The Effectiveness of Pitch-raising Surgery in Male-to-Female Transsexuals: A Systematic Review

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Summary: Objectives. This study aimed to review the evidence of the effectiveness of pitch-raising surgery performed in male-to-female transsexuals.

Methods. A search for studies was performed in PubMed, Web of Science, Science Direct, EBSCOhost, Google Scholar, and the references in retrieved manuscripts, using as keywords "transsexual" or "transgender" combined with terms related to voice surgery. We included eight studies using cricothyroid approximation, six studies using anterior glottal web formation, and six studies using other surgery types or a combination of surgical techniques, leading to 20 studies in total.

Results. Objectively, a substantial rise in postoperative fundamental frequency was identified. Perceptually, mainly laryngeal web formation seems risky for decreasing voice quality. The majority of patients seemed satisfied with the outcome. However, none of the studies used a control group and randomization process. Further investigation regarding long-term results is necessary.

Conclusion. Future research needs to investigate long-term effects of pitch-raising surgery using a stronger study design.

Key Words: transsexualism–male-to-female–voice–surgery.

INTRODUCTION

"Transsexualism is a problem of gender identity where an individual is firmly convinced that his or her psychologic gender is the opposite of his or her anatomic gender. The transsexual has a strong desire to physically resemble the opposite sex and wishes to be accepted by society as belonging to that sex."[1] The most salient acoustic cue to gender identity is speaking fundamental frequency (f0).[2–4] Hence, to be perceived as the other sex, the f0 of transsexual persons needs to be altered. Female-to-male transsexuals generally demonstrate an acceptable male voice after long-term androgen therapy.[5] To be perceived as females, male-to-female transsexuals need to increase their speaking f0 of about 120 Hz to 150–155 Hz.[3,4] This increase can be accomplished through voice therapy or through pitch-raising surgery. In general, two types of surgical techniques can be performed: raising the tension of the vocal folds through elongation, or decreasing the vibrating portion of the vocal folds. Elongation of the vocal cords is usually accomplished by cricothyroid approximation (CTA), which means fixing the cricoid cartilage to the thyroid cartilage. A decrease of the vibrating portion of the vocal folds can be accomplished by creating a web in the anterior commissure or reducing thyroid cartilage and vocal folds. The goal of the present study was to review the evidence of effectiveness of pitch-raising surgery performed on male-to-female transsexuals. To the best of our knowledge, no such systematic review has been performed previously.

METHODS

A literature search was performed in PubMed, Web of Science, Science Direct, EBSCOhost, and Google Scholar, using as search terms "transsexual" and "transgender" combined with "voice surgery," "thyroplasty," "cricothyroid," "cricothyroid approximation," "webbing," "cricothyroplasty," "pitch raising surgery," "scarification," "evaporation (by laser)," "chordal injection of the steroid," "phonosurgery," "cricothyroidopexy," "laryngeal framework surgery," "thyroid cartilage and vocal fold reduction," "laryngofissure," "operative voice therapy," and "longitudinal incision." Inclusion criteria were as follows: (1) type of participants: male-to-female transsexuals; (2) type of intervention: pitch-raising surgery; (3) types of outcome measures: objective (eg, acoustic) and/or subjective (eg, perceptual analysis or self-report); and (4) type of study: original pre-post research reports published in English in peer-reviewed journals, without restriction based on date. In consensus between two of the authors, one article reporting the results of a modified surgical technique published in a non–peer-reviewed journal was included.[6]

RESULTS

In total, 3185 publications were identified. Based on reading of the titles and abstracts and excluding repetitions and research reports using a posttest-only design, 20 articles were selected for complete reading. Eligible studies were categorized by surgery type (CTA, laryngeal web formation, and other), and quality was appraised using a quality assessment tool for pre-post studies without control group.[7] One of the tool's criteria concerned interventions that were conducted at group level. Because surgical interventions are applied at the individual patient level, this criterion was not included in the quality appraisal.

Descriptive analysis

As shown in Table 1, the study objectives were clearly stated in all studies.[6,8–26] In 12 cases, eligibility criteria were described.[6,8,15–19,21–23,25,26] As far as age is concerned, in most cases, study participants were representative for the clinical population.[6,8,9,13–15,17–26] Exceptions were the studies by Debruyne et al,[10] Donald,[11] and Gross,[12] which provided no details about

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TABLE 1.
Quality Appraisal and Summary of Studies Included in the Systematic Review

	Study Question	Eligibility Criteria	Representative Participants	All Eligible Participants Enrolled	Sample Size	Intervention Clearly Described	Outcome Measures Clearly Described, Valid, and Reliable	Blinding of Outcome Assessors	Follow-up Rate	Statistical Analysis	Multiple Measurements of Outcome
Cricothyroid approximation											
Brown et al[9]	x	NR	x		n = 14	x	x Acoustic: modal f0: 142 Hz to 174.6 (+31.57 Hz); Perceptual: significant correlation between perception as female and modal f0		x	x	x in 4/14
Debruyne et al[10]	x	NR			n = 5		x Acoustic: mean f0: ↑[16–131 Hz]; range ↑; spectrum: H1↑, H2 and H3 ↓		x		x in 3/5
Hamdan[13]	x	NR	x		n = 1	x	No measurements		x		
Neumann and Welzel[18]	x	x	x		n = 67	x	x Acoustic: mean f0: +25% (5–6 ST); f0 range + dynamic range: ↓; Anatomical: length vocal folds + 5 mm (CT); Perceptual: pitch: ↓ in male, ↑ in female, and neutral range		x		x in 45/67
Pickuth et al[20]	x	NR	x		n = 29		x Acoustic: mean f0: 118 Hz to 226 Hz (+108 Hz); Anatomical: mean reduction of cricothyroid distance: −6 mm ($P < 0.01$), correlation with pitch elevation.		x	x	
Söderpalm et al[22]	x	x	x		n = 2		x Acoustic: P1: mean f0: 152 Hz to 164 Hz (+12 Hz); range: identical. P2: mean f0: 143 Hz to 172 (+29 Hz); range: −12 semitones		x		x in 1/2
Van Borsel et al[24]	x	x	x		n = 9		x Acoustic: mean f0: +50.62 Hz Perceptual: post-op rating of femaleness: male < MTF < female	x	x	x	
Yang et al[26]	x	x	x		n = 20	x	x Acoustic: mean f0: 134 Hz to 185 Hz (+51 Hz); jitter and range: no significant change. Perceptual: post-op satisfaction: 58% satisfied.		x		x in 14/20
Anterior glottal web formation											
Anderson[6]	x	x	x	x	n = 6	x	x Acoustic: 134 Hz to 244 Hz (+110 Hz); f0 range ↓; dynamic range reported to be ↓ for at least 6 months post-op; jitter and shimmer: no change.		x		
Anderson[8]	x	x	x	x	n = 10	x	x Acoustic: mean f_0: 128 Hz to 238 Hz (+110 Hz); range/jitter/shimmer: no difference.		x	x	x
Donald[11]	x	NR			n = 3	x	No measurements		x		
Gross[12]	x	NR			n = 10	x	x Acoustic: mean f0: 117 Hz to 201.0 Hz (+84 Hz); f0 range ↓; dynamic range↓.		x		
Mastronikolis et al[17]	x	x	x		n = 31	x	x Acoustic: mean f0: 136 to 206 Hz (+70 Hz); range/MPT/PQ: no significant difference; ESGP: ↑. Perceptual: self-evaluation (VHI): no significant difference; voice quality: grade ↑		x	x	
Remacle et al[21]	x	x	x	x	n = 15	x	x Acoustic: median f0: 150 to 194 Hz (+44 Hz); range ↓; jitter ↑; EGSP ↑: MPT, PQ: no significant difference Perceptual: grade ↑; VHI: no significant difference		x	x	x
Other											
Isshiki et al[14]	x	NR	x		n = 1	x	Acoustic: mean f0: 110 Hz to 164 Hz (+54 Hz)		x		
Kanagalingam et al[15]	x	x	x		n = 21	x	x Acoustic: modal f0: 120 Hz to 191 Hz (+71 Hz); irregularities: no significant change.		x	x	x in 15/21
Kunachak et al[16]	x	x			n = 6	x	x Acoustic: mean f0: 147 Hz to 315 Hz (+168 Hz); jitter: 2.35% to 0.98 %; shimmer: 0.82 to 0.69 dB; MPT: 15 to 14 s. Perceptual: all subjects satisfied.		x		x in 4/6
Orloff et al[19]	x	x	x		n = 31	x	x Acoustic: mean f0 142 Hz to 168 Hz (+26 Hz); Perceptual: gender perception by blinded listeners: 6/10 female, 1/10 male, 3 both; self-perception: ↓ loudness, range, and clarity.	x		x	
Thomas and Macmillan[23]	x	x	x		n = 76	x	x Acoustic: mean f0: 139 Hz to 196 Hz (+57 Hz); range: significant decrease.		x	x	
Wagner et al[25]	x	x	x	x	n = 14	x	x Acoustic: mean f0: increase of 11 Hz (7 patients >160 Hz); range and irregularities: no significant change. Perceptual: 78.5% of patients and 71.5% of speech therapists satisfied.		x	x	

Note: NR = not reported.
Abbreviations: CT, cricothyroid; EGSP, estimated subglottic pressure; MPT, maximal phonation time; MTF, male-to-female; PQ, phonation quotient; ST, semitones.