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VOICE-RELATED OUTCOMES AFTER LONG-TERM ANDROGEN TREATMENT IN TRANS MALES

TRANS ERKEKLERDE UZUN DÖNEM ANDROJEN TEDAVİSİNİN SESLE İLİŞKİLİ SONUÇLARI

Seher Sirin[1,2*], Aslihan Polat[3,4]

University of Kocaeli, School of Medicine, [1]Department of Otorhinolaryngology-Head and Neck Surgery, [2]Voice Clinic, [3]Department of Psychiatry, Gender Dyshoria Clinic, [4]Community Mental Health Center, Kocaeli, Turkey

ORCID iD: Seher Sirin: 0000-0002-2982-9379; Aslihan Polat: 0000-0001-9649-8701

***Sorumlu Yazar / Corresponding Author:** Seher Sirin, **e-posta / e-mail:** ugurseher@hotmail.com

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Abstract

Objective: The aim of this study was to evaluate voice-related outcomes of long-term androgen treatment in trans male individuals.
Methods: Trans male individuals who were under hormone treatment for at least one year were evaluated. Self-Perception of Voice Masculinity (SPVM) scale, adapted Transsexual Voice Questionnaire for trans males (a-TVQ^{FtM}), Voice-related Quality of Life (V-RQOL), and the mean fundamental frequency (f0) were used to assess voice outcomes.
Results: Of the thirteen trans male individuals in this study, the mean age was 26.15 years. The median SPVM was 4, which equated to "somewhat male". The median f0 was 119 Hz and did not differ from Turkish cisgender male normative data. The median a-TVQ^{FtM} scores showed a decreasing trend and the median V-RQOL scale scores showed an increasing trend in accordance with the decrease of median f0 scores. Two individuals were within a gender ambiguous f0 range and a failure rate of 15.4% was observed. Of these two individuals who were still within a gender ambiguous f0 range, one perceived his voice as gender neutral, while the other one perceived his voice as very male.
Conclusion: Cross-sex hormone treatment was largely effective in voice masculinization for trans male individuals seeking treatment. Its pitch lowering effect is associated with a significant improvement in the voice-related quality of life of trans individuals, especially in vocal identity. In some cases, a cisgender male frequency may not be achieved. This situation should be evaluated with caution when discussing treatment outcomes and the necessity of additional interventions.

Keywords: *Voice, hormone therapy, transgender, testosterone, quality of life, self-perception*

Öz

Amaç: Bu çalışmanın amacı trans erkek bireylerde uzun süreli androjen tedavisinin sesle ilişkili sonuçlarını değerlendirmektir.
Yöntem: En az bir yıldır hormon tedavisi gören trans erkek bireyler değerlendirmeye alındı. Sesin Erkeksiliğini Algısal Değerlendirme (SPVM) ölçeği, trans erkekler için uyarlanmış Transseksüel Ses Anketi (a-TVQ^{FtM}), Sesle ilişkili Yaşam Kalitesi (V-RQOL) ve fundamental frekans (f0) ses sonuç ölçütleri kullanıldı.
Bulgular: Çalışmaya dahil edilen 13 trans erkek bireyin yaş ortalaması 26.15 idi. Medyan SPVM skoru 4 olup biraz erkeksi algılandığı gözlendi. Medyan f0 skoru 119 Hertz idi ve Türk erkek normatif verilerinden farklı değildi. Medyan a-TVQ^{FtM} skorlarındaki azalma eğilimi ve medyan V-RQOL ölçek skorlarında artış eğilimi, medyan f0 skorlarının düşüşü ile uyumlu idi. İki bireyin f0'ı cinsiyet belirsiz ses aralığındaydı ve % 15,4'lük bir başarısızlık gözlendi. Cinsiyeti belirsiz ses aralığında olan bu iki bireyden biri sesini nötral algılarken diğeri sesini çok erkeksi algıladı.
Sonuç: Karşı cins hormon tedavisi, tedavi isteyen trans erkek bireyler için erkeksi ses elde etmede etkilidir. Ses perdesini düşürücü etkisi, trans bireylerin sesle ilgili yaşam kalitesinde, özellikle de ses kimliği ile ilişkili anlamlı iyileşme sağlamaktadır. Bazı olgularda, erkek ses aralığı elde edilemeyebilir. Böyle bir durumda, tedavi sonuçları ve ek müdahalelerin gerekliliği dikkatle değerlendirilmelidir.

Anahtar Kelimeler: *Ses, hormon tedavisi, transseksüel, testosteron, yaşam kalitesi, öz algı*

Introduction

The term ‘trans’ or ‘transgender’, refers to individual whose self-gender identity differs from the sex they were assigned at birth based on their sexual characteristics. Accordingly, the term 'trans male' is used to address individuals whose self-gender identification is male for at least six months when their sex assigned at birth was female, while ‘cisgender male’ is used to define individuals whose self-gender identity and sex assigned at birth remains the same.[1]

With regards to voice, trans individuals represent a unique population. Whereas they have an anatomical and functionally intact vocal apparatus, they experience difficulties due to their voice features which do not match their gender identity which can further restrict both their social and working life.[2] Thus, obtaining a gender-appropriate voice is one of the essential and indispensable parts of the transition process of transgender individuals to acceptance in their new gender.[3]

Cross-sex hormonal treatment (CSHT) is considered to be the basic treatment for the gender transition process. The effect of testosterone on increasing muscle mass also occurs in vocal muscle mass and causes thickening of the vocal fold, which results in lowering the voice pitch and deepening of voice, as seen in boys during puberty.[4] These virilizing effects of testosterone treatment enable trans male individuals seeking treatment to achieve a voice that is more congruent with their gender identity and is considered to be an effective method of voice alteration in the desired direction. The voice pitch and its acoustic correlate, mean fundamental frequency (f0), has been reported to be the most important indicator of voice gender.[3,5] Lowering the voice pitch and deepening of the voice lead to a perception of voice as masculine.[4]

In the literature, although there are many studies investigating trans females’ vocal outcomes, there are only a small number of studies in trans males.[6] Most of the research in this field comes from western countries. Thus, there is a need for data from other regions of the world with different socio-cultural backgrounds.[2] To the best of our knowledge, there is no study reporting voice-related outcomes of hormone treatment of trans male individuals in Turkey.

The aim of this study was to evaluate voice-related outcomes after long-term androgen treatment in trans male individuals and the impact on these individuals’quality of life.

Methods

The study protocol was approved by the Institutional Review Board of the University of Kocaeli Medical School (KU/GOAEK 2019/18.23/302). Written informed consent was obtained from all participants included in the study.

Participant Selection

Medical records of the trans male individuals who completed the subjective and objective assessment measures in a single sitting were reviewed. Individuals who were under hormonal treatment for at least one year were included. The exclusion criteria were: individuals who were under hormonal treatment for less than one year, incomplete assessment measures, and hormone naïve individuals.

Outcome Measures

Sociodemographic Questionnaire

A sociodemographic questionnaire including age, job, educational status, socioeconomic status, employment status, relationship status, and smoking habit was used.

Self-Perception of Voice Masculinity (SPVM)

Participants rated their self-perception of the masculinity of their voice (SPVM) on a five-point Likert scale and each item has the following possible choices ranging from 1 to 5: ‘very female’, ‘somewhat female’, ‘gender neutral’, ‘somewhat male’ and ‘very male’. This rating scale was based on equal interval scales anchored with very female/feminine at one end and very male/masculine at the other.

Adapted Transsexual Voice Questionnaire for trans male (a-TVQ^{FtM})

The transsexual voice questionnaire (TVQ^{MtF}) is a population-specific self-administered measurement consisting of 30 items evaluating self-perception of voice and its impact on daily life for trans females, developed by Dacakis et al.[7] It’s a four-point Likert scale with scores ranging from 1 (never or rarely) to 4 (usually or always) and the total score varies between 30 and 120. Higher scores relate to a greater perception of negative voice-related experiences and negative psychosocial impact. An adapted transsexual voice questionnaire for trans male (a-TVQ^{FtM}) is in clinical use to serve a similar role.[8-11] The a-TVQ^{FtM} is quite similar to the original questionnaire; only the gender-specific words are different. The wording ‘feminine’ was changed to ‘masculine’ and ‘low pitch’ was changed to ‘high pitch’ while protecting the integrity of the sentence meaning. The remaining 24 items were used as in the same original measurement. According to the factor analysis of the a-TVQ^{FtM}, eleven items out of 30 relate to anxiety and avoidance (factor 1) and include questions about feeling anxious and restriction in social life or work because of the voice; eight relate to vocal identity (factor 2) and include questions about feeling less masculine/feminine than desired because of the voice and the incongruence between appearance and voice; and eleven relate to vocal function (factor 3) and include questions about voice characteristics.[11] Validity and reliability of TVQ^{MtF} in a Turkish population has been studied by Taşkın et al.[12] The psychometric properties of the Turkish version a-TVQ^{FtM}, which provides confidence to its suitability for use with Turkish trans male individuals, has been conducted by Sirin et al.[13].

Voice-Related Quality of Life (V-RQOL)

Voice-Related Quality of Life (V-RQOL), is a self-administered measurement consisting of 10 items evaluating the impact of voice-related problems experienced during the person's daily life, developed by Hogikyan and Sethuraman[14]. It is a five-point Likert-type scale ranging from 1 (none, not a problem) to 5 (bad as it can be). In addition, the overall QOL effect can also be calculated. V-RQOL scores were converted to a scale of 0 to 100, with a higher number indicating a better voice-related QOL. Validity and reliability of V-RQOL in a Turkish population has been studied by Tezcaner and Aksoy[15].

Acoustic Analysis

Analysis of the voice samples was performed with the Computerized Speech Lab software, Multi-Dimensional Voice Program (MDVP) model 5105 (Kay Elemetrics Corporation, Lincoln Park, New Jersey, USA) following a demonstration by the examiner. The average of two recorded voice samples of a sustained vowel /a/ was used in a quiet room with less than 50 dB of background noise with a microphone placed at a distance of 10 cm were calculated. A mean of 127.11 Hz ± 16.77 is accepted as the normative f0 data for Turkish cisgender males which was reported in a study with a similar methodology.[17] Testosterone treatment response was evaluated by its f0 lowering effect in trans male individuals.[17] Accordingly, the following f0 values were used: cisgender male normative frequencies ≤ 131 Hz and a gender ambiguous frequency range between 150 Hz and 185 Hz.[5,17,18] The gender-ambiguous range is defined as the range where the person's gender is unable to be identified by the voice pitch.[5] This gender-ambiguous range is also considered to indicate hormone treatment failure.[17,19]

Statistical Analysis

Statistical analysis was performed with SPSS v20 (IBM Corp., Armonk, NY, USA). Descriptive statistics are reported for all variables. Shapiro-Wilk test and graphical examinations were used to test the normality of the data. Non-parametric tests were applied to non-parametric data and in instances when the sample size was small. Data are expressed as mean (standard deviation) and median (range). One-sample t-test was used to compare with normative data. The correlation coefficient analyses were performed using Spearman's correlation test. All differences associated with a chance probability of 0.05 or less were considered statistically significant.

Results

Thirteen trans male individuals who were under hormone treatment for at least one year were included in this study. The mean±SD age was 26.15±7.60 (median 23, range 20-45,) years. The mean±SD duration of hormone treatment was 14.8±4.49 months (median 12, range 12-27,). Sociodemographic characteristics of the participants are presented in Table 1.

Table 1. Sociodemographic data of the participants

Sociodemographic characteristics	*n	%
Educational Status		
College	2	15.4
High School	9	69.2
Middle School	2	15.4
Employment Status		
Student	3	23.1
Employed	8	61.5
Unemployed	2	15.4
Socioeconomic Status		
Low	-	
Moderate	13	100
High		
Relationship Status		
Partnered	3	23.1
Single	10	76.9
Married	-	
Current Smoking	11	84.6

*Total number of participants

The mean±SD and median (range) of the subjective (SPVM, a-TVQ^{FtM}, V-RQOL) and the objective (f0) voice measurements were given in Table 2. With regard to SPVM, none of the participants perceived their voices as feminine. The median SPVM was 4 (range: 3-5), indicating "somewhat male". Five of the 13 participants (38%) perceived their voices to be very male, while seven of them (54%) perceived their voices to be somewhat male. Only one participant (8%) perceived his voice as gender neutral. The median overall a-TVQ^{FtM} score was 34 (range: 30-55) and the median V-RQOL scale score was 100 (range: 70.00-100.00), meaning a good voice-related quality of life. The median f0 was 119 (105-160) Hz, was within the cisgender male normative frequencies (≤ 131 Hz). The mean f0 of the study group was also compared with the normative data of Turkish cisgender males and no statistically significant difference was observed (p=0.902).

Table 2. Mean (SD) and median (range) of the a-TVQ^{FtM}, V-RQOL, SPVM, and f0 of the participants

Outcome Measures	Mean (SD)	Median (range)
SPVM	4.31 (0.63)	4 (3-5)
a-TVQ^{FtM}		
Anxiety and avoidance (f1)	13.31 (2.93)	13 (11-22)
Vocal identity (f2)	10.23 (2.49)	9 (8-15)
Vocal function (f3)	13.00 (2.24)	13 (11-19)
Total	36.54 (6.60)	34 (30-55)
V-RQOL	95 (9.52)	100 (70.00-100.00)
f0 (Hz)	126.46 (18.64)	119 (105-160)

SPVM: Self-perception of Voice Masculinity; a-TVQFtM: Adapted Transsexual Voice Questionnaire for trans male; V-RQOL: Voice-related Quality of Life; f0: Mean Fundamental Frequency; Hz: Hertz

When the hormone treatment responses were evaluated, two of 13 participants were within a gender ambiguous range (between 150 and 185 Hz) and thus a failure rate of 15.4% was observed. Interestingly, one of these two patients perceived his voice as gender neutral with an f0 of 160 Hz, while the other perceived his voice as very male with an f0 of 155 Hz.

The median subjective and objective voice measurement scores were evaluated according to masculine gender performance based on f0 values (Table 3). As the gender performance tended towards masculine, the median a-TVQ^{FtM} scores showed a decreasing trend and the median V-RQOL scale scores showed an increasing trend in accordance with the decrease of median f0 scores.

The strength and direction of the relation of f0 with the trans-specific voice questionnaire, a-TVQ^{FtM}, was evaluated. The f0 scores did not show a significant relation with the anxiety and avoidance factor or the vocal function factor and neither did they correlate with the overall scores of a-TVQ^{FtM} scores (r=0.374, r=0.079, and r=0.483, respectively), whereas a significant strong positive correlation with vocal identity factor was observed (r=0.632, p=0.020).

Discussion

The main purpose of the CSHT is to obtain secondary sexual characteristics in order to enable trans male individuals to acquire more masculine features that are more appropriate to their gender identity and, therefore, reduce their gender dysphoria. In addition to cessation of menstruation, an increase in body and facial hair, an increase in lean mass and strength, a decrease in fat mass,

Table 3. Median (range) a-TVQ, SPVM, and f0 scores of the participants according to masculine gender performance based on f0 values

Masculine Gender Performance	a-TVQ$^{FtM}_{T}$	V-RQOL	f0 (Hz)	SPVM	Smoking	Hormone duration
150-185 Hz, n (2)	47 (39-55)	85.00(70.00-100.00)	175.50 (155-160)	4 (3-5)	100%	12 (12-12)
132-149 Hz, n (2)	40.5 (40-41)	88.75 (80.00-97.50)	144.50 (142-147)	4 (4-4)	100%	15 (12-18)
≤ 131Hz, n (9)	33 (30-38)	100.00 (90.00-100.00)	116.00 (105-127)	4 (4-5)	77.8%	12 (12-27)

a-TVQFtM: Adapted Transsexual Voice Questionnaire for trans male; SPVM: Self-perception of Voice Masculinity; f0: Mean Fundamental Frequency; V-RQOL: Voice-related Quality of Life

Table 4. Frequency-related voice outcomes in trans male individuals under hormone treatment for at least one year of the aggregated literature

Source	n	f0 (Hz) Median	Range	Average of hormone duration	Reported failure rate (%) (f0 range,Hz)
Cosyns et al.[19]	38	109	83-163	≥ 10.7 years	10% (150-163)
Nygren et al.[21]	36	127	89-170	12 months	16.7% (143-170)
Current study	13	119	105-160	14.77 months	15.4% (155-160)
Deuster et al.[22]	9	119	96-140	13 months	-
Scheidt et al.[23]	8	114	103-139	22.6 months	-
Hancock et al.[24]	7	119	87-128	12 months	-
Van Borsel et al.[20]	2	140	128-152	12.5 months	50%
Van Borsel et al.[25]	2	161	120-182	31.5 months	50%
Damrose et al.[26]	1	113	-	16 months	-

n: number of participants; f0: Mean Fundamental Frequency; Hz: Hertz

and voice masculinization are the most desirable effects of androgen therapy for trans males.[4]

Achieving masculine characteristics provide a more congruent feeling with their gender identity and well-being, and, therefore improves the quality of life of trans individuals seeking treatment. It has been reported that more congruent voice features predict greater psychosocial well-being.[10] Watt et al.[10] reported a mean a-TVQ^{FtM} score of 40 in individuals receiving hormone therapy for an average of 15 months. In a long-term follow-up study by Bultynck et al.[9], improved a-TVQ^{FtM} scores were reported in all three subscales (factor 1:14.28 ± 6.20, factor 2:12.20 ± 6.08, and factor 3:16.88 ± 6.58, respectively). In our study group, a good voice-related quality of life was also found in accordance with the literature. Additionally, f0 was found to be correlated to the vocal identity subscale (factor 2) of a-TVQ^{FtM} in our sample. This finding might well support the rationale of using f0 as an objective voice masculinity criteria in order to measure CSHT success.

The importance of masculine voice was highlighted by Van Borsel et al.[20], where 14 out of 16 cases reported voice alteration as important as sex reassignment surgery. The f0 lowering effect of testosterone treatment is accepted as leading to a perception of voice as masculine. Since the mean voice f0 in our study group did not differ from the Turkish cisgender male normative data, it can be said that testosterone treatment is effective in serving this purpose.

There is a paucity of studies investigating voice-related outcomes of testosterone therapy.[6] The most likely reason for this is thought to be the effectiveness of hormone therapy in obtaining an acceptable masculine voice.[6] Indeed, f0-related outcomes of long-term androgen treatment of some of the studies that in this field have been summarized in Table 4.[19-26] Including our study, almost all reported an average f0 within cisgender male normative range. However, the details of these studies reveal that this is not the case for each and every individual and several cases can still have an f0 within a gender ambiguous range.[19-21,25]

Testosterone is not completely successful in reducing the f0 to cisgender male normative range. Cosyns et al.[19] reported that pitch-lowering difficulties were observed in 10% of their 38 cases and this was partly related to decreased androgen sensitivity. Nygren et al.[21] reported an insufficiency in pitch lowering in six (16.7%) of their 36 cases who were on their first-year hormone treatment. A combined estimated rate of failure to achieve a cisgender male frequency has been reported to be 21%.[17] In our study, two out of 13 individuals were within a gender ambiguous f0 range despite long-term testosterone treatment. Thus, the failure rate of 15.4% in our cohort was consistent with the literature.

However, f0 should not be the only criteria to judge the success of CSHT in trans males. Although testosterone acts by lowering f0, the ultimate goal of the CSHT is the individual's voice satisfaction during gender reassignment process. Hancock et al.[24] reported the SPVM scores of their seven participants who have all achieved a cisgender male f0 to be as male. Whereas Nygren et al.[21] reported that although most of their participants were satisfied with their voice following testosterone treatment, some of them presented with voice complaints and received voice therapy. Nonetheless, they did not provide detail about the satisfaction status of the above-mentioned six cases who failed to achieve sufficient pitch lowering. In our study, f0 and SPVM were assessed together. All of the individuals who achieved a cisgender male f0 perceived their voices as male. Of the two individuals who were still within a gender ambiguous f0 range, one perceived his voice as gender neutral. Interestingly, the other one perceived his voice as very male. There may be different explanations for this very masculine voice perception felt in the ambiguous f0 range. First of all, f0 is not the only distinctive acoustic parameter between masculine and feminine voice. Other factors such as formant frequencies, sound pressure level, voice range, resonance, voice quality, resonance, and, speech and communication properties are known to play a role in voice gender perception.[20,27,28] Beyond these, the perception of voice masculinity may vary from person to person and trans individuals can not be considered as a homogeneous group in terms of perception and expectation.[29]

It is important to also highlight this situation from a clinical point of view. Although these two individuals have similar

f0 results, only the one who perceives his voice as gender neutral asked for further intervention including voice therapy and surgery. On the contrary, the other one who perceived his voice as very male did not require any additional procedure as he was satisfied, even though he did not reach cisgender male normative voice range.

Although our findings should be interpreted with caution because of the small sample size this is the first study reporting the results of CSHT in Turkish trans male individuals. The question is how do the subjects that we assume as failed perceive their voice in terms of satisfaction? When discussing the success of CSHT regarding to voice, both subjective and objective voice parameters should be taken into consideration because further intervention may not be necessary for some cases. Beyond these, a non-binary perspective should also be kept in mind when evaluating self-perception and expectation of voice, especially before treatment management decision.

Limitation

Although relatively small sample size is the main limitation of our study, it should be taken into consideration that most of the studies in this field have small sample size, as emphasized by Azul et al.[6] Due to the lack of an age and smoking matched cisgender male control group, we have compared our results with the reported normative data for Turkish cisgender males. Lastly, being a single-institution prevents generalization of our results to other institutions.

Conclusion

CSHT is effective in voice masculinization for trans male individuals seeking treatment. Its pitch lowering effect is associated with a significant improvement in the voice-related quality of life of trans individuals, especially in vocal identity. In some cases, a cisgender male frequency may not be achieved with CSHT. This situation should be evaluated with caution when discussing treatment outcomes and the necessity of additional interventions. Finally, a non-binary perspective should also be kept in mind by all healthcare providers.

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Conflict of Interest

The authors have no conflicts of interest to declare.

Compliance with Ethical Statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval was obtained from the Institutional Review Board of the Kocaeli University, School of Medicine (KU/GOAEK 2019/18.23/302). Informed consent was obtained from all individual participants included in the study.

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Author Contributions

SS, AP: Design; SS, AP: Project development; SS: Data collection; SS, AP: Analysis; SS, AP: Literature search; SS, AP: Manuscript writing

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