

## CIS II Seminar Presentation Critical Review

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Project: Robotic Soft Tissue Manipulation Assessment

Paper: Voice Outcomes Following Treatment of Benign Midmembranous Vocal Fold Lesions Using a Nomenclature Paradigm by Akbulut et al., 2015

### Paper Selection

For our project "Robotic Soft Tissue Manipulation Assessment", the focus is to simulate a cyst removal operation using robotic assistance and manually, then assessing the treatment subjectively and quantitatively. Our main concern is not the type of vocal fold lesion, however it may be important for future experiments since different types of lesions result in significantly different surgical success rates. "Voice outcomes following treatment of benign midmembranous vocal fold lesions using a nomenclature paradigm" attempts to standardize a nomenclature for the type of lesions and make a connection to their treatment success.

### Summary of Problem & Key Result

"Benign midmembranous vocal fold lesions (BMVFLs) are common voice disorders, but interpretation of outcomes following treatment is difficult due to the lack of a standardized nomenclature system for these lesions." (Akbulut et al., 2015)

The study investigates the outcomes of patients with BMVFLs using a previously validated nomenclature, and provides incidences and outcome results for each diagnosis. The key result of the paper is producing the first outcomes-based report of BMVFLs using a strictly defined nomenclature system for stratification of lesions.

### Significance of Key Result

Drawing a parallel between the types of lesions and the outcomes of respective treatments can be beneficial for further analysis and improvement of treatments by third parties.

Through the pre-treatment, treatment and post-treatment data collection from 224 patients, the paper demonstrates the ability to return most BMVFL patients to normal speaking voice capabilities following treatment.

### Necessary Background

Benign midmembranous vocal fold lesions (BMVFLs) are a common cause of dysphonia. (Dikkers, 1991) The study uses a previously validated naming system shown in Table 1 to divide the lesions into 9 specific categories given their stroboscopic findings, lesion morphology, lesion size change following voice therapy, and when applicable, surgical findings.

The measure for the success of treatment is the mean change in The Voice Handicap Index-10 (VHI-10) which was included in patient data analyzed by the authors.

Type	Definition
Vocal fold nodule	Bilateral, fairly symmetric, normal or mild impairment of mucosal wave, resolve (complete or nearly complete) with voice therapy.
Vocal fold polyp	Unilateral or bilateral, exophytic, gelatinous material that is unorganized in the SE space.
Vocal fold cyst, SE or lig	Encapsulated lesion within the SE or lig location, often associated with reduced mucosal wave, does not resolve with voice therapy.
Fibrous mass, SE or lig	Amorphous fibrous material within the SE or lig location, often associated with reduced mucosal wave, does not resolve with voice therapy.
Reactive vocal fold lesion	Contralateral lesion (SE) to a fibrous mass, cyst, or polyp. Will often resolved or get smaller with voice therapy.
Pseudocyst	Unilateral or bilateral superficial lesion associated with glottal incompetence (e.g., vocal fold scar, vocal fold paresis, vocal fold paralysis). High likelihood of recurrence following surgical removal if associated glottal incompetence is not addressed.
Nonspecific vocal fold lesion	Persistent unilateral or bilateral lesion following voice therapy. Lesion is not treated with surgery given the improved clinical voice function that the patient experiences from voice therapy.

lig = ligamentous; SE = subepithelial.

**Table 1:** Previously Validated Definitions of Benign Midmembranous Vocal Lesions (Rosen et al., 2012).

## Theory & Experiment

The paper included patients that underwent three types of BMVFL treatment as an assessment criteria: Voice Therapy Intervention which involves vocal exercises; Medical Intervention that involves medicinal therapy, behavioural and dietary modifications; and Surgical Intervention which involves microsuspension laryngoscopy with microflap excision. Patient records from January 2009 to June 2014 were included if records indicated the following inclusion criteria: age older than 18 years and primary diagnosis of BMVFL

Patients completed the VHI-10 at their initial evaluation visit (pretreatment). To decrease time as a confounding variable, the follow-up time points for each were selected in a similar time period.

The VHI-10/CSID closest to but not less than 3 months post-surgery and 1 month after completion of voice therapy were selected as post-treatment.

The percentage decrease of  $\Delta$  VHI-10 is shown in Table 2.

	Polyp	FM-lig	FM-SE	cyst-lig	cyst-SE	NSVFL	Nodules	Pseudocyst
No.	69	10	48	10	12	54	19	2
Mean age, yr	43	38	41	47	50	35	40	45
Gender	F = 65%, M = 35%	F = 80%, M = 20%	F = 69%, M = 31%	F = 80%, M = 20%	F = 83%, M = 17%	F = 93%, M = 7%	F = 58%, M = 42%	F = 100%, M = 0%
Incidence	30.8%	4.5%	21.4%	4.5%	5.4%	24.1%	8.5%	0.9%
Pre-VHI-10	22.67	21.2	21.77	21.1	24.17	15	16.79	22
Post-VHI-10	7.91	15.9	9.6	10	7.75	9.54	8.11	7.5
$\Delta$ VHI-10	14.76	5.3	12.17	11.1	16.42	5.46	8.68	
<i>P</i>	.001	.033	.001	.002	.001	.001	.001	
% change	65.1%	25%	55.9%	52.6%	67.9%	36.4%	51.7%	
% with normal VHI-10 post-treatment	64.80%	20%	56.30%	50%	66.70%	58.20%	63.20%	
<p>% change = percentage change of VHI-10 score following treatment (pretreatment – post-treatment/pretreatment); <math>\Delta</math> VHI-10 = delta VHI-10 score (pretreatment VHI-10 – post-treatment VHI-10); Cyst = vocal fold cyst; F = female; FM = fibrous mass;</p> <p>M = male; lig = ligamentous; Nodules = vocal fold nodules; NSVFL = nonspecific vocal fold lesion; Polyp = vocal fold polyp; Post-VHI-10 = post-treatment VHI-10; Pre-VHI-10 = pretreatment VHI-10; SE = subepithelial; VHI-10 = Voice Handicap Index-10.</p>								

**Table 2:** Incidence of Benign Midmembranous Vocal Fold Lesions and VHI-10 Results of Treatment, N = 224.

### My Assessment (Relevance, possible next steps)

The study presents a significant opportunity to see which types of lesions have the lowest success rate defined in terms of percentage change in VHI-10 pretreatment and post-treatment. Our research "Soft Tissue Manipulation Assessment" is intended to show the success rate of soft tissue manipulation increases with robotic assistance during the treatment. Our findings would have a greater impact on the surgeon community if robotic assistance made a significantly higher post-treatment improvement regarding of soft tissue manipulation.

Given the computational resources and abundance of patient data in databases and research papers today, further studies can use natural language processing techniques to carve out meaningful information from the already available digitized research papers and institutional databases. Instead of doing a future experiment with larger number of patients, authors of this study or third parties interested in the correlation between types of lesions and their success rate can programmatically go through available data to draw correlations. Such increase in the number of patient data without using as much material and logistic resources may allow new and stronger correlations to be drawn for the same budget allocated for the research.

## Conclusions

The existence of a standard form of nomenclature for the types of lesions and their treatment success would be a significant advantage for those who are working on developing novel surgical methods. One of the key opportunities provided by this study is that fibrous mass–ligamentous (FM-lig) has a substantially lower post-treatment percentage decrease in VHI-10 even after surgery.

## References

- Akbulut, S., Gartner-Schmidt, J. L., Gillespie, A. I., Young, V. N., Smith, L. J., & Rosen, C. A. (2016). Voice outcomes following treatment of benign midmembranous vocal fold lesions using a nomenclature paradigm. *The Laryngoscope*, *126*(2), 415-420.
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