

# The role of thyroplasty in the management of sulcus vocalis

## Sulkus vokalis tedavisinde tiroplastinin yeri

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**Objectives:** The results of objective and subjective evaluation of postoperative vocal function were assessed in patients treated with thyroplasty for the correction of sulcus vocalis.

**Patients and Methods:** Six patients (5 males, 1 female; mean age 26 years; range 18 to 34 years) underwent thyroplasty for sulcus vocalis. Voice evaluations were performed one week before and two months after surgery. None of the patients had voice therapy before evaluations in the postoperative period. The mean follow-up period was 14.8 months.

**Results:** Compared to the preoperative values, postoperative voice handicap index scores were significantly different ( $p=0.002$ ). However, the difference between the dysphonia severity index (DSI) scores were not significant ( $p=0.810$ ).

**Conclusion:** A subjective rather than an objective improvement was observed in voice. Our results suggest that, in the evaluation of voice patients, therapeutic success should not be based only on objective criteria, but subjective criteria should also be considered.

**Key Words:** Thyroid cartilage/surgery; speech acoustics; vocal cords/pathology/surgery; voice disorders/surgery.

**Amaç:** Bu çalışmada sulkus vokalisin düzeltilmesi için tiroplasti ameliyatı yapılan hastalarda ameliyat sonrası objektif ve subjektif ses değerlendirme sonuçları incelendi.

**Hastalar ve Yöntemler:** Çalışmaya sulkus vokalis nedeniyle tiroplasti ameliyatı yapılan altı hasta (5 erkek, 1 kadın; ort. yaş 26; dağılım 18-34) alındı. Ses değerlendirmeleri ameliyattan bir hafta önce ve iki ay sonra yapıldı. Hastaların hiçbirine ameliyat sonrası dönemde ses değerlendirmeleri öncesinde ses terapisi uygulanmadı. Ortalama takip süresi 14.8 aydı.

**Bulgular:** Ameliyat öncesi ile karşılaştırıldığında, VHI (voice handicap index) skorlarında anlamlı değişiklik görüldü ( $p=0.002$ ). Disfoni şiddet indeksi skoru ise, ameliyat öncesine göre anlamlı farklılık göstermedi ( $p=0.810$ ).

**Sonuç:** Bu çalışmada hastaların seslerinde objektif düzelmeden ziyade subjektif düzelme olduğu görüldü. Bulgularımız, ses hastalarının değerlendirilmesinde başarının sadece objektif ölçütlere dayandırılmayacağı, aynı zamanda subjektif ölçütlerin de göz önüne alınması gerektiğini göstermektedir.

**Anahtar Sözcükler:** Tiroit kartilaj/cerrahi; konuşma akustiği; vokal kord/patoloji/cerrahi; ses hastalıkları/cerrahi.

The term sulcus vocalis has been applied to a spectrum of disorders ranging from minor vocal fold indentations to destructive lesions causing severe dysphonia.<sup>[1]</sup> The condition is characterized by a

groove of mucosa along the surface of the vocal fold(s). In the area of the sulcus, the mucosa is scarred down to the underlying vocal ligament, giving it a retracted appearance. Videostroboscopy

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reveals an area of decreased mucosal wave corresponding to the sulcus and more clearly demonstrates the associated incomplete closure.

The symptoms of the patients with sulcus vocalis are hoarseness, vocal fatigue, voice weakness, and increased effort, which are mostly the signs of glottal insufficiency. The voice is hoarse and breathy, and vocal performance is decreased.

Sulcus vocalis may be congenital or secondary to vocal trauma, infection, degeneration of benign lesions, or surgery.

Treatment of sulcus vocalis needs to achieve anatomical and functional improvements that satisfy the behavior of the larynx and vocal quality.<sup>[2]</sup> There is no consensus on the treatment of sulcus vocalis. Though some authors advise the voice therapy techniques, most of the authors prefer surgical management with/without voice therapy. It is our belief, that only voice therapy will not fulfill the requirements needed to treat the symptoms of sulcus vocalis. But, before considering surgery, any concomitant condition such as reflux laryngitis affecting voice should be treated and abusive behaviors in voice should be reduced to maximize the benefits of surgery. Then, patients with sulcus vocalis are scheduled for surgery in our clinic. Voice therapy is performed only in patients with unsatisfactory surgical results.

In this study, thyroplasty results of six patients with sulcus vocalis are reviewed.

## PATIENTS AND METHODS

Six patients (5 males, 1 female; mean age 26 years; range 18 to 34 years) were included in the study. They were operated between October 2002 and June 2004. The mean follow-up time was 14.8 months. The voice evaluations were performed one week before and two months after the surgery. None of the patients had voice therapy before the voice evaluation in the postoperative period.

### Videolaryngoscopy

The diagnosis of sulcus vocalis was established by videolaryngoscopy using a 70° rigid scope (Karl Storz, Tuttlingen, Germany).

### RBH (Auditive analysis)

Roughness(R), breathiness(B), and hoarseness(H) were estimated by the author with the patients read-

ing a passage from the Turkish text "Kasagi" by Omer Seyfettin. These parameters were evaluated as 0= normal or absent deviance, 1= slight deviance, 2= moderate deviance, 3= severe deviance.

### Acoustic analysis

Analysis of jitter(%) allows the relative evaluation of the period-to-period variability of the pitch within the analyzed voice sample. These parameters were analyzed on a sustained /a:/ using the Multi Dimensional Voice Program (MDVP) with the Computerized Speech Lab CSL 4300B (Kay Elemetrics Ltd., Lincoln Park, NJ, USA).

### Voice range profile (VRP)

Voice range profile identifies the minimal I (low) and maximal amplitude and the lowest and highest frequency F<sub>0</sub>(high) of the voice range. They were measured by Computerized Speech Lab CSL 4300B (Kay Elemetrics Ltd., Lincoln Park, NJ, USA).

### Maximum phonation time (MPT)

Maximum phonation time is the simplest aerodynamic parameter of phonation in seconds. This parameter was measured on a sustained /a:/ after full inspiration in a comfortable loudness.

### Disphonia severity index (DSI)

In assessing the dysphonia severity, the formula [DSI= 0.13xMPT+0.0053xF<sub>0</sub>(high)-0.26xI(low)-1.18x jitter(%) +12.4] was used.<sup>[3]</sup>

### Voice handicap index (VHI)

This is a question and answer tool that has been developed for the assessment of the amount of disability that the voice disorder is causing. The questions or statements in the index are statements that many people have used to describe their voices and the effects of their voices on their lives. The patients were instructed to mark one of the responses below that indicates how frequently they have the same experience.

0= Never, 1= Almost never, 2= Sometimes, 3= Almost always, 4= Always.

Responses are scored from 0 to 4 for each question. At the completion of the VHI, the score can be totaled for a VHI score ranging from 0 to 120. The higher the number, the greater amount of disability due to a voice-related problem. The interpretation of the results: A score from 0 to 30= This is a low score

and indicates that there is most likely a minimal amount of handicap associated with the voice disorder. A score from 31 to 60= Denotes a moderate amount of handicap due to the voice problem. A score from 61 to 120= This score represents a significant and serious amount of handicap due to a voice problem.<sup>[4]</sup>

These examinations were performed according to the recommendations of the Union of European Phoniaticians (UEP).<sup>[5]</sup> Statistical analysis was performed using paired sample t-test.

### RESULTS

Table I shows the pre- and postoperative voice evaluation scores of the patients. Postoperative VHI scores were significantly different than the preoperative scores (p=0.002). The difference between pre- and postoperative DSI scores was insignificant (p=0.810).

### DISCUSSION

A clinically useful classification for sulcus vocalis is as follows: type 1 is a physiologic variant accentuated by atrophy but with intact lamina propria; types 2 (sulcus vergeture) and 3 (sulcus vocalis) are characterized by severe dysphonia, loss of vibratory activity, and destruction of the functional superficial lamina propria.<sup>[1]</sup>

Incidence of sulcus vocalis is not known. In a study of autopsy specimens by Nakayama et al.<sup>[6]</sup> sulci were identified in 20% of specimens. Most sulci are undiagnosed because of subclinical symptoms (type 1), lack of clinician awareness, and difficulty in identification due to limited availability of laryngoscopy.

As a rule of thumb, anatomic changes in the vocal folds are difficult or impossible to treat with medication alone. In the management of sulcus vocalis, any concomitant condition such as reflux laryngitis affecting the voice should be evaluated and treated. Misuse and/or abusive behaviors in voice should be treated or at least reduced before considering a surgical therapy to maximize the benefits of surgery.

Voice therapy is focused on improving phonatory technique and vocal hygiene. The primary goal of voice therapy is to improve vocal efficiency.

Medialization of the affected cord through thyroplasty or vocal fold augmentation techniques, or restoring the sliding motion of the affected mucosal cover are the goals of surgical therapy.<sup>[7-9]</sup> In addition; through thyroplasty type 3, the tension in the vocal cord could also be reduced. In one of our patients, thyroplasty type 1 to the effected cord and type 3 to the other vocal cord were both applied, but

TABLE I

THE SURGERIES PERFORMED AND VOICE ANALYSIS DATA OF THE STUDY GROUP PRE- AND POST-OPERATIVELY

Patient number	Age	Sex	Surgery	R	B	H	Jitter (%)	F <sub>0</sub> -High (Hz)	I-Low (dB)	MPT (sec)	DSI	VHI
1 (Pre-op)	18	F	Thyroplasty type 1+3	3	1	3	2.70	466	50	13	0.5	92
1 (Post-op)				3	1	3	2.98	445	48	16	0.9	72
2 (Pre-op)	21	M	Thyroplasty type 1	2	2	2	0.58	262	48	13	2.4	94
2 (Post-op)				2	1	2	0.98	255	55	14	0.2	67
3 (Pre-op)	34	M	Thyroplasty type 1	2	2	2	1.32	587	56	11	0.9	47
3 (Post-op)				2	1	2	1.44	602	50	14	2.8	27
4 (Pre-op)	32	M	Thyroplasty type 1	2	2	2	0.528	415	58	11	0.4	40
4 (Post-op)				2	2	2	0.412	449	55	14	1.9	28
5 (Pre-op)	26	M	Thyroplasty type 1	2	0	2	8.91	660	52	24	-4.9	39
5 (Post-op)				2	0	2	6.44	643	60	22	-4.4	25
6 (Pre-op)	29	M	Thyroplasty type 1	2	2	2	5.587	440	54	10	-4.5	98
6 (Post-op)				2	1	2	4.112	469	55	14	-2.3	60

MPT: Maximum phonation time; DSI: Disphonia severity index; VHI: Voice handicap index; F: Female; M: Male; R: Roughness; B: Breathiness; H: Hoarseness.

the results were not different from the other patients to whom only thyroplasty type 1 was applied.

Medialization laryngoplasty may be effective in patients with good arytenoid mobility but thin, lateralized, fibrotic, and adynamic cort. Benninger et al.<sup>[7]</sup> recommended medialization for glottic gaps of at least 1.5 mm. This procedure may be combined with lipoinjection in an attempt to reestablish the mucosal wave.

Autologous fat probably is the best augmentation material currently in use. More forgiving placement of autologous fat within the larger muscle bed is possible, and longevity has improved through development of viable adipocytes.

Strap muscles can also be used to medialize the vocal cord. Su et al.<sup>[10]</sup> reported that medialization laryngoplasty with strap muscle transposition is a safe and effective technique for correcting glottic incompetence caused by sulcus vocalis. Fat injection and fascia transplantation alone have also been used to treat patients with sulcus vocalis, and the results were satisfactory.<sup>[11]</sup>

However, after thyroplasty or vocal fold augmentation, voice quality is not improved because the sulcus has not been directly addressed, but since the vocal efficiency is improved and the effort for phonation is reduced, the patients are able to speak louder, more understandable and they do not feel any voice fatigue. The statistically significant difference in VHI scores of our patients proves this condition.

Studies by Ford et al.<sup>[1]</sup> and Pontes and Behlau<sup>[2]</sup> used microsurgical techniques in 30 patients with pathologic sulcus. Both studies, based on objective measures, reported voice improvement in most patients. Sataloff et al.<sup>[12]</sup> described voice improvement and limited return of mucosal wave using fat implantation methods. Most patients can expect significant voice improvement from either technique, but improvement is not equal to pre-morbid conditions in most individuals. In addition, insufficient data are available on the longevity of the improvement.

In our study, the post-operative improvement is subjective rather than objective. Disphonia severity index scores after thyroplasty were similar to pre-operative scores. We believe that surgery of any kind mentioned above is unfortunately unable to return

the patients' voice to normal levels. The glottic gap can be closed through surgery but since the mucosal wave will stop where the sulcus resides, there will not be a clear voice either. However, from the patients' point of view, that is VHI, though voice is not a clear voice, it is satisfactory. Surgery resulted in diminished voice fatigue, elaborated breathiness, voice weakness, and increased effort (There is not a gap postoperatively and subglottic pressure can be now established). The importance of this study comes from the evaluation of the surgical results also from the patients perspective. If this study were done without measuring VHI scores (patients' point of view), it could be proposed, that thyroplasty alone is ineffective in sulcus vocalis management.

Thyroplasty can bring patient satisfaction in the surgical management of sulcus vocalis. But more importantly, especially in the evaluation of voice patients, success should be based not only on acoustic (computed) analysis, but also on subjective measurements, such as voice handicap index.

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