Contemporary clinical voice related technologies for the diagnosis of dystonia patients.

The study is made in cooperation with Cost 2103 of advanced voice assessment, workgroup 5 of public relations in theEuropean Union

Mette Pedersen MD Dr. Med. Sci. et h.c. Ear-Nose-Throat specialist, Chair of PR, Work Group 5 COST 2103. Advanced Voice Assessment - www.mpedersen.org

Mette Pedersen, MD, Ear-nose-throat specialist, Dr.Med.Sci et h.c., FRSM, 1

Shahzleen Rajan stud. medicine, 2

Daniel Feddersen stud. HA(dat.) 3

Julie Pedersen BsC Logopedics 2

From

- 1. The Medical Centre Oestergade 18 3 Copenhagen Denmark
- 2. Copenhagen University, Denmark
- 3. Copenhagen Business School, Denmark

Abstract

- We have made a prospective case control study of High Speed films, measuring accurate single movements of the vocal cords which supplement earlier measures of the voice in a valuable way. With the High Speed apparatus (Wolf Ltd.), 4000 or 2000 pictures pr second can be chosen for 2 seconds. In 55 patients with dystonia, the acoustic and electroglottographical waves (EGG) were evaluated visually including also kymography, and FFT up to 2000 Hz. With Spead software (Laryngograph Ltd.), the fundamental frequency and intensity during reading of a standard text and intonation of a sustained tone were analysed as well as the EGG closed phase Qx% of the vocal cords. A control group of 30 amateur singers and 12 other normal non singers was used. The 55 patients were divided in 5 groups according to their own evaluation of treatment effect, using a score from 1-100. To evaluate the possible use of High Speed films in dystonia patients we used the statistics of nominal logistic fit for the subjective improvement score. In the patients with laryngerial dystonia and related disorders, the open quotient for the middle part of the vocal cords, and the rear open quotient of the first examination at High Speed films were significant for use, with a probability ChiSqr of 0.0009 and 0.0008 respectively. At the second examination the area measurements between the vocal cords and the open quotient in front were 0.0002 and 0.0027 respectively. Another interesting result analysis was the change of the five groups toward normal, with subjective complaints measured on the visual scale from 1-100. In the five groups the fundamental frequency was comparable. The ANOVA test showed a trend of difference of the middle quotient of the open phase at the High Speed films, comparing the dystonia patients with non dystonia patients. The visually coordinated rhythmic intonations that were found at the first examination with EGG and acoustical analysis were better at the second examination in the way, that they resembled the normal population. In this presentation, quantitative High Speed film measures of vocal cords open phases were made on open quotients in the front -, middle - and rear parts and the whole area, in real time. The results were compared with a normal group and amateur singers. The patients with treatment effect became significantly better as for the measured High Speed film results. In the future, special phonetically balanced texts using the Spead software (Laryngograph Ltd.) can result in quantitative measurements of frequency and intensity differences between normal clients and dystonia patients in many languages.

Introduction

- We have been using the High Speed film camera in color from the firm, Wolf Ltd. in Germany, among others in our daily routine on dystonia patients.

- The measurement software was routinely combined with electroglottography (EGG), kymography and acoustical measures including FFT which goes up to 2000 Hz only, in the High Speed software.

Introduction

- Our first 12 patients with dystonia were presented in Stockholm at the AQL conference in September 2008.
- The question was presented there by a specialist of oto-rhino-laryngology who had been working with High Speed films for a long time:
- Why use stroboscopy in the future?

Methods

- High Speed films for 2 seconds, 4000 pictures pr. second were used in the dystonia patients with a High Speed color set up (Wolf Ltd.).
- Till now the apparatus only has quantitative measures of
  - the open quotient in the front, middle and rear area between the vocal cords and the total area, based on the total pictures or chosen pictures of movements.

Methods

- The movements of our first 12 patients are presented (if the film does not function, we also present the setup for calculation of movements of front, middle and rear as well as area here).
- We try to present the film:
- Play

Methods

- The question was if some quantitative deviations for dystonia could be found in the larger material presented now for the 4 parameters:
  - open quotient between the vocal cords in front, middle and rear as well as the total open area.

Methods

- When we, in 1977 in Folia Phoniatrica, made a quantitative calculation of the open/close phases of the electroglottography (EGG) compared with stroboscopy the measures were made manually
- this will be the case in the near future for pathology in High Speed films, till software is established of:
- a: kymography including start and termination of intonation
- b: acoustical patterns of single movements and series as well
- c: EGG movements
- d: FFT
- all possibly changing with treatment

Tanya, our 1. patient

- The picture presents the quotients and area calculations (12:12 o’clock)
- Then the observation triggered a seizure treated with pulmicort, 3 inhalations of 200 micrograms
- A series of pictures are presented after the seizure. (12:24 o’clock)

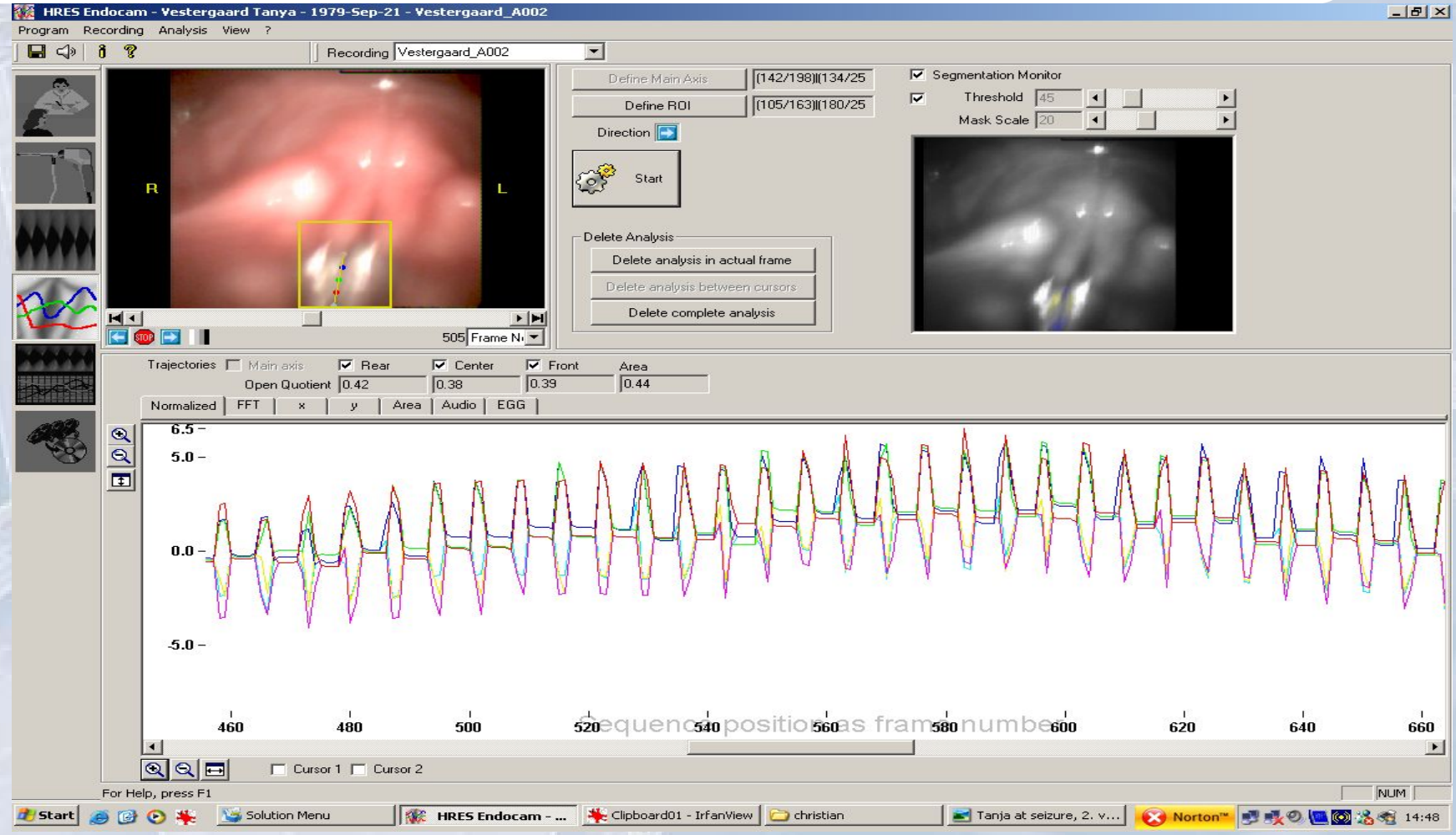
Methods

- In kymography, a typical more regular movement was found after treatment and the intonation pattern included less use of the false vocal cords.
- The acoustical differences with the rythmic aspects are presented.

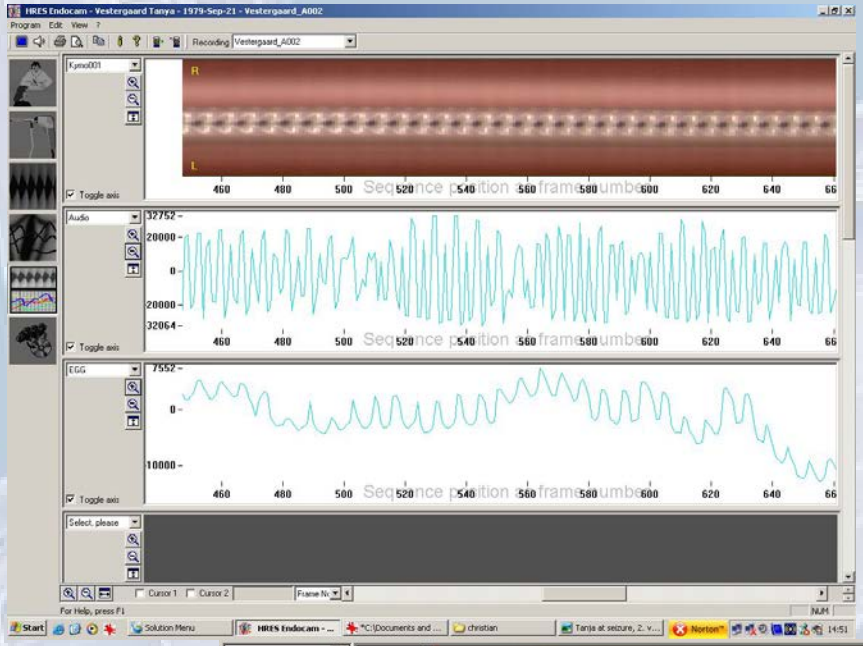
Methods

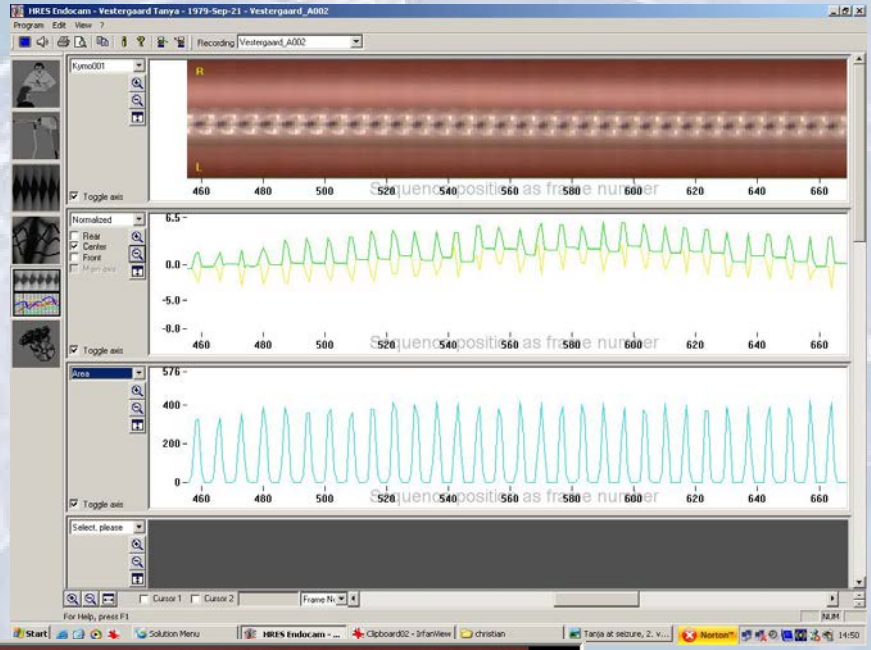
- The electroglottigraphical curves on the High Speed films were not necessarily varying as the acoustical one,
- because of the difference between the voice source (EGG) and the resonance area (acoustical curve).

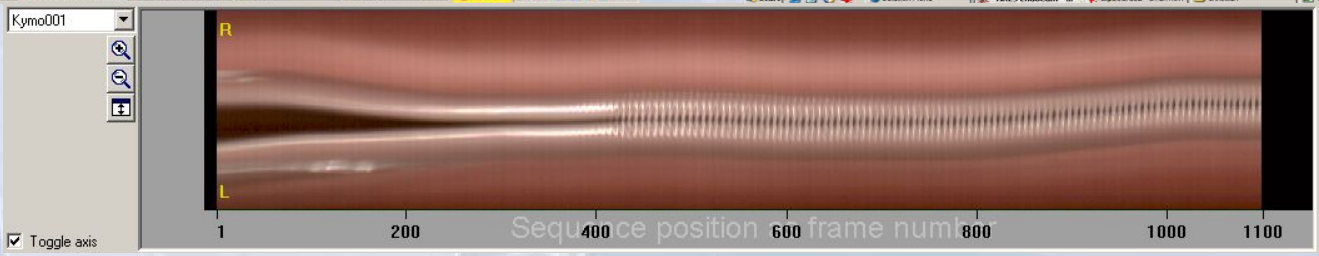
Tanya just before relapse



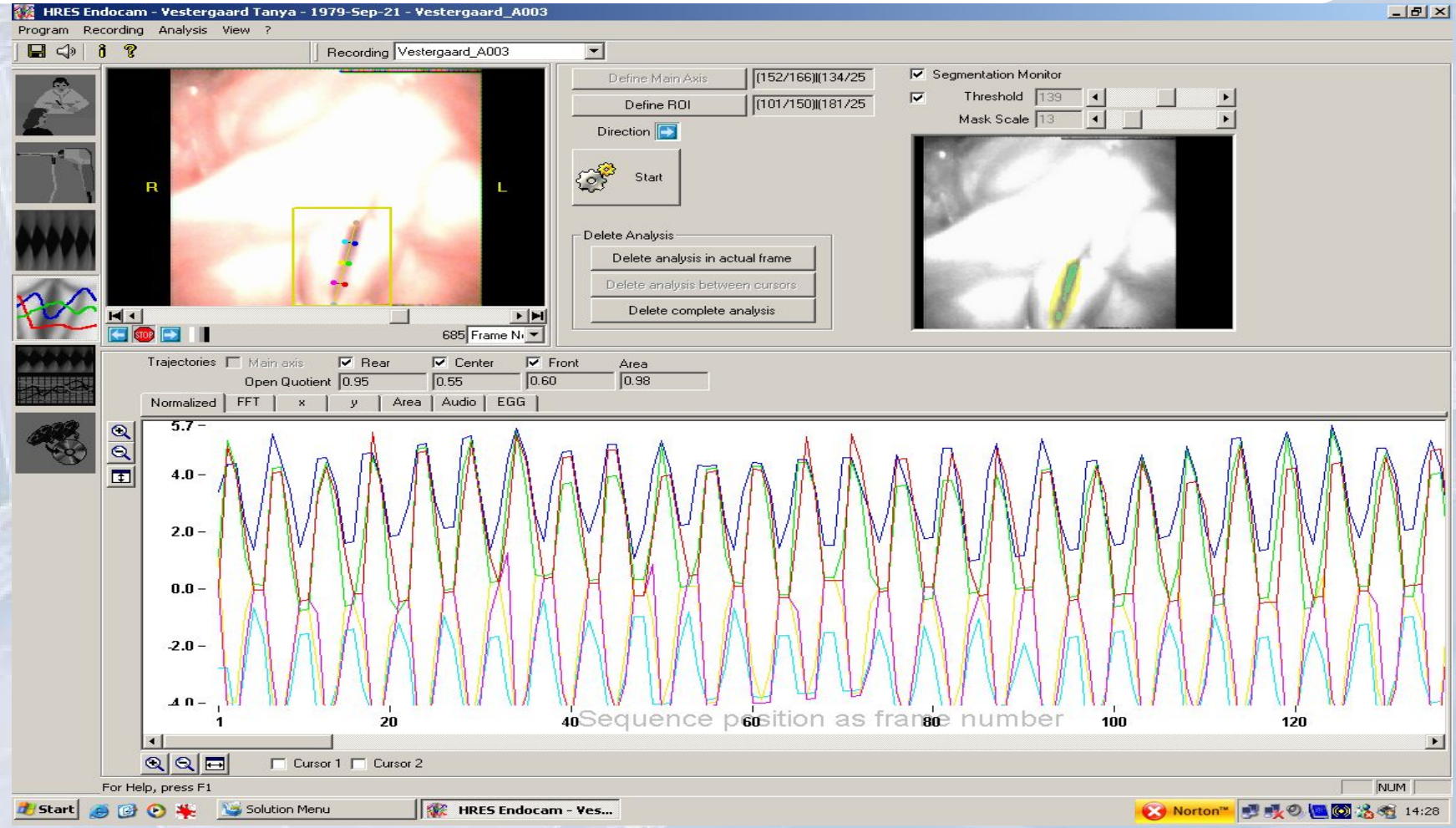
before relapse



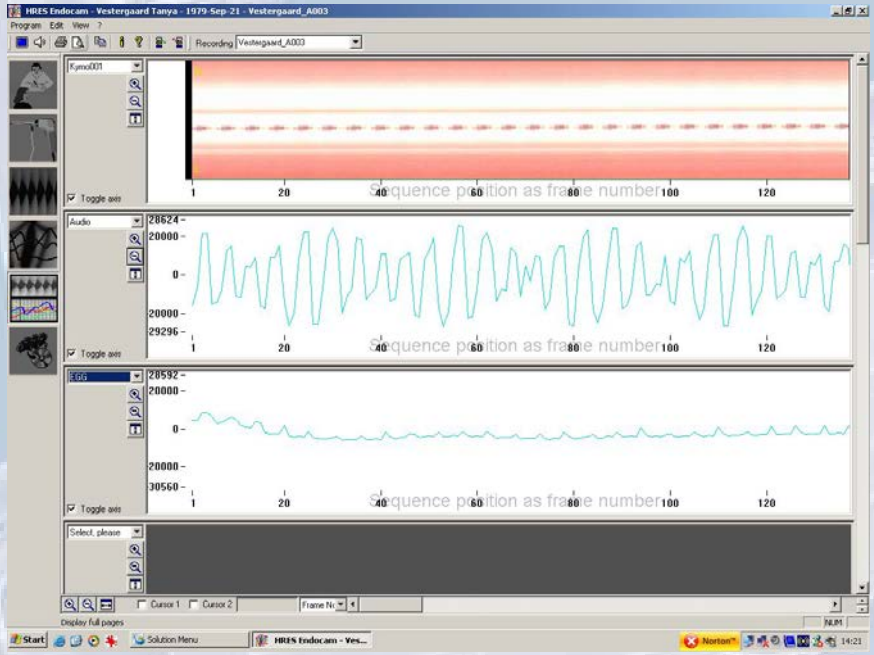


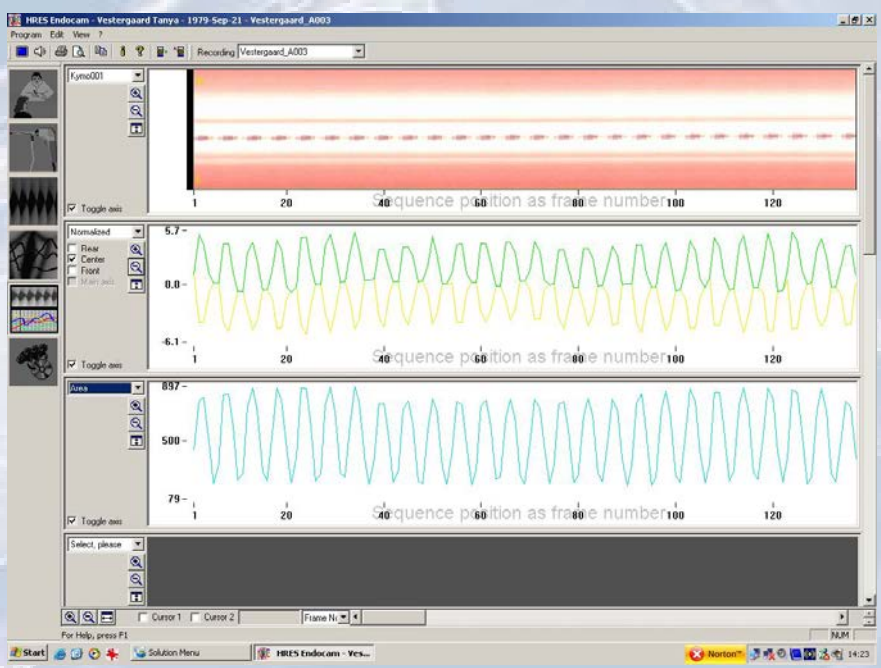


Tanya after relapse



Tanya’s data after relapse





Material

- For the test of the value of High Speed films before and after treatments:
- 55 patients with dystonia that involved the larynx were chosen in a prospective case – control study for eight months with two or three examinations of each patients.
- The patients were compared with a group of normal clients in all 42 persons.

Material

- We discovered nothing special with stroboscopy in most cases.
- Play
- This has also been our experience with pubertal boys at the shift from child to adult voices. High Speed films of pubertal voices were presented in Aachen at the COST 2103 meeting 2008.

Material

- The measurement of dystonia patients before and after treatment with High Speed films was compared with normal persons:
- the stroboscopies,
- jitter, shimmer, and
- the closed phase of the vocal cords with EGG on MDVP (Laryngograph Ltd.)

Material

- Statistical analysis (SAS JMP) included comparing the quantitative measures in the High Speed films
- The qualitative aspect of kymography, EGG, acoustical analysis and FFT.
- A visual score from 1-100 was based on the subjective evaluation of therapy by the patients.

Results

- In the patients with laryngerial dystonia and related disorders
- The open quotient for the middle part of the vocal cords, and the rear open quotient of the first examination at High Speed films were significant for use
- With a probability ChiSqr of 0.0009 and 0.0008 respectively.

Results

- At the second examination
- The area measurements between the vocal cords and the open quotient in front were significant with a ChiSqr of 0.0002 and 0.0027 respectively for use at the second examination.
- Another interesting result was the change of groups toward normal of subjective complaints measured on the visual scale effect from 1-100.
- The the fundamental frequencies were comparable.

Results

- The ANOVA test showed a trend of difference of
- the middle quotient of the open phase at the High Speed films, comparing the dystonia patients with non dystonia patients.

Results of dystonia clients

- The values before treatment of the **open quotient** in the dystonia group were devided for effect of treatment on the visual score of five dystonia groups (100 is total rehabilitation) compared with measures after treatment:
- Before treatment After treatment

Visual score

	Front	middle	rear	area	Front	middle	rear	area
76-100	0,44	0,53	0,62	0,74	0,54	0,64	0,68	0,77
51-75	0,69	0,51	0,43	0,74	0,81	0,69	0,72	0,89
26-50	0,49	0,50	0,56	0,66	0,61	0,63	0,63	0,84
1-25	0,52	0,46	0,66	0,77	0,61	0,53	0,44	0,73
0	0,43	0,54	0,64	0,67	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Results of comparing normal clients with the total dystonia group at High Speed

With SAS, JMP calculation of probability of improvement there is no significant difference between the normal controls and the dystonia patients, but only a trend for the middle qoutient in the High Speed films. If the patients are devided in groups as presented earlier there is a significant difference for the whole material of 0.0577 at the middle qoutient for the group with 51-75% effect on the visual score.

Control group High Speed measures		Quotients		
	front	**middle**	rear	area
Non singers 3 M	0,47	0,52	0,64	0,71
Amatuer singers 12 M	0,47	0,57	0,64	0,68
Non singers 9 F	0,46	0,56	0,64	-
Amatuer singers 18 F	0,43	0,54	0,49	0,65
All S.D. are 0,2 to 0,3				

Dystonia patients average High Speed measures		Quotients		
1 examination	front	**middle**	rear	area
Males	0,58	0,54	0,54	0,79
Females	0,49	0,49	0,49	0,69
All S.D. are up to 0,5				
2 examination				
Males	0,77	0,77	0,54	0,86
Females	0,54	0,54	0,54	0,81
All S.D. are up to 0,28				

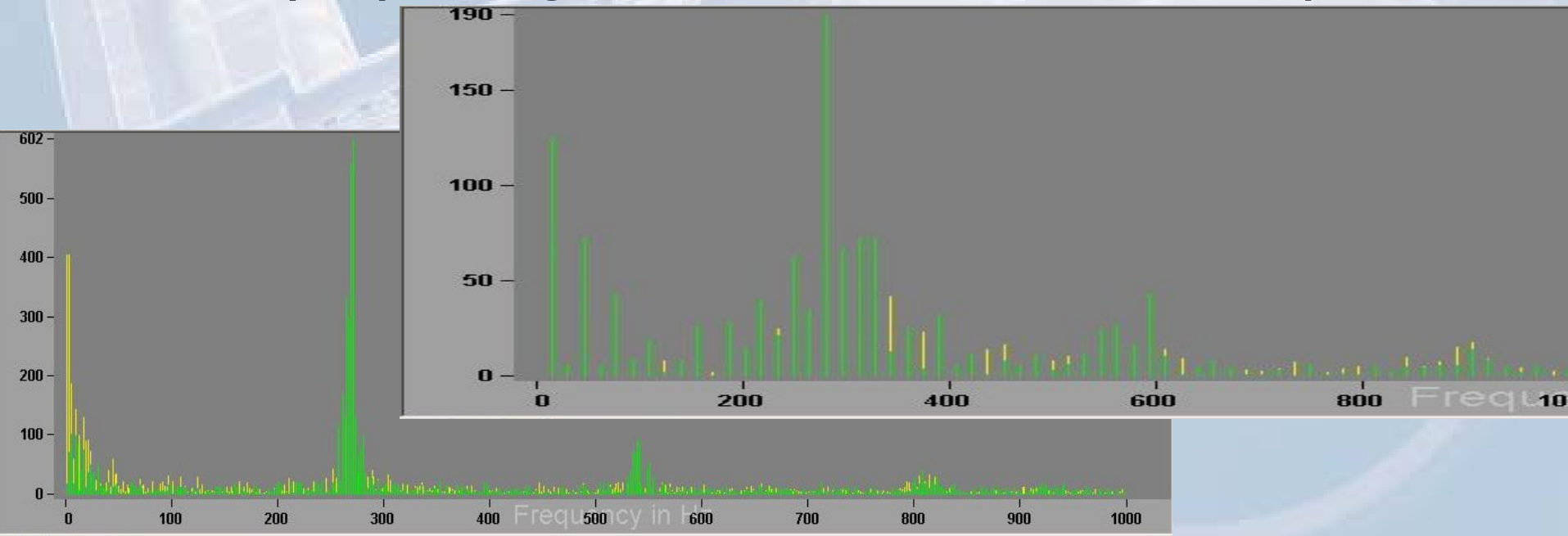
Results of jitter, shimmer and the close phase in % in electroglottography

MDVP by Laryngograph Ltd.	Dystonia clients				Normal clients			
	Tone		Speech		Tone		Speech	
	Males	Females	Males	Females	Males	Females	Males	Females
Jitter	0,8	15,3	13,9	18,6	1	1,5	5,5	5,8
Shimmer	5,9	8,7	16,1	15,6	2,8	2,7	18,5	13,5
Close phase in glott.	51%	46,70%	48,60%	45,30%	49,70%	49,70%	51,20%	49,70%

laryngoscopy: Arytenoids oedema changed from score 3 to score 2 out of 5.

Results

- Examples are given before and after treatment of FFT and unfortunatly only to 1-2000 Hz measured on the High Speed setup, (background before, front after)



Conclusion

- Differences of dystonia can be analysed with High Speed films for the open quotient in the middle and rear parts of the vocal cords before treatment, related to after treatment. The front quotient and the total area between the vocal cords are related to treatment.
- Kymography, EGG, the acoustical curve and FFT signals analysis will still be dependend on visually made hypotheses and evaluation.

- Thanks to all helpers at the centre and to Kasper Munck from SAS statistical institute