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Original article

Voice outcome indicators for unilateral vocal fold paralysis surgery: A survey among surgeons



G. Desuter^{a,c,*}, M. Dedry^a, B. Schaar^a, J.T. van Lith-Bijl^{a,b}, P.P. van Benthem^c, E.V. Sjögren^c

^a Otolaryngology, Head & Neck Surgery Department, Voice & Swallowing Clinic, Cliniques universitaires Saint-Luc, Université catholique de Louvain, Brussels, Belgium

^b Otolaryngology Department, Flevoziekenhuis, Almere, The Netherlands

^c Otolaryngology, Head & Neck Surgery Department, LUMC, University of Leiden, Leiden, The Netherlands

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ABSTRACT

Introduction: Standardization of voice outcomes indicators (VOIs) is an important issue when it comes to evaluating and comparing surgical treatments for Unilateral Vocal Fold Paralysis (UVFP). In a recent review, 11 VOIs were found to represent 80% of the VOIs cited in the literature. A survey was launched among the European laryngologists to acquire surgeons' opinions on the above mentioned preselected VOIs.

Material and method: The electronic survey took place between November and December 2016. Three general questions were asked about surgeon's practice setting(s) and experience. The eleven next questions concerned (a) surgeon's VOIs preference and (b) their estimates of post-operative target values, they would consider being satisfactory.

Results: The response rate was 16% (50 surveys). The majority of responders worked in tertiary hospitals (50%), had 15 years of experience with UVFP and performed on average 20 UVFP related procedures a year. The VOIs that were favored by the responding surgeons were, in decreasing order of importance, Voice handicap Index (VHI-30), Maximum Phonation Time (MPT), GRBAS-I, Mean Airflow Rate (MeAF), Jitter and Shimmer. There was an excellent consensus on post-operative VOI target values between survey's results and the literature data, except for three VOIs that showed somewhat divergent tendencies (absolute VHI-30, Jitter and Shimmer).

Conclusions: Three VOIs are favored by surgeons: VHI-30, MPT and GRBAS-I. Jitter and Shimmer, although very frequently reported and statistically valid in the literature, come last concerning surgeon's choice as VOI for UVFP treatment assessment.

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1. Introduction

Standardization of voice outcomes indicators (VOIs) is an important issue when it comes to evaluating and eventually comparing surgical treatments for Unilateral Vocal Fold Paralysis (UVFP) [1].

* Corresponding author at: Otolaryngology, Head & Neck Surgery Department, Voice & Swallowing Clinic, Cliniques universitaires St-Luc, Université catholique de Louvain, 10, avenue Hippocrate, suite 407, 1200 Brussels, Belgium.

E-mail addresses: gauthier.desuter@uclouvain.be, gdesuter@post.harvard.edu (G. Desuter).

More than 15 years ago, the European Laryngological Society (ELS) published a basic protocol for functional assessment of voice pathology, in order to be able to evaluate, compare and investigate effectivity of phonosurgical treatments [2]. Our recently performed review of the literature looking at VOIs used for the assessment of UVFP surgical treatments showed that this protocol was not systematically used [3]. The same review showed that Maximum Phonation Time (MPT), GRBAS-I perceptual scale and Mean Airflow Rate (MeAF) were most frequently used and were most effective in terms of statistically significant improvement after surgery. Jitter, Shimmer and Voice Handicap Index (VHI-30) had an intermediary position whereas Fundamental Frequency (F0)

and Mean Sub-glottic Pressure (MSGP) showed the least significant improvement.

These VOIs were found to be the most frequently used according to recent literature, but how these findings relate to daily treatment of UVFP remains unclear. In order to relate these literature review findings to common opinion among laryngologists treating UVFP, a survey was launched among ELS members. The aim of the survey was:

- to acquire surgeons' opinions on the above mentioned pre-selected VOIs;
- to reveal any other VOIs that may be commonly used but overlooked by the literature review.

2. Material and Methods

The survey was performed with the "Monkey Survey Platform" internet software.

All active members of the ELS of whom an e-mail address was available were addressed.

The link to the survey along with a general introduction was sent by e-mail to the 310 ELS members on November the first, 2016. A second round of e-mails took place 15 days later on November 2016.

Collection of surveys was closed on December 2016, one month after the first round of e-mails, 15 days after the second round of e-mails.

After a written introduction about the aim of the survey and the identity of the authors, three general questions were asked. These were:

- the number of years of practice regarding surgical treatment of UVFP;
- the average number of these interventions performed by year;
- the type of setting(s) the surgeon was working in (tertiary hospital, secondary hospital and private practice).

The two first questions were open numeral questions whereas the last one offered scroll-down option of answers. This set of questions allowed for surveys filled in by non-surgeon to be disregarded and gave some socio-professional data as well as the degree of experience of the responder. The next eleven questions related to the VOIs. **Table 1** lists the 11 questions of the survey. For the survey to be valid, all questions had to be answered.

2.1. The Voice Outcomes Indicators (VOI)

In our recent literature review [3], 11 VOIs accounted for 80% of the most cited VOIs for UVFP surgical treatments assessments. These were: Maximum Phonation Time (MPT), Jitter, Shimmer, Video-stroboscopy, Noise to Harmonic Ratio and Harmonic to Noise Ratio (NRH/HNR), Mean Airflow Rate (MeAF), Fundamental frequency (F0), GRBAS-I (Only Global Score G), Mean Subglottic Pressure (MSGP), Voice Handicap Index -30 (VHI-30) and the group of "infrequent perceptual scale".

Of these 11 VOIs, five were not selected for the survey for the following reasons:

- infrequent perceptual scales are by definition specific to each center and/or not validated;
- video-stroboscopy has no universally accepted protocol for standardization, even though it was considered by authors as "a must have" of the laryngologist's facilities when it comes to UVFP treatment;

Table 1
Questions and answering modalities of the survey.

Question	Answering modalities
1. In which order would you classify these voice parameter indicators, from the most important to the least important?	The 6 VOIs had to be listed in order of decreasing importance.
2. Which indicators are considered by you as a must for UVFP assessment?	One to six VOIs could be selected
3. What post intervention time point(s) do you consider the most relevant for voice outcome measurement?	Options: 1, 2, 3, 9, 12 months one or more answers possible
4. What relative percentage improvement of the VHI-30 score would you consider a satisfactory post-intervention result?	Options: 25%, 50%, 75%, one choice allowed
5. What absolute numeral improvement of the VHI-30 would you consider a satisfactory post-intervention result?	Options: scores of 20, 40 or 60, one choice allowed
6. What according to you is the threshold under which the Jitter should go down post-intervention to be satisfactory?	Options: 2.5%, 5%, 7.5%, one choice allowed
7. What according to you is the threshold under which the Shimmer should go down post-intervention to be satisfactory?	Options: 2.5%, 5%, 7.5%, one choice allowed
8. What do you consider a satisfactory score for G (grade) post-intervention?	Options: scores of 0, 1, 2, one choice allowed
9. What according to you can be considered as a satisfactory increase of MPT post-intervention?	Options: 5sec., 7 sec., 10 sec., one choice allowed
10. What threshold should the MPT exceed post-intervention to be satisfactory?	Options: 10 sec., 12 sec., 14 sec., one choice allowed
11. Which MeAF post-intervention would you consider as satisfactory?	Options: 200 ml/sec., 250 ml/sec., 300 ml/sec., one choice allowed

- the NHR/HNR, the MSG and the F0 were not considered for the survey because they showed an overall "percentage of significance" of less than 50%.

Finally, the following six VOIs were selected for the survey and submitted for the surgeon's evaluation: VHI-30, Jitter, Shimmer, G score of GRBAS-I, MPT and MeAF. Surgeons were also asked to suggest alternative VOI's within the free-text section.

For each of these 6 VOIs, three options of answers were possible. Each answer corresponded to a post-operative value of VOI, surgeons would personally consider as most satisfactory to them.

The questions were designed such that the mean post-operative value obtained by the literature review corresponded to the middle option. For each question, a higher and a lower value proposition were arbitrarily proposed. Ideally, these upper and lower propositions would correspond to the P25 and P75 of the literature's mean value result. As the literature review was not a meta-analysis, these data were not available.

The fact that the middle value corresponded to the literature data was not disclosed to the survey participants.

The aim of this method was to assess the degree of consensus, among surgeons, relative to the average post-operative VOI value found in the literature. Accordingly, questions showing a large dispersion of answers will be the reflection of a low consensus on the post-operative VOI value suggested by the literature. Inversely, questions showing a concentration of answers on the middle proposition will reflect a reasonable agreement of the responding surgeons on the post-operative value suggested by the literature review.

Regarding the answers to question 1 of **Table 1**; in order to aggregate the results of VOI's classification for the entire group of responders, a global score was ascribed to each VOI based on the following formula: for each responder 6 points were ascribed to the highest ranking VOI, 5 for the second highest and so on with the lowest ranking VOI receiving 1 point. Ranking points were then multiplied by the respective percentage of responders assigning

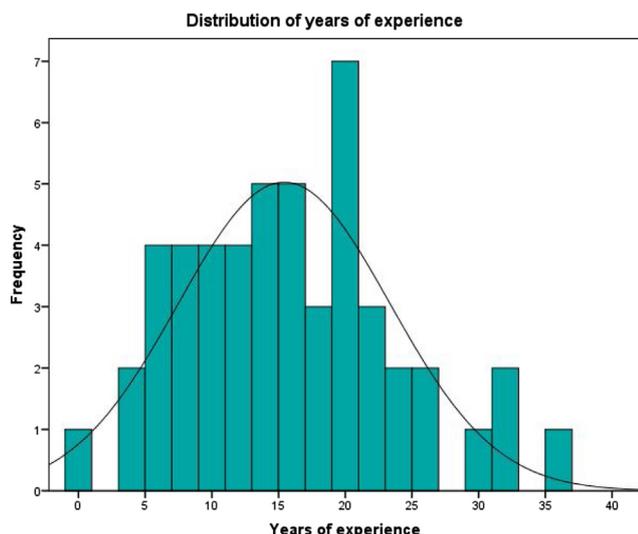


Fig. 1. Displays experience of answering surgeons in terms of years of UVFP surgical treatments practice.

a particular rank to a VOI and added up to obtain a global score, divided by 100.

For instance, the global ranking score of the VHI-30 is: $42(\%) \times 6 + 30(\%) \times 5 + 14(\%) \times 4 + 8(\%) \times 3 + 4(\%) \times 2 + 2(\%) \times 1 = 492/100 = 4.92$.

3. Results

After the first round of 310 e-mails, 160 “laryngologists” opened the e-mail of which 46 completed the survey. After a, non-selective, second round of 310 e-mails, 146 laryngologists opened the e-mail and another 16 more surveys were collected. Double submission was electronically not possible.

In total, 62 of the 310 ELS members responded. This represents a response rate of 20%. Of the 62 responders, 10 (16%) were not complete and were excluded. Two surveys were filled out by other professionals than surgeons and were subsequently also excluded. Therefore, the results represent the outcome of 50 surveys. Forty of these surveys were collected after the first round of e-mails and 10 after the second round.

Fifty percent of responders worked in a tertiary university hospital; 12% in a secondary hospital and 18% exclusively in a private practice. Six percent had a combined tertiary/private practice and 4% a combined secondary/private practice. Mean of UVFP-related procedures a year was 20 (Min.0, Max.80) Fig. 1 shows surgical experience in years of experience of UVFP surgery.

Fig. 2 displays the global ranking score of each VOIs (Question 1 of Table 1). The VOIs that were favored by the responding surgeon were, in decreasing order of importance, VHI-30, MPT, GRBAS-I, MeAF, Jitter and Shimmer.

Regarding the answers to question 2 of Table 1, both VHI-30 and the MPT are considered as “a must” by 33,1% of surveyed laryngologists. The GBRAS scale is considered “a must” by 20,8% while for MeAF, Jitter and Shimmer the score was 5,6%, 4% and 2,4% respectively.

Regarding the answers to question 3 of Table 1, thirty-eight percent of the surgeons advocate a post-operative voice assessment at 3 months, 16% at one month, 12% at 6 months and 2% at 12 months. Multiple post-operative voice assessments are favored by some responders who suggested post-operative assessments both at 3 and 12 months for 12% and 1 and 6 months for 8% of the surgeons.

Table 2 summarizes the answers to questions four to eleven of Table 1.

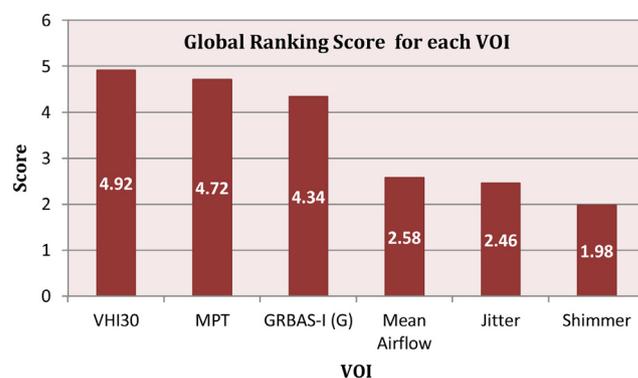


Fig. 2. Shows the global ranking score of each VOIs according to surgeon's preference.

Regarding the answers to question 4 of Table 1, 60% of the surgeons would be satisfied with a relative improvement of 50% of the VHI-30.

Regarding the answers to question 5 of Table 1, the improvement of the absolute value of the VHI-30 generates more divergences with 48% of surgeons that would be satisfied with an increment of 40 points, while 38% would consider an increment of 20 points of VHI-30 sufficient.

Regarding the answers to question 6 and 7 of Table 1, the satisfactory value of Jitter and Shimmer would be 5% for 54% of the surgeons. These questions generated numerous negative free comments and 34% of the answering surgeons declared that they hardly pay attention to these VOIs. More than 30% of surgeons considered a reduction of 2,5% of jitter as a satisfactory post-operative result. Similarly, 30% of surgeons considered a reduction of 2.5% of Shimmer as satisfactory.

Regarding the answers to question 8 of Table 1, a post-operative general score (G) of the GRBAS-I of 1 was considered as satisfactory by 78% of the surgeons. 16% scored a 0 and 6% scored a 2 as satisfactory.

Regarding the answers to questions 9 and 10 of Table 1, a post-operative MPT improvement of 5, 7 and 10 seconds would be a satisfactory increase for respectively 28%, 58% and 14% of the respondents. A post-operative threshold value of 12 seconds would be considered a satisfactory result by 56% of the surgeons. Twenty-two percent would accept a threshold of 10 sec and the same percentage of responders would accept a threshold value of 14 sec.

Finally, regarding the answers to question 11 of Table 1, sixty percent of the surgeons would be satisfied with a post-operative MeAF of 250 ml/sec. Twenty-four percent would be satisfied with a MeAF of 200 ml/sec whereas 16% would expect a MeAF of 300 ml/sec.

Twenty-two percent of the surgeons wrote a free comment concerning the MeAF. The majority of the comments indicated that, despite the fact that they valued the VOI, they were not using it as a routine VOI.

No other VOI besides ones proposed in the survey were spontaneously advocated by the survey participants.

4. Discussion

This survey represents, to our knowledge, the first survey interviewing surgeons on their opinions concerning relevance of VOIs in assessment of surgical treatments for UVFP.

The results of the survey show that VHI is highly valued by the surgical community. In fact, it was found to be the most important VOI in their opinion. This is in contrast with the literature review that ranked VHI-30 in 11th position in terms of utilization and 7th

Table 2
summarizes the answers to questions four to eleven of Table 1.

Questions	Answers			
What relative percentage improvement of the VHI-30 would you consider as a satisfactory post-operative result?	Answers options	25%	50%	75%
	%age of answers	14%	66%	20%
What absolute numeral improvement in VHI-30 would you consider as a satisfactory post-operative result?	Answers options	_20 pts	_40 pts	_60 pts
	%age of answers	38%	48%	14%
What according to you is the threshold under which the Jitter should go down post-intervention to be satisfactory?	Answers options	2.5%	5%	7.5%
	%age of answers	30%	54%	16%
What according to you is the threshold under which the Shimmer should go under post-intervention to be satisfactory?	Answers options	2.5%	5%	7.5%
	%age of answers	30%	54%	16%
What do you consider a satisfactory score for G (grade) post-intervention?	Answers options	0	1	2
	%age of answers	16%	78%	6%
What, according to you, can be considered as a satisfactory increase of MPT post-intervention?	Answers options	↗5sec	↗7sec	↗10sec
	%age of answers	28%	58%	14%
What threshold should the MPT exceed post-intervention to be satisfactory?	Answers options	10sec	12sec	14sec
	%age of answers	22%	56%	22%
Which MeAF post-intervention would you consider as satisfactory?	Answers options	200 ml/sec	250 ml/sec	300 ml/sec
	%age of answers	24%	60%	16%

position in terms of “percentage of significance” (64% of the studies utilizing the VHI-30 as a VOI showed significant post-op results). Surprisingly, a certain consensus exists among surgeons about the relative increase the VHI should show post-operatively, whereas no real consensus could be found regarding its numeral post-operative improvement. Surgeons indeed show a tendency to target somewhat lower than VHI-30 difference in absolute value indicated by the literature.

MPT and general score (G) of the GRBAS-I scale represent the two next VOIs favored by surgeons. The survey revealed a good consensus among surgeons for MPT (absolute and relative increase) and an excellent one for G of GRBAS-I regarding the desired post-operative values as revealed by the literature review.

The MeAF seems to have a special status for surgeons. They acknowledge its value and importance, but, at the same time, confess its little use. Did this group of surgeons read the recent literature advocating the use of a disease-specific set of indicators including the MeAF [4] or do they have the sense that another aero-dynamic indicator would be necessary when it comes to UVFP assessment? This survey cannot answer this question. A couple of responders mentioned that they were using the Phonatory Quotient (PQ=Vital Capacity divided by the MPT) instead. The PQ is known to be directly correlated to the MeAF and thus might be considered of a surrogate of it [2]. A reasonable consensus exists among surgeons to consider the 250 ml/sec as a satisfactory post-operative value. This is in accordance with the data obtained and observed in the literature.

According to the survey results, Jitter and Shimmer are not preferred by the surgeons. It is not clear what the reason is. These indicators could have a low predictability for the surgeons, concerning the intended voice improvement, especially if they have limited experience in interpreting the measures. Moreover, surgeons may feel that these indicators correspond less to clinical factors such as perceptive dysphonia and voice fatigue than other VOIs. Finally, there is no wide consensus on the satisfactory post-operative value these VOIs should have. Surgeons, as a group, seem to hesitate between 2.5% and 5%. The fact that more than 10% of surgeons chose the 7.5% supports the idea that there is a lack of knowledge of these acoustic parameters.

Several limits and bias of this survey have to be underscored. The survey participation rate was of 16% of the ELS members gathering also physicians that are not involved, at all, in voice surgery. This represents a sample of 50 laryngologists practicing UVFP surgeries on a regular base. This participation rate was the lower limit that was foreseen by authors to declare the survey valid.

Authors were well aware of a possible bias due to the design of the answer options in this survey. The questions were designed

such that the mean post-operative value obtained by the literature review corresponded to the middle option. For each question, a higher and a lower value proposition were arbitrarily proposed. This design may give a tendency to favor the middle option, and thus, favor the consensus. This bias is called “the central tendency bias” [5]. Results should be interpreted accordingly. The bias favoring consensual answers, gives an extra weight to answers that were not so consensual, such as answers on the numeral improvement of VHI-30, the Jitter and the Shimmer.

Video-stroboscopy, while being largely used as a post-surgery outcome indicator, was not included in the survey. This was a deliberate choice as there is no universally accepted protocol for standardization. The number of VOIs was limited. They were however selected by a previously done literature review and no voice outcome indicators were claimed to have been omitted by the survey responders. Options of responses were limited and could only be overruled by free comments. These were abundantly used for the questions relative to the Jitter and the Shimmer. Finally, all questions had to be answered before taking the next one. Two of the responders indicated that they had rather skipped some questions, had it been possible.

5. Conclusion

Based on this survey, three VOIs are favored by surgeons: VHI-30, MPT and GRBAS-I.

Although strongly valued by surgeons, there is no clear consensus about the post-operative difference of VHI-30 absolute value that should be targeted. There is a discrepancy between the high value that surgeons appear to attribute to the VHI-30 as UVFP treatment VOI and its rather moderate percentage of significance revealed by the literature review.

The Jitter and the Shimmer, although very frequently reported and statistically valid in the literature come last in surgeon's choice as VOI for UVFP treatment assessment. Furthermore, many surgeons expect post-operative values of Shimmer that are higher than those found within the literature. Further studies should investigate this discrepancy to better ascertain the value of these acoustic parameters as voice outcome measures after phonosurgery generally and surgical treatment of UVFP specifically along with surgeon's knowledge about acoustics parameters.

MeAF seems to be valued by surgeons but is not used as much as surgeons would like. The access to a pneumotachograph could be an explanation for its under-use.

No other VOI besides ones proposed in the survey were spontaneously advocated by the survey participants.

Finally, expected VOI's results after surgical treatment for UVFP that were chosen by a majority of surgeons were generally in accordance with the data provided by the literature review.

Ethical statement

This article does not contain any studies with human or animals performed by any of the authors.

Informed consent collection is not applicable to this study.

Disclosure of interest

The authors declare that they have no conflict of interest.

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