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Video Stroboscopy Compared with High-Speed Films of Pathological Vocal Folds

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Abstract

Background: Video stroboscopy has been the only way to visualize vocal fold movement for more than 50 years. Now we can capture the true movement of the vocal folds with high-speed recordings.

Objective: A prospective randomized study was made to show if high speed films gave supplementary information that was better than video stroboscopy for diseases of the laryngeal function.

Method: Randomized treatments planned on high speed films compared with treatment plans based on video stroboscopy were made.

Results: There were interesting differences between the treatments in the way that video stroboscopy indicated voice training and cortisone where on high speed films such indications was not found.

Conclusion: As in other fields, evidence based focus is on the genetic – mucosal - vocal function. Correction of behavior models was found only to be supplementary.

Keywords: High speed films; Video stroboscopy; Voice; Laryngeal mucosal function; Genetics

Introduction

The development of tissue understanding is ongoing [1]. In our clinical voice research two aspects have been important, the view of the vocal folds and larynx tissue regulators. It was a step forward when stroboscopy in the clinic was developed [2]. But shortly afterwards electroglottography (EGG) measures supported the averaged stroboscopy of a few pictures per second and after one generation online high speed films with several thousand pictures per second were made clinically feasible for voice measures as a continuation of EGG combined with stroboscopy [3,4]. We soon discovered that the diagnoses made by high speed films were different from the video stroboscopy [5]. We noticed that the larynx including the arytenoid regions had new diagnostic aspects, as an introduction to the whole upper airway. The swallowing process and the lower airways were also better understood related to high speed films of the arytenoid region [6]. To document that the high speed films give different – supplementary understanding of the larynx – including the voice, respiration and swallowing processing, it was suggested by the statistician to randomize the patients in a way to show that diagnoses and treatment were different based on video stroboscopy and high speed films. Therefore a prospective and randomized study has been made. 12 patients were needed based on a power calculation of 95%, assessing arytenoid-region edema score 1-5, vocal fold abnormalities, front-, middle- and rear open quotients and suggested treatment after each examination on high speed films compared with video stroboscopy which did not include the referred on line measured parameters but visual evaluation of function: mucosal movement, regularity, amplitude and closure of the vocal folds [7,8].

When introducing new technology, the benefits have to be understood. In the clinic we strive to deliver the best clinical service basing treatment on evidence and expand the evidence where possible. With high speed films it is possible to see the vocal folds movement (4.000 frames per sec) in more details than the average pictures provided by the video stroboscopy (mostly 25 frames per sec). Vocal folds move in an adult man ~110 Hz (pictures per second) and in a woman ~220 Hz (pictures per second). The magic flute by Mozart, the high F is ~1300 Hz, looking at 25 pictures per second will not show the true motion of the vocal folds movement. It is unknown how often there is a treatment related difference and the relevance of the difference is not known.

Method

We included patients prospectively in the clinic, after a written consent, with hoarse voices for more than two weeks and assessed each patient with both high speed films and video stroboscopy in a randomized sequence. High speed films were assessed with visual arytenoids-region edema score 1-5, vocal fold abnormalities and front, middle and rear open quotients. Suggested treatments were based on the examination done, saved before proceeding. With video stroboscopy averaged movements of the vocal folds were possible with mucosal movement, regularity, amplitude and closure of the vocal folds. Comparing diagnosis given for each patient based on the examinations (either video-stroboscopy or high speed film) and ultimately, the corresponding treatment was also done, saved in this prospective randomized way (Tables 1 and 2).

Evidence Hierarchy
Systematic Review
(Meta-Analysis)
Randomized Controlled Trial
Cohort Study
Case-Control Study
Cross-Sectional Survey
Case Report

Table 1: Evidence based research has an evidence hierarchy, where systematic review is at the highest level.

Type	Examples
Systematic Review	Summary of results of all relevant trials
Meta-Analysis	Summary of average results of trials.
Randomized Controlled Trial	Isolation of effect. All other differences are random and thus statistically controllable.
Cohort Study	For example number of cortisone inhaler prescriptions before and after high speed films could be introduced, or number of patients referred to speech therapy based on voice diagnosis.
Case-Control Study	Looking at patients with a certain disease and patients matching these patients except for the disease.
Cross-sectional Survey	Looking at a representative sample here and now: How many took medication A and did not have disease B.
Case report	Description of individuals: A patient took medication A and it cured disease B (but no proof what caused, disease B to be cured).

Table 2: Examples of the evidence hierarchy.

Analysis

How do we prove that one type of examination is better than another one? The question is what to measure, considering the SMART goal criteria: specific, measureable, achievable, relevant, timely and how do we compare the examinations, which design and analysis is best?

Is relevant but for whom, Table 3 gives an example of that.

Patient Getting the best treatment with minimal personal risk Minimize the discomfort of the examination (Quality of Life)	Investigator Understand root cause for pathological voices (not only symptoms)
Society Minimize use of pharmacologist Minimize number of sick days	Regulator (National State) Want the cheapest possible examination Safest possible examination Acceptable reliability of examination
Minimize cost for treatment and examination	

Table 3: Design and analysis it.

Results

Table 4 shows the strikingly different aspects of treatments of patients for voice training and cortisone/formeterol inhaler for high speed films and video stroboscopy. Other treatments were not statistically different. Since the comparison was made on the same patients we have a study which includes 24 examinations. The statistical evaluation based on power calculations showed that the material was adequate.

	High Speed Films	Video stroboscopy
Voice training	0/12	5/12
Cortisone/formeterol inhaler	0/12	2/12

Table 4: Statistical Evaluation for High Speed Films and Video Stroboscopy.

In the logistic regression model where the correlation between the two randomized assessments on the same patient is taken into account, the two sided p-value was 0.0190 when comparing video stroboscopy with high speed films, a statistically significant higher proportion of patients had treatment involving either voice training or pharmacological treatment with local cortisone/formeterol inhaler.

Discussion and Conclusion

The base line was hoarseness for two weeks or more without other earlier treatment - the outcome was normalized voice in this prospective randomized study comparing high speed films with video stroboscopy. The two sided p-value was 0.0190 when comparing video stroboscopy with high speed films, showed statistically significant higher proportion of patients where treatment involved either voice training or local cortisone inhaler with adrenalin for video stroboscopy. It is interesting to look into new methods for mucosa studies which are made possible with high speed films, especially arytenoid regions in the larynx. The high speed films analysis, now much cheaper than before, showed that voice disorders were more related to other phenomena e.g. mucosa function and genetics and not behaviour. The future aspects include optical coherence tomography (OCT) and genetics for further understanding of the mucosal function of the upper airways [9,10].

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