THE EFFECTS OF SUBCUTANEOUS TESTOSTERONE IMPLANTATION ON THE FEMALE VOICE

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INTRODUCTION

It has been well-documented in the literature that there is a relationship between hormones and human voice in males and females at the cellular, anatomical and physiologic levels.

Androgen, progesterone and testosterone receptors have been identified on the vocal folds, with androgen receptors identified most frequently [2,3]. Voice change during uninterrupted puberty in men typically occurs between ages 12.5 and 14, resulting from a series of specific laryngeal changes, including growth of the thyroid cartilage, decrease in thyroid angle, thickening of the thyro-arytenoid muscle and mucosal layers, and widening of the cricothyroid muscle [4]. An approximate one octave decrease in fundamental speaking frequency in males results due to increased vocal mass [4].

During uninterrupted puberty in women, estrogen and progesterone secretion causes a slight thickening of the thyroarytenoid muscle, resulting in a growth of approximately 34% [4]. Additionally, small doses of androgens are secreted, resulting in low pitched harmonics to develop [4]. There is a lowering of 2.5 semitones that may be imperceptible to the untrained ear. The menstrual cycle can be divided into two primary phases, the follicular phase (days 1-14) and the luteal phase (days 15-28), during which varying levels of estrogen and progesterone affect the larynx is specific and unique ways [5]. Estrogen contributes to a thickening of the mucous membrane, resulting in an increase in vibratory amplitude. Permeability of the blood vessels contributes to improved oxygenation [5]. Progesterone secretion, occurring only during the luteal phase, results in thickening of the vocal folds due to desquamation [5]. Secretions thicken and there is a decrease in vocal fold muscle tone [5]. Functionally, this may result in vocal fold dryness and impaired flexibility. Premenstrual vocal syndrome typically occurs one week before menses (with menses beginning on day one), with the secretion of progesterone resulting in laryngeal mucosal dryness and diminished vocal fold flexibility, thus increasing susceptibility to vocal injury [1]. Masculinity of the female voice may occur during menopause secondary to reduction in the ratio of systemic progesterone and estrogen levels to testosterone levels [5]. The effects of the reduction in these hormones may be further compounded with the natural effects of aging on the larynx, such as atrophy and thinning of the vocal folds, leading to decreased elasticity.

A woman turning 25 in the year 2013 is expected to live, on average, until age 85 [6]. The systemic consequences of androgen deficiency in post-menopausal women have not been fully established; though decreased libido, chronic headaches, cognitive difficulties, fatigue, decreased strength, pain and hot flashes are some of the most common physical complaints that have been documented. Testosterone therapy is being increasingly prescribed to improve these symptoms in both pre and postmenopausal woman.

Testosterone may be administered in the form of a small pellet, slightly larger than a grain of rice, inserted subcutaneously under local anesthesia, through a small trocar. This method of delivery allows for the consistent gradual release of testosterone into the bloodstream for acceptance by the target hormonal organs. Testosterone, delivered by pellet implant, has been shown to relieve somatic, psychological, and urogenital symptoms in both pre and postmenopausal women [7].

To date, no studies have documented the potential positive or negative effects of testosterone pellet implantation on the female voice. The aim of this prospective collective case study compilation is an attempt to determine whether or not testosterone treatment via pellet implantation will result in significant change of fundamental speaking frequency within the female speaking voice.

METHODS

Human Data

Ten female subjects were included in this study ranging in age from 35 to 59. All subjects were referred to The Blaine Block Institute for Voice Analysis and rehabilitation for this study by their treating physician (RG) after being identified as potential candidates for testosterone implantation therapy.

Instrumentation and Measurement

Acoustic data was collected at four specified intervals: pre-implantation of pellet, three months into treatment,

six months into treatment and one year into treatment. Acoustic samples were recorded in a quiet room using an Olympus digital recorder at a measured distance of 10 cm. Samples consisted of the CAPE-V sentences, the Rainbow passage and a conversational speech sample. Samples were segmented by task and analyzed via Real Time Pitch with fundamental frequency of each sample analyzed and averaged.

Analysis

A single factor analysis of variance with repeated measures was conducted to determine if there was a quantitative change in fundamental frequency from pre- to post- treatment.

RESULTS

No statistically significant differences in average fundamental speaking frequency were noted between the pre-treatment group and any post-treatment groups. However, within-subject variability was noted. Findings of this study suggest the biggest change in fundamental frequency between pre-treatment and three months into treatment. For the purposes of discussion, results will be examined as individual case studies in order to provide pilot data for future investigations.

DISCUSSION

Three subjects were noted to have lower than normal fundamental speaking frequencies prior to pellet implantation as compared to previously established normative data for average fundamental speaking frequencies of adult women [8]. Of the three subjects with an initial finding of lower than typical fundamental speaking frequency, two of them presented with an upward trend of fundamental speaking frequency following three months, six months and one year after implantation. This may indicate that the implantation of testosterone pellets in lower than average fundamental frequency female subjects may trend towards increasing their speaking frequency to a more expected range.

In contrast, three subjects who fell within an expected fundamental speaking frequency range pre-implantation for their age and gender resulted in a downward trend of fundamental speaking frequency, indicating the possibility of a negative effect of testosterone implantation on fundamental speaking frequency.

Two subjects presented with variability in fundamental speaking frequency over time with no obvious pattern. Subject variability within a specific task may explain this, as one audio recording was taken per patient, per session. Multiple audio samples with novel materials during each session may ensure more representative samples. Lack of homogeneity in this study is considered a primary limitation, as four of ten subjects were smokers with an additional subject having quit one month prior to the study.

CONCLUSION

Despite voice difficulties reported in this private practice clinic by patient's undergoing subcutaneous testosterone treatment, the majority of these patients elect to continue treatment, reporting a marked improvement in quality of life. Though no statistically significant change in fundamental frequency was noted among subjects in the group study, variability among subjects and study limitations should be recognized. Future investigations should utilize and more homogenous sample size with women with pre-treatment fundamental speaking frequencies within normal limits for age and gender. Upward trending noted suggests a need for a study regarding the potential positive impacts of this treatment for patients with a lower than typical fundamental speaking frequency. Lastly, women younger than the mean onset of menopause are being considered for testosterone implantation treatment, indicating the need for examination the effects of this treatment on a younger female population.

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