only affects the laryngeal skeleton without damaging the important structure (the free border) of the VFs.

The laser vaporisation technique—diode or CO₂— is now normally used with suspension micro-laryngoscopy, to remove various laryngeal injuries. It has recently been noted that a vaporisation of 5 W or less, at 1–2 mm from the free border of both VFs, extending from the vocal process towards the anterior commissure as close as possible without damaging them, creates a controlled scar that reduces VF mass and increases their rigidity. The procedure leads to an increase in vocal pitch. This surgical technique, called LAVA (Laser-Assisted Voice Adjustment), was proposed by Orloff et al.¹⁶ and is less traumatic than other interventions, being used normally in surgery for voice professionals (singers, newscasters, etc.).

The method most used in MTF transsexuality surgery is currently a technique called the Wendler glottoplasty, consisting of VF shortening through an anterior synchiae.¹⁷ It was known that high vocal pitch was a common characteristic in patients having congenital or acquired anterior synchiae and that what determines vocal pitch is the vibratory longitude of the fold itself.¹⁸ Taking this observation as a base, early in the 1990s Wendler proposed a technique that would make it possible to elevate the vocal pitch by creating a union or anterior synchiae surgically, shortening the longitude of VF vibration and increasing emission tonal frequency. Various studies¹⁹,₂₀,₂¹ have reported good results from applying this Wendler technique. Specifically, it has the advantage that better long-term results can be confirmed, besides avoiding the anti-aesthetic cervical incision that other techniques require. Outcomes of the Wendler technique are:

1. An increase in fundamental frequency (Fo) of some 9 semitones, with reduction of the lowest frequencies and harmonics.
2. The Fo variation is normally maintained with a latency of at least 4 years post-surgery. However, in 20% of the patients the increased Fo can gradually drop over time, which has been linked to secondary transsexuality (aged over 45 years) and with smoking.
3. The youngest patients seem to be more susceptible to post-surgery Fo increase, according to the results shown by Mastronikolis et al.¹⁹
4. The level of self-reported satisfaction, generally based on the Voice Handicap Index (VHI), is high.
5. Complications when using the Wendler technique are irrelevant after several months of follow-up, although granulomas may appear in the suture area or excessive feminization can occur from making the laryngeal membrane too large. To prevent these complications, Anderson²₀ has proposed that, after de-epithelializing the anterior third of both VFs, they should be approximated through injecting gelfoam in both vocal muscles instead of suturing the VFs.
6. The most recent studies using the Wendler technique³,¹⁹ insist that post-surgery speech therapy treatment for voice modulation is essential to achieve optimum feminization results in MTF transsexual patients.

There is still a lack of uniformity on the pre- and post-surgery criteria and measures that should be assessed to monitor and analyse the effects of the operation involving the Wendler technique, on the true role that speech therapy treatment plays and on obtaining better medium- and long-term follow-up control to help to observe more adequately the objective voice results of the MTF transsexual patients who had the operation.

The objective of this study is to compare the pre- and post-surgery results in a series of 10 MTF transsexual patients that had Wendler glottoplasty (with minor modifications) and were evaluated with a series of measures proposed in the ENT Service at Hospital Quirón de Marbella (Málaga, Spain), in collaboration with the Speech Therapy Degree Voice Research Unit at the University of Málaga.
Methods

The Ethics Committee at Hospital Quirón de Marbella approved this study.

Patients

Ten individuals who had transsexual male-to-female (MTF) gender reassignment surgery, from 30 to 52 years old (with a mean age of 39.9) were included in the study. Three of them were moderate smokers (fewer than 10 cigarettes/day) and 2 were professional voice users (an elementary school teacher and a variety singer) at the time of the assessment and surgery.

Procedure

The patients were treated at the ENT Service Voice Unit between January 2012 and July 2013. The protocol of action was as follows:

1. Initial clinical voice assessment at the clinic.
2. Surgery (the same surgeon operated on all the patients using the technique called the Wendler glottoplasty\(^{17}\)).
3. Postoperative speech therapy.
4. Patient follow-ups at the clinic, by phone or by Skype: at 1, 3 and 6 months.
5. Final re-evaluation of the post-treatment voice in a face-to-face clinic visit (at 12 months after surgery).

Clinical Voice Assessment

The patients in this study were evaluated at the beginning and the end of the study with a series of voice parameters and measures normal in ENT/speech therapist voice examination:

1. Laryngostroboscopy (Atmos Endo-Stroboscope L 250W; continuous light, slowed 0.5–2 Hz; still image 0–400; change phase; pilot flash for about 10 s; freq. adjustable from 100 to 400 Hz \((\pm 10\%)).
2. Fundamental frequency (Fo/Hz): obtained using the free PRAT programme for scientific voice and speech (http://www.fon.hum.uva.nl/praat/).
3. Maximum phonation time (MPT) for the vowel /a/ after a deep inhalation at a comfortable volume and frequency (pitch)\(^{31}\) measured in seconds with a stopwatch. It is defined as the longest time that a subject is capable of phonating (emitting) the vowel /a/.
4. Subjective evaluation of the voice was carried out using the Spanish translation of the Transgender Self-Evaluation Questionnaire\(^{23}\) (TSEQ) (“Cuestionario de autoevaluación transsexual” in Spanish). This is a new self-evaluation questionnaire for transsexuals measuring the functional, physical and psychological impact that the patient’s own voice produces on them. It consists of 30 questions, each scored from 0 to 4 based on the severity of the self-reported symptoms. The maximum score is 120 points. This questionnaire is similar to the Voice Handicap Index (VHI), more commonly used in voice pathology, but the TSEQ is specifically designed for transsexual patients. The TSEQ is currently being used most frequently in the USA and Western Europe,\(^{23}\) and has begun to provide some interesting empirical data that back its validity and reliability\(^{24}\) to the point that it could shortly become a definitive substitute for the VHI\(^{25}\) as a self-report measure of reference in the transsexual population.
5. Perceptual evaluation (PE), normally called perceptual \([sic]\) instead of “perceptiva”/perceptive by different professionals in Spain. The patient has to read the first fragment of a well-known text from the universal lyric narrative in Castilian Spanish, which has a wide phonetic variability and is frequently used in Ear, Nose and Throat (ENT) consultations and speech therapy for perceptual voice evaluation: “Platero and yo” [Platero and Me] by Juan Ramón Jiménez (“Platero es pequeño, peludo, suave...”) [Platero is small, hairy, soft..] The vocal emission quality of reading the text is evaluated independently by 4 expert markers (the percent of inter-evaluator agreement over 1 of the possible scores is considered). The evaluators are told that they should rate the voice that they are hearing on a visual analogue scale (VAS) from 1 to 5, with 1 being a very feminine voice; 2, a somewhat feminine voice; 3, gender-neutral; 4, a somewhat masculine voice; and 5, a very masculine voice.

Surgery

The surgery (Fig. 1) is performed using general anaesthesia. The endolarynx is exposed for the intervention through direct suspension laryngoscopy, making the anterior commissure completely visible. The free border and the upper and the lower anterior third surface of both VFs is de-epithelialized with cold instruments (tweezers and scissors), as can be seen in Fig. 1A. Special care must be taken in handling the VFs so as not to de-epithelialize further than the anterior third or injure the vocal ligament. The 2 VFs are firmly sutured to make a new “V” in the anterior commissure. It is very helpful to use a special needle-holder and a “knot-pusher” that lets the surgeon knot the sutures strongly. In our patients, we use a 19-mm straight needle, with 4–0 Vicryl thread and a special 70-cm length (Fig. 1B). Likewise, 2 suture points are used, beginning with the one closest or next to the anterior commissure (Fig. 1C). The operations ends with vapourising the upper surface of both VFs, with 5 W or less, at 1–2 mm from their free borders, extending from the vocal process towards the anterior commissure, as closely as possible without damaging it (Fig. 1D) and then reducing partially the mass of the VF free borders. It is important to remember that the vocal muscle is not to be included deeply. For more detailed, dynamic information, there are images on Internet showing one of the interventions performed in this study; see:

https://www.youtube.com/watch?v=H58X7zwKqLY
https://www.youtube.com/watch?v=0EMa5AY99uo

Seven patients requested that we perform a thyroid chondroplasty (Adam’s apple reduction) in the same surgical step. With this thyroid cartilage reduction technique an
exclusively aesthetic result that does not influence voice quality is planned.

After the intervention, a 15-day absolute vocal rest is essential to avoid suture dehiscence. Postoperative treatment consists of antibiotic coverage for a week (amoxicillin + clavulanic acid 1 g every 8 h), inhaled corticoids twice a day for a week, codeine as an antitussive as needed, and proton pump inhibitors for 6 weeks. The patient is advised not to perform any physical exercise for 3 weeks.

By means of this technique, the vocal folds are shortened and their vibratory mass is reduced. In the final re-evaluation of the vocal measures (12 months after the surgery), patients are given a laryngostroboscopy, to visualise the results of the treatment of surgery + speech therapy.

Speech Therapy

All of the patients in this study received post-surgery speech therapy sessions, which were part of the treatment plan. The speech therapy treatment consisted of a classic rehabilitation protocol for voice disorders, adapted to the special characteristics and needs of the voice in the post-Wendler-surgery transsexual. Two weeks after surgery, patients were sent for 24 sessions of post-surgery speech therapy rehabilitation (with a schedule of 2–3 sessions a week) over 8–12 weeks. Generally speaking, each patient received 2 sessions a week. However, if there was a problem of illness or scheduling conflicts, making a patient unable to attend the scheduled session, the patient received only 1 weekly session and the treatment period was prolonged until the corresponding 24 sessions were received. Each session lasted approximately 45 min.

Beginning in the second treatment session, work with the patient was initiated by performing a short review or summary of the previous session. Likewise, at the end of each session the speech therapist and participant attempted to review the day’s new information and exercises briefly. The participants were trained and encouraged to practice the techniques and exercises at home (some 15 min twice a day). All the intervention sessions consisted of working on 5 objectives:
Basic information and suggestions. All patients received a series of vocal hygiene recommendations, which they were given and reminded of throughout the treatment.

Relaxation (5–15 min, depending on the patient’s personality). Work was done both standing and sitting.

Breathing (5–10 min, depending on the treatment stage). These exercises facilitated a relaxed posture and correct breathing, avoiding muscle rigidity and attempting to eliminate behaviors indicating improper airflow management during verbal production.

Emission, collocation and modulation (15–25 min). The key short-term objective in this stage consisted of modulating the masculine larynx to feminine tones.

Maintenance and generalisation (5–10 min, depending on the treatment stage). The goal of this stage was to help to transfer the new learning (voice habits, techniques and gestures) to real-life situations (at home and work, in social relationships, how to speak in noisy surroundings such as pubs or discos, etc.).

Statistical Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) 22. The mean and standard deviation (SD) of the continuous variables were considered. Changes in the measurements analysed were evaluated through the nonparametric statistic of the Wilcoxon signed rank test for paired samples, given that statistical normality could not be assumed for the sample analysed. The analyses were interpreted statistically a level of confidence of 5%.

Results

The pre-surgery laryngostroboscopy results revealed a normal masculine larynx and a symmetric, periodic mucosal wave present, with complete glottic closure. The post-surgery laryngostroboscopies corresponded to anterior synechiae with the presence of oedema and fibrosis, which affected a bit less than the anterior third of the glottis, with reduced symmetric and periodic mucosal waves.

Table 1 presents the mean scores and SDs obtained by each patient in the quantitative measures used in pre- and post-surgery phases. It can be seen that all the patients increased their Fo value in the post-surgery phase. The statistical comparison between the 2 phases, using the Wilcoxon nonparametric test, reveals a significant change (P=.005) for the average in Fo value from 137 Hz (min–max range=126–157; SD=9.8) in pre-surgery to 243 Hz (min–max range=208–260; SD=18.35) after completing treatment (surgery + speech therapy).

In MPT results measured in seconds likewise reveal statistically significant pre- vs post-surgery differences (P=.011). The mean pre-surgery MPT is 21.6 s (min–max range=20–25; SD=1.84), while the mean is 20.8 s (min–max range=19–24; SD=1.93) in post-surgery. There is a tendency in most patients (7/10) for the MPT to worsen in the post-surgery phase. However, there are no cases where a post-surgery dyspnoea appears (the post-surgery glottic space result is enough for optimum breathing).
improvement in emission Fo coincide with and are even superior to other studies that have reported on the Fo measure in evaluation of voice treatment in MTF transsexuals. For example, Gross and Orloff et al. used techniques different from Wendler's or, as in our study, applying the Wendler glottoplasty in the intervention (Remacle et al. and Mastronikolis et al.). The outstanding advance in our study patients compared to other similar ones is probably due to factors not controlled here and that might have influenced the good results reached. These might be circumstances such as a longer, more systematic speech therapy than that in other studies—rarely described and poorly detailed—or our patient ages (around 40 years old). Mastronikolis et al. show more notable differences in Fo among the younger patients in their study; the differences could be the basis for the Fo changes achieved by the 10 patients evaluated in this study. In the future, it would be a good idea to control these factors to improve our knowledge of the variables that influence voice variations after the intervention.

A function measure widely used by ENT specialists and speech therapists in evaluating proper voice use is the MPT of the vowel /a/ measured in seconds. If breathing is used appropriately and if the air column makes the VFs vibrate properly, the greatest amount possible of air becomes "voice". In our study, post-surgery MPT was significantly less on average; the phonation length of the MPT patients treated here was lower in most cases (7 out of 10). Even so, these data should be interpreted cautiously because reducing VF size by the anterior synechiae and consequently increasing their resistance (besides provoking an elevation in pitch frequency) means there is also a need to increase glottic tension and subglottic pressure, which induce the vibration of the free VF borders (sound emission). This usually requires a period of adaptation and speech therapist vocal training, and it appears that it might have been insufficient at the time of carrying out the evaluation in the patient post-treatment stage. An effect similar to ours is described in other studies, although in those cases the drop in MPT was not statistically significant. Both Remacle et al. and Mastronikolis et al. indicate a lack of important MPT changes in their patients after surgery by the Wendler technique (including post-surgery speech therapy treatment). It would be a good idea to include longer observation of this measure in future studies and, once the patient has followed (for a longer time period) the appropriate speech therapy training to achieve the necessary functional potential, the patient should be allowed to maintain a longer phonation time with the new fundamental tone and mid-range tone.

Shifting the discussion to self-report perception measures, they are widely-used, useful tools to measure changes perceived and degree of patient satisfaction in ENT clinical practice; for example, in patients with dysphonia after treatment. It should be emphasised that patient self-evaluation of his or her voice before and after treatment, although subjective by definition, is very important in clinical practice. According to the literature, the most widely used questionnaire to quantify the self-perceived changes in vocal well-being after a surgery, with or without speech therapy, is the VHI. This questionnaire is versatile and
easy for the patient to do, and also the one that contains the most relevant information about voice-related quality of life. However, it has been shown to be poor at detecting post-surgery changes when evaluating MTF transsexual patients, not finding significant differences between pre- and post-Wendler glottoplasty. That is why other specific questionnaires have recently been developed for this population group, which does not have a vocal pathology per se, but which considers their voice as an important part of their life and sexual identity. In this study we used a Spanish translation of the TSEQ, a new self-evaluation questionnaire for transsexuals that is increasingly used in medical settings. As seen in our results, the 10 MTF patients evaluated reported significant positive advances in respect to vocal quality and psychological well-being achieved after the intervention. Such positive self-perceptions of their own voice and psychological condition after the intervention most probably has to do with the Fo changes detected after the intervention (surgery + speech therapy) of the MTF patients in our study. In fact, other authors have emphasised that variation in pitch is the most important factor in perceiving the transsexual’s voice as that of a woman. As specialists well know, to differentiate a masculine voice from a feminine one the main parameter normally taken into account is vocal pitch, which is the perceptive or psychological equivalent of Fo. There is consequently a linear correlation between that and perceiving a voice as being masculine or feminine. Spencer has indicated that masculine voices generally have an Fo between 80 and 120 Hz, while it ranges from 180 to 220 Hz in feminine voices. Subjects with an Fo of around 180 Hz are perceptually identified as women and those with an Fo lower than 150 Hz, as men. The fact that our patients had an average post-surgery Fo value of 243 Hz, means that their voices emit a sustained /a/ (MPT) fairly comfortably at that frequency. This suggests that they will modulate their speaking voices in a conversational mid-tone above 180 Hz.

At any rate, although it is important that Fo is established by laryngeal features such as VF longitude, tension and size, Fo does not seem to be indispensable for distinguishing between masculine and feminine voices. There are others factors affecting the determination of the femininity of a voice: intonation (greater variability in the tonal curve in feminine voices), sound quality (softer in feminine voices), how the laryngeal joints are configured and act, and the resonance of the nasal cavity, paranasal sinuses and cranium. All these factors can play an important role in and can be influenced by vocal training in emission and modulation through specific techniques from what is called the “speech therapy aesthetics”. These techniques are similar to those used with training for voice professionals such as actors, public speakers and individuals that dub films and TV series.

The progress in conversational mid-tone achieved by the MTF transsexual patients in this study is also demonstrated by their results in perceptual evaluation. This is generally the type of clinical measure that is normally used with pathological voices through the GRBAS scale. This tool has a system of inter-evaluator agreement, in which patient voices are rated before and after treatment using a scale that evaluates 5 domains: grade for hoarseness (G), roughness (R), breathiness (B), and being aesthetic (weak) (A) and strained (S). Applying the GRABS scale would not properly evaluate feminization (which is the goal of the Wendler technique), although it would undoubtedly provide an evaluation of “vocal quality” obtained. In turn, this would give us data of interest to back the good results achieved. Every surgical technique affecting the VF’s is capable of being evaluated using this extensive, practical questionnaire. However, in our study we have chosen to use a perceptual scale that helps the evaluators to place the patients on a visual analogue continuum (VAS). The evaluators numerically rate the voices they hear as “feminine” (scores nearer to 1) or “masculine” (scores nearer to 5), so the greater the Fo and conversational tone are, the greater the sensation of femininity in the voice that a patient transmits is. Our study results are again conclusive in this aspect. The evaluators rated their average pre-treatment agreement at a score of around 4 (“somewhat masculine voice”), while their opinion changed after the surgery-speech therapy treatment ended, establishing a score of a bit more than 2 (“somewhat feminine voice”). This is more than consistent with the results found in the Fo register and in the self-evaluation of the patients themselves measured using the TSEQ.

According to the opinions and experiences described in the studies reviewed (see Remacle et al. and Mastronikolis), surgery alone does not seem to achieve the optimum results that MTF transsexual patients wish. Neither do the use of merely functional techniques (vocal technique) by themselves. Consequently, the success of the surgery through the Wendler technique appears to depend as much on correct ENT intervention from expert, well-trained hands as on the participation in the process of post-surgery treatment; such treatment covers functional techniques of voice emission, modulation and projection, with the help of an experienced speech therapist, who promotes the change in the vocal emission behaviour of the MTF transsexual patient to a register and intonation cure of the more naturally feminine voice. In this study, we have followed this rehabilitation process with our patients and all of them consequently received speech therapy after the surgery and the obligatory vocal rest.

In conclusion, it can be said that the Wendler glottoplasty, properly applied and with the necessary precautions not to damage the vocal ligament—which is the main risk—seems to be a very effective procedure, less aggressive than other techniques, to achieve acceptable voice feminization in MTF transsexual patients. This feminization can be demonstrated by the use of several pre- and post-surgery control measures evaluated in this study: changes in emission Fo, self-evaluation of the voice through a specific questionnaire (TSEQ) and perceptual evaluation measured by a visual analogue scale (VAS) of inter-evaluator agreement. The success of this type of treatment also seems to depend on factors such as the use of vocal re-education techniques by speech therapy training in voice emission, projection and modulation in conversation and in reading texts. The results shown in this study replicate, with partially different measures, those reached by other professionals from other countries around us. However, future studies should analyse, in depth and using the pertinent control groups, the true extent of systematic, prolonged voice training (speech therapy) in obtaining more feminine
voices after the Wendler glottoplasty. Up until now, the scientific literature—including this study—has not done so. The advisability of speech therapy training after the intervention can only be suggested heuristically. Further, more systematic designs of the variables and groups to be considered are needed, which would make it possible to better ascertain the scope of the treatment and the role played by speech therapy training in this process. For example, the achievement of long-term goals in voice feminization for transsexuals should include\(^\text{11,33}\): (a) going beyond the boundary of average tone between men and women of 155–165 Hz, (b) varying and modulating pitch in the frequent, exaggerated manner that a woman uses and (c) generalising and consolidating what the patient has learned into daily life.

Although the results obtained in this study are notable, we should acknowledge that this is only a retrospective study, with all the problems that such a study involves in homogenising the procedures used. Consequently, it will be necessary to form new sample groups with wider populations and more demanding designs, which allow us to better understand the keys required for effective management of this type of patients, their needs and the best treatment for them.

**Conflict of Interest**

The authors have no conflicts of interest to declare.

**References**

