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%, ultimate, the corresponding treatment was also done, saved in this prospective randomized way (Tables 1 and 2).

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 [7,8].
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.

<table>
<thead>
<tr>
<th>Type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systematic Review</td>
<td>Summary of results of all relevant trials</td>
</tr>
<tr>
<td>Meta-Analysis</td>
<td>Summary of average results of trials.</td>
</tr>
<tr>
<td>Randomized Controlled Trial</td>
<td>Isolation of effect. All other differences are random and thus statistically controllable.</td>
</tr>
<tr>
<td>Cohort Study</td>
<td>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.</td>
</tr>
<tr>
<td>Case-Control Study</td>
<td>Looking at patients with a certain disease and patients matching these patients except for the disease.</td>
</tr>
<tr>
<td>Cross-sectional Survey</td>
<td>Looking at a representative sample here and now: How many took medication A and did not have disease B.</td>
</tr>
<tr>
<td>Case report</td>
<td>Description of individuals: A patient took medication A and it cured disease B (but no proof what caused, disease B to be cured).</td>
</tr>
</tbody>
</table>

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, measurable, 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.

Table 3: Design and analysis it.

<table>
<thead>
<tr>
<th>Analysis</th>
<th>High Speed Films</th>
<th>Video stroboscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimize cost for treatment and examination</td>
<td></td>
<td></td>
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</tbody>
</table>

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.

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice training</td>
<td>0/12</td>
</tr>
<tr>
<td>Cortisone/formeterol inhaler</td>
<td>0/12</td>
</tr>
</tbody>
</table>

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].

References

mannose binding lectin and other immunological parameters with diagnostic use of phonetary function studies, European Archives of Otorhinolaryngology 269: 1477-1482.


