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1. CONTEXT / INTRODUCTION

A poster presentation at the 8th World Congress on Brain Injury.

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There is nowadays a better understanding of universal and local voice related dystonia. High speed films of the vocal cords have shown to be a valuable tool in many connections. There is a measure of the distance between the front, middle and rear part of the vocal cords that can be used quantitatively (figure 1). The real movements of the vocal cords are seen, and with segmentation, marking of the free border of the vocal cords reveals pathological phenomena (figure 2).

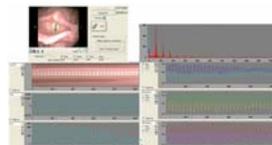


Figure 1: High speed data of a normal male, showing kymographic curve, the electroglottograph (EGG), the area between the vocal cords, the Fast Fourier Transmission (FFT), and the opening phases of the rear, center and front part of the vocal cords.

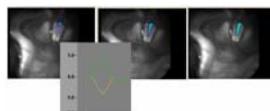


Figure 2: Segmentation is demonstrated by the colour variations seen in the figures below. The coloured curve shows the center movement between the vocal cord.

In stroboscopy (figure 3), there is mostly an average of 4-5 compressed pictures/second of the vocal cords, and due to this, the real movement evaluation compared with EGG and acoustical measures, including the open phases, cannot be made.

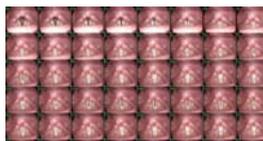


Figure 3: With stroboscopy, front, center and rear parts cannot be well defined.

2. METHOD and MATERIALS

The routinely made high speed films included on average 1-2 seconds of film including 4000-8000 frames. Segmentation was made with marking of the free edges of the vocal cord. The following modes were analysed (as presented in figure 1):

- kymography
- Electroglottograms (EGG)
- Acoustical curves
- Presentation of the area between the vocal cords
- Fast Fourier Transmission (FFT) up till 2000 Hz.
- Specific presentation of the right and left vocal cords' movement in the front, middle and rear area of the open phases.

A software calculation was given in the front, middle and rear part of the vocal cords (Wolf Inc). Statistics were made of differences before and after the given treatment (using the SAS statistics).

We have a standard treatment for inflammation in the upper airways, with local steroids and supplemented with a strong antihistamine in maximum dose.

The index dystonic patient came into the clinic with throat complaints, her main disorder being universal dystonia. She was treated according to the standard treatment for inflammation in the upper airways. The picture below demonstrates the dystonic symptoms she was suffering from:



Figure 4: The index patient

The dystonia was surprisingly eliminated completely within 14 days as a result of the treatment, and can seldom be triggered by upper airway infections.

During a consultation at the first follow up after the dystonia had disappeared, the index patient suddenly experienced a relapse with universal spasms, triggered by irritation of the high speed camera in the larynx region. The patient was immediately given 4-5 inhalations of local steroids, where after the symptoms disappeared. The high speed results are presented below, including the kymography, the electroglottography (EGG), acoustical curve, vocal movement, area and open quotients.

2. METHOD and MATERIALS continued

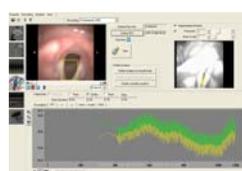


Figure 5: Open quotients in the front, middle and rear parts of the vocal cords, with segmentation while the dystonia still persisted. Notice the reduced open quotients. The curve shows the open quotient of the center part of the vocal cords.

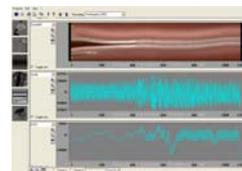


Figure 6: Showing the kymography, acoustical curve and EGG for the index patient while the dystonia still persisted during the described relapse.

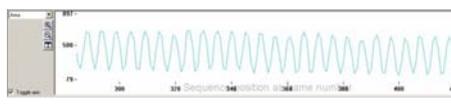


Figure 7: Showing the area while the dystonia still persisted. Notice the sharp closure.

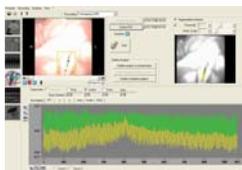


Figure 8: Open quotients in the front, middle and rear parts of the vocal cords, with segmentation after the elimination of the dystonia. Notice the higher open quotients compared with figure 5. The curve shows the open quotient of the center part of the vocal cords.

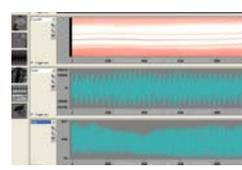


Figure 9: Showing the kymography, acoustical curve and area for the index patient after the dystonia was eliminated.

An example is given of how a pressed voice can be seen on the kymograph:

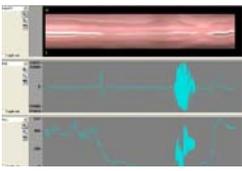


Figure 10: Kymography, EGG and the area for a pressed voice

The dystonic patients

Following the surprising results of the index patient, a prospective cohort study was carried out. 55 patients with localised and universal dystonia were referred to the clinic in a period of 8 months mostly, from our co-workers in physiotherapy, even if they have had dystonia for many years. The patients' were complaining of all round voice problems. The physiotherapists wanted a systematically overall status of the patients immune systems and eventual treatment of upper airway mucosal problems.

The patients were in dystonia training groups already established. Surprisingly, the effect of mucosal treatment of the upper airways was, in several cases that the dystonia was reduced or even disappeared. Therefore, visual scores from 1-100 of the treatment effect of the immune system were graded by the patients after end of treatment. A control group of normal individuals was set up.

The dystonic material included 14 males, 41 females of which 12 males and 14 females were in work. 14 males and 36 females received botox treatment. Immune system deficiencies were found in all patients.

3. RESULTS

The dystonia related changes of voice were seen on the kymography and the EGG, especially when compared with the acoustical curves. We evaluated the "cycle look" of the variance of frequency. In those cases where there was a treatment effect the frequency stabilized. The open quotients between the vocals cords normalized.

In figure 12-16, the visual score of treatment effect presented in percentage of all patients are shown. A relation is also made with symptom duration. In table 1, a calculation is made of the open phases in the front, center and rear part of the vocal cords, before and after immunological treatment (including local steroids and a strong antihistamine). Using Nominal Logistic Fit for improvement, a chi square calculation was significant for the treatment effect of the center opening phase between the vocal cords (0.0009).

A calculation has been made, comparing an earlier material with normal patients and the dystonic patients. If the patients are divided in groups as presented, there is a significant difference for the whole material of 0.0577 at the center opening phases for the group with 51-75% effect on the visual score.

3. RESULTS continued

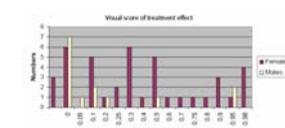


Figure 12: General visual score of treatment in males and females

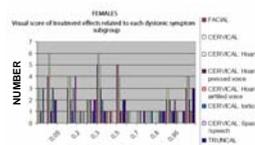


Figure 13: Visual scores of improvement in each dystonia subgroup for females

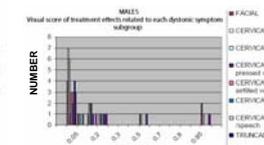


Figure 14: Visual scores of improvement in each dystonia subgroup for males

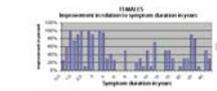


Figure 15: Improvement in relation to symptom duration in years for females

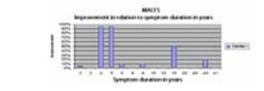


Figure 16: Improvement in relation to symptom duration in years for males

Group	Before treatment			After treatment		
	Front	Center	Rear	Front	Center	Rear
Normal	0.00	0.00	0.00	0.00	0.00	0.00
Dystonic	0.00	0.00	0.00	0.00	0.00	0.00

Table 1: Showing the opening phases of the front, center, and rear parts of the vocal cords in each group of visual score of treatment

4. DISCUSSION

Voice analyses in neurological patients have been discussed at several conferences (Pedersen MF 1991, Pedersen MF & Christensen AL 1992). Later Izbicki K (1998) described verbal listeners tests to use in spasmodic dysphonia. A Cochrane review was made in 2006 by Watts C, and Chad N. in which the reviewers concluded that "the evidence from randomised controlled trials supporting the effectiveness of botulinum toxin for management of spasmodic dysphonia is deficient". Vena GA et al 2008 thoroughly described the effects of H1-antihistamines. Pedersen et al 2008, 2009 had presentations at the Pacific Voice Symposium at UCLA on new treatment possibilities on laryngeal dystonia and related disorders and discussed clinical voice related technologies and upper airways treatment. A meta-analysis was made of acoustical measurements in 2008 by Maryn Y. et al. concluding that "although acoustic measures are routinely utilized in clinical voice examinations, the results of this meta-analysis suggest that caution is warranted regarding the concurrent validity and thus the clinical utility of many of these measures". Hopefully, the new digital quantitative analysis of high speed imaging can be used for clinical evidence (Yullg Y. et al 2009). Focusing on the upper airways is traditionally done in singing and the treatment we used could lead to a partial normalization of the vibrato related system (DeJonckere et al 1995, Timmermans B et al 2005).

5. CONCLUSIONS

With the use of high speed films, many voice related neurological disorders can be more accurately diagnosed. High speed films should therefore be used much more in the field of neurology, at least as a standard of diagnosis of neurological voice disorders. High speed films can also prove to be a useful tool in documenting the effect of treatment.

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