

# *Internal Section of the Vocal Ligament - A New Technique for the Treatment of the Sulcus Vocalis*

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## **SUMMARY**

- Introduction:** The sulcus vocalis is a congenital laryngeal lesion that provokes important negative impact in the vocal quality. Its diagnosis and treatment remains a great challenge for the laryngologists.
- Objective:** To present a new micro-surgical technique for the treatment of the sulcus vocalis defined as Internal Section of the Vocal Ligament.
- Method:** Study carried through from the analysis of the cases of patients submitted to the microsurgical treatment of the sulcus vocalis. Data and surgical results had been collected and analyzed through an evaluation protocol. All patients had been submitted to the microsurgical treatment of the sulcus vocalis for the technique of Internal Section of the Vocal Ligament.
- Results:** Of the 12 patients, the majority was female, age range from 14 to 46 years old. Half of the patients presented bilateral sulcus. All the cases consisted of sulcus vocalis, type vergeture. Improvement of the vocal quality was achieved in all the patients, with complete closing of the glottic chink in the majority of cases (10 patients).
- Conclusion:** The authors conclude that microsurgical technique called internal section of the vocal ligament consists in a new procedure, systematic and efficient for the treatment of sulcus vocalis.
- Key words:** vocal fold, voice, hoarseness.

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## INTRODUCTION

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Among several organic diseases that cause vocal disorders the so-called minimum structural alterations (MSA) of vocal folds are of primary importance. Out of the 5 known MSA in this group, the following are highlighted: sulcus vocalis, that is defined as a scar-shaped lesion or longitudinal fissure in the vocal fold, parallel arranged to its free edge (1). It is histologically found confined to scale epithelium showing thickening of basement membrane, shortening or absence of superficial layer of lamina propria (Reinke space), a great number of thick collagen fibers and diminution of elastic fibers (2). Its etiology is not completely elucidated although congenital origin is sustained by most of the authors (1,2,3).

Several types of classifications for sulcus vocalis are found in literature considering its morphological characteristics and structural compromising level (4,5). One of the most used classification is the one proposed by PONTES and cols. (3) classifying lesions in occult sulcus, major stria sulcus, minor stria and bag sulcus. Occult sulcus is characterized by thickening of lamina fibers, resulting in diminution of tunica mucosa mobility and diagnosis is only possible through videostroboscopy. Minor stria sulcus is an invagination of epithelium that leads to a small virtual cavity, better identified when manipulating the fold. Major stria sulcus is a fissure in the mucosa with a shape of canal attached to the deepest structures configurating an upper lip and a lower lip Bag sulcus is more similar to the previous one but, in this case, its lips touch each other and the invagination creating a real space in a bag shape.

Sulcus vocalis is generally bilateral, showing vocal characteristics worse than unilateral sulcus. Individuals having this kind of pathology, due to alteration in vocal fold vibration, show a breathy rough hoarse voice and vocal tiredness. They also have difficulty in reaching perpetuation of notes and tones and have maximum phonation time (MPT) shortened. Functional characteristic is the presence of fusiform scar and the reduction of mucosa wave to phonation or its absence with great impact on vocal quality (1).

Initial treatment of sulcus vocalis, in most of the cases, is phonotherapy. However surgical treatment is indicate if no desirable recovery is observed. Many are the microsurgical techniques proposed by different authors in literature in order to diminish injury caused by sulcus on the cordal structure and consequently improve voice quality. The most used ones are: the pediculate flap technique (6), micro-sutures (7), fillings with collagen (8), fat (9), Teflon, apatite hydroxide and Gore-tex® and also fascial muscular implants (10). There is not, until

now, a consensus in relation to the best surgical method because the results and complication rates vary considerably.

The objective of the study is to present a new microsurgical technique for the sulcus vocalis treatment defined as internal section of the vocal ligament (ISVL) showing epidemiological profile of patients, functional and anatomical alterations, type of lesion and surgical results.

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## METHOD

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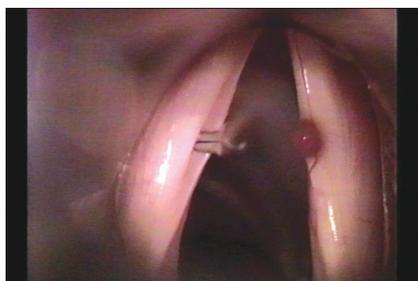
The study was performed through case analysis of patients submitted to microsurgical treatment of sulcus vocalis in the period between January 2004 and April 2006, by the Department of Laryngology and Voice in this institute. All the procedures were performed by the same surgeon.

The sample consisted of 9 female patients (75%) and 3 male patients (25%) between 14 and 46 years old (average age 31,5 years).

The patients were submitted to a protocol of evaluation consisted of epidemiological questionnaire, videostroboscopy examination and perceptual analysis of the voice, pre and post surgery. Regarding the questionnaire, the following epidemiological data were collected: name, age and sex. Endoscopic diagnosis was performed with a Storz rigid optic of 70°, attached to Toshiba micro-camera, with continuous and stroboscopic alternating illumination through Bruel-Kjael stroboscopic source. All patients were previously booked, appearing fasted. Topical anesthesia of pharynx using Lidocaine spray at 10% in all cases. Videoendoscopy evaluated: type of lesion, if uni or bilateral and presence or absence of glottic scar and of mucosa wave in sulcus area. Perceptual analysis of the voice consisted of evaluating the maximum phonation time (MPT), pitch and voice type.

In relation to the surgical procedure all patients were submitted to pre-anesthetic evaluation with the own anesthesiologist of the service. A 12-hour minimum fasting was orientated. The surgical technique itself consisted of the following steps:

1. Patient in horizontal dorsal decubitus with the head slightly deflected.
2. General anesthetic application.
3. Placement and fixation of suspension laryngoscope for larynx exposure.
4. Exposure of vocal folds and sulcus vocalis under microscopical view (objective lens of 400mm)



**Picture 1.** Superior Cordectomy.



**Picture 2.** Medial displacement of the mucous sulcus of the free edge.



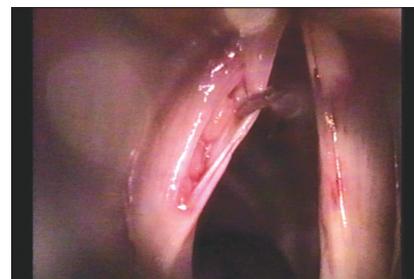
**Picture 3.** Lateral displacement of the muscular layer.



**Picture 4.** Ample exposition of the vocal ligament.



**Picture 5.** Performing of the transversal sections in the vocal ligament.



**Picture 6.** Placement of the structures - auto-grafting.

5. Upper cordotomy (Picture 1).
6. Medial displacement of sulcus of free edge mucosa (Picture 2).
7. Lateral displacement of muscular layer (Picture 3).
8. Wide exposure of vocal ligament (Picture 4).
9. Performance of transverse incisions on vocal ligament (Picture 5).
10. Placement of structures – auto-fillings (Picture 6).
11. Closing of the planes (Picture 7).



**Picture 7.** Closing of the planes.

During post surgery period the patients remained under observation for a few hours receiving hospital discharge on the same day with prescribed symptomatic medicines, if necessary, and with orientations related to the diet, hydration, vocal rest, physical exercises and phonotherapy.

All patients returned for evaluation 30 days after surgery with videostroboscopic exam and voice perceptual analysis post surgery.

Collected data were registered and analyzed through a database named Epi Info 2000 developed for epidemiological purposes. Wilcoxon test was applied in the statistical analysis.

A term of free and clear consent was applied to patients that participated in the research and the Ethic Committee in Research of *Universidade Federal do Paraná* approved the protocol for this research.

## RESULTS

Through pre surgery videoendoscopy 6 (50%) patients showed bilateral sulcus vocalis and 6 (50%) unilateral of which 5 (41,6%) were located in the right vocal fold and only 1 (8,4%) in the left vocal fold. The 12 patients (100%) showed major stria sulcus. Examination also showed that all patients presented fusiform scar and diminution of wave mucosa. During post surgery period there was improvement of stroboscopic alterations with only 2 (16,6%) patients still presenting fusiform scar although they presented normal mucosa (Table 1).

Voice perceptual analysis showed that during pre

**Table 1.** Results of the pre and post operating video stroboscopic exams.

Patient	Video Stroboscopic PO	
	Mucous wave	Glottic opening
1	Present	Complete closing
2	Present	Complete closing
3	Present	Complete closing
4	Present	Complete closing
5	Present	Incomplete closing
6	Present	Complete closing
7	Present	Complete closing
8	Present	Complete closing
9	Present	Complete closing
10	Present	Complete closing
11	Present	Complete closing
12	Present	Incomplete closing

surgery period patients presented a diminution of vocal quality and Graphic 1 shows the present alterations.

Maximum phonation time (MPT), during pre surgery period, oscillated between 14 and 20 seconds with average of 16,5 seconds. During post surgery period improvement of vocal quality and an increase of MPT in all patients were observed with statistical significance level ( $p=0.00218$ ) as described in table 2.

## DISCUSSION

The sulcus vocalis is still a great challenge, both, due to the diagnosis difficulties, which has determined several diagnostic attempts, and its difficult resolution.

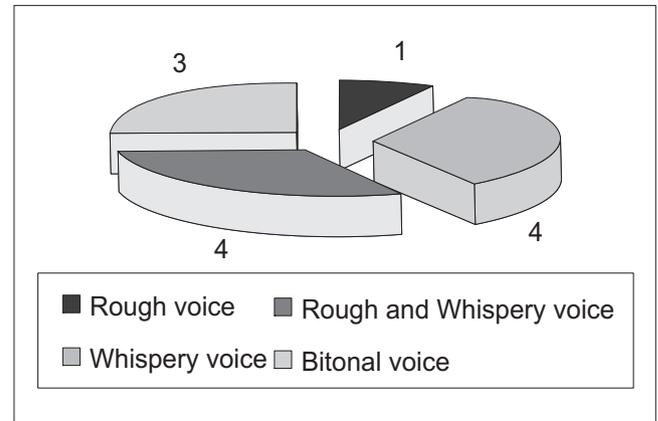
For the sulcus vocalis treatment it has been suggested a great variety of microsurgical techniques, each of them bringing particular advantages from the structural and physiopathologic points of view. However, until the present moment, these several techniques has been emphasizing the handling of the mucous, mainly through displacement and exeresis and, finally, the use of implants of several materials, aiming at creating an arching in the whole vocal fold, having more evident effect in the free edges.

PONTES (1989) proposes the pediculated flap technique of the vocal folds, as a way of minimize the phonatory impact caused by the stiffness of the vibratory layer resulting from the sulcus vocalis. In this technique, transverse incisions to the free edge in depth, including the mucous and the internal layers, it is intended to reduce the retraction and the forces which determinates the arching of the vocal folds, considering that the resulting scar tissue has more functional phonatory characteristics than the sulcus vocalis itself.

**Table 2.** Pre and post operating perceptual analysis of the voice.

Patient	Vocal standard	TMF	
		Pre	Post
1	Improve	16	20
2	Improve	15	21
3	Improve	18	25
4	Improve	18	25
5	Improve	14	21
6	Improve	16	25
7	Improve	16	23
8	Improve	14	16
9	Improve	15	23
10	Improve	20	25
11	Improve	20	24
12	Improve	16	20

**Subtitle:** Wilcoxon Test ( $p=0.002218$ ).



**Graphic 1.** Types of alterations in the vocal standard.

Woo et al. (1995) used a 6.0 chromium plating catgut suture to repair non vibrating segments of the vocal fold after microsurgeries of pathologies such as spindle-shaped polyp, sulcus vocalis, cyst and keratosis. These non vibrating areas were caused by the epithelial thickening, glottic opening and contracture.

FORD and cols (1995) studied the use of bovine collagen in pathologies of the vocal fold, including the sulcus vocalis, atrophy and secondary fibrosis trauma and cordectomy. They observed adverse immunological response, limiting its use. They started to use autogenous collagen, better tolerated and more stable in the course of the time. However, the results of the use of these collagens in the glottic insufficiency were similar. In the literature, several other materials for the fulfilling of the sulcus vocalis are still described, such as fat, Teflon®, Apatite Hydroxide®, Gore-tex® and more recently the use of homologous tissues, supposedly more adaptable to the vocal folds internal anatomy.

The microsurgical technique ISVL (internal section of the vocal ligament), proposes to the treatment of the sulcus vocalis of the groove type, a combination of microsurgical acts, which begins with the displacement of the vocal ligament mucous and the treatment of this ligament, through its musculature displacement, in its face, culminating with the transverse incisions, which determinates the loss of internal tension of this vocal ligament, main reason of the arching observed in the vocal folds in rest and in the phonation. This section creates rectangular shred of the vocal ligament, which we denominate auto-grafting, which reproduces the fulfilling effect.

PÉROUSE and COULOMBEAU, published in their study about stretch marks (*vergetures*) anatomic clinical considerations, that the surgical techniques still need develop a way to treat the glottic tension in these cases, because there are already plenty of techniques of displacement and fulfilling to the treatment of the vocalis sulcus.

Among the basic rules of the phono-surgery, it should be considered the preservation of the characteristics of the vocal folder layers, the anatomy of the glottic region, the larynx functional qualities, from the phonatory functional unit, which it is observed in the vibratory condition of the vocal folder. These considerations are important to the larynx function, providing the production of a normal sound, making possible to the operated patient a good capacity of communication.

Among the ISVL technique advantages are included: The preservation of the free edges mucous (phonation functional unit), the breach of the force line, which produces tension and arching, and the construction of the auto-grafting to the fulfilling effect.

This microsurgical technique, this way, shows itself faster in the surgical times, less aggressive in the handling of the fold structures and less expensive, due to the non use of the other materials associated to the method, mainly to the internal fulfilling.

The video stroboscopic exam and the voice perceptual analysis in the pre and post operating allow the evaluation of the result of new surgical technique. As observed in the 12 studied cases, the clinical improvement is evident, with statistically significant improve ( $p=0.002218$ ) of the TMF and the vocal folds vibrating standards.

The ISVL technique proposes a change in the philosophy of the sulcus vocalis treatment, due to the systematization of the internal structures handling, breaking the paradigm of the vocal ligament surgical handling.

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## CONCLUSION

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We conclude that the ISLV microsurgical technique (internal section of the vocal ligament) is a new procedure, easy to execute, systematic and efficient for the treatment of the disphonic patient, carrier of the sulcus vocalis.

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