The presenter

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Questions to be answered

How to prevent injury of the child voice

- Is an child voice more likely to be damaged by singing than adult voices? If so, why?

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Core messages

- ***There are two aspects to prevent damage of the voice in children:***
  - ***1.*** to make phonetograms and fundamental frequency measures to secure that the child does not feel tempted or pressed to sing outside the measured area of phonetographic voice function.
  - ***2.*** to take care of well known, especially mucosal disorders of the upper airway, with focus on the vocal cords, functionally included in the larynx area.

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Core messages

- ***The hormonal studies related to phonetograms have earlier been made, and it should therefore not be necessary to repeat the hormonal analysis every time there are problems with child voices since the relations between the hormones of development and phonetograms have been made.***
- ***How hormones are related to phonetograms is published in the book:***
- Pedersen M. Normal Development of Voice in Children. Ed. Springer 2008.

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Abstract

- Background research was presented in the book on evidence based development of voice in childhood comparing development of adrenal hormones and paediatric parameters with computed averaged phonetograms and electro-glottographical (EGG) fundamental frequency during reading of a standard text in a stratified way (Pedersen M., Springer 2008).
- When diagnosing and treating pathologies of the singing voice in childhood, differential diagnoses between **development** and pathology are focused upon, which is the difference to adults.. Since the relations between paediatric/ hormonal- and phonetogram/ fundamental frequency- connections have been documented it is enough to make an acoustical analysis in pathological cases to define the developmental state. And here it is of course mandatory for the child not to try to sing bordering the phonetogram area, since **a tissue related strain will be the result.**

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Abstract

- **Pathology of the tissue** can make the singer – and singing teacher insecure of allowing choir children to sing. There are in the larynx special acute and chronic pathological upper airway conditions to be aware of: immunological -, infectious- and swallowing. The pathology can be treated and the documentation with phonetograms and fundamental frequencies can show full age related restoration. New diagnostic possibilities open up with high speed films as a supplement to videostroboscopies, differentiating online electro-glottography (EGG) of the vocal cords from the acoustical resonance measure and giving analytic segmentation of vocal movements in front, centre and rear areas.
- **In conclusion,** there are two aspects to prevent damage of the voice in childhood: 1. to make phonetograms and fundamental frequency measures to secure that the child does not feel tempted or pressed to sing bordering the measured area of phonetographic voice function. 2. to take care of well known, especially mucosal disorders of the upper airway, with focus on the vocal cords, they are functionally included in the larynx area.

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Introduction

- As in many other fields, evidence based studies are also scarce on understanding of the normal development of voice. Background research was presented in the book on **statistical evidence based development of voice** (not only expert evaluation) in childhood (Pedersen 2008, Cochrane Handbook 2009) comparing development of adrenal hormones and paediatric parameters with computed averaged phonetograms and electro-glottographical (EGG) fundamental frequency during reading of a standard text in a stratified way. When diagnosing and treating pathologies problems of the singing voice in childhood, differential diagnoses between **development and pathology** are focused upon, which is the difference to adults. Since the relations between paediatric/ hormonal- and phonetogram/ fundamental frequency- connections have been scientifically documented it is routinely enough to make an acoustical phonetographic analysis in pathological cases (e.g. using Lingwaves software, Brooks 2005) to define the developmental state. It is of course mandatory for the child not to press the voice at the borders of the phonetogram area, since **a tissue strain will be the result.**
-

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Examples from the book of the normal voice development in childhood

Average yearly change in a stratified study of phonetograms from the 3rd to 12th grade of each 4-5 girls and boys with standard deviations

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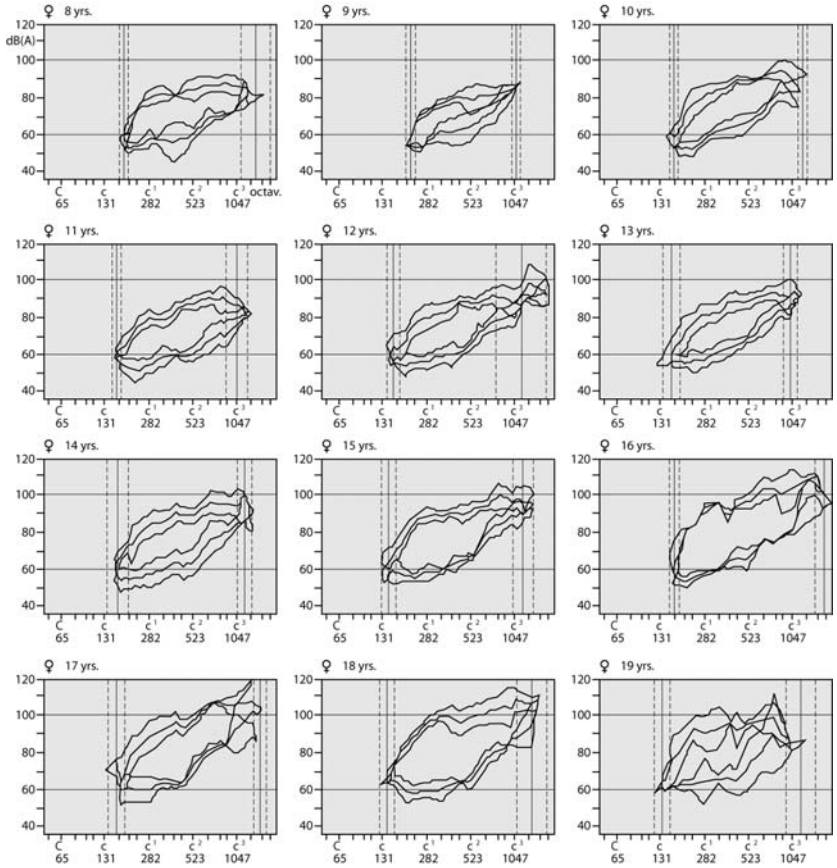

- Average phonetograms for girls with standard deviations, as a function of age.
- The abcissa is divided up into semitones, with the frequency in Hertz for each octave marked. The scale on the ordinate is in dB(A).

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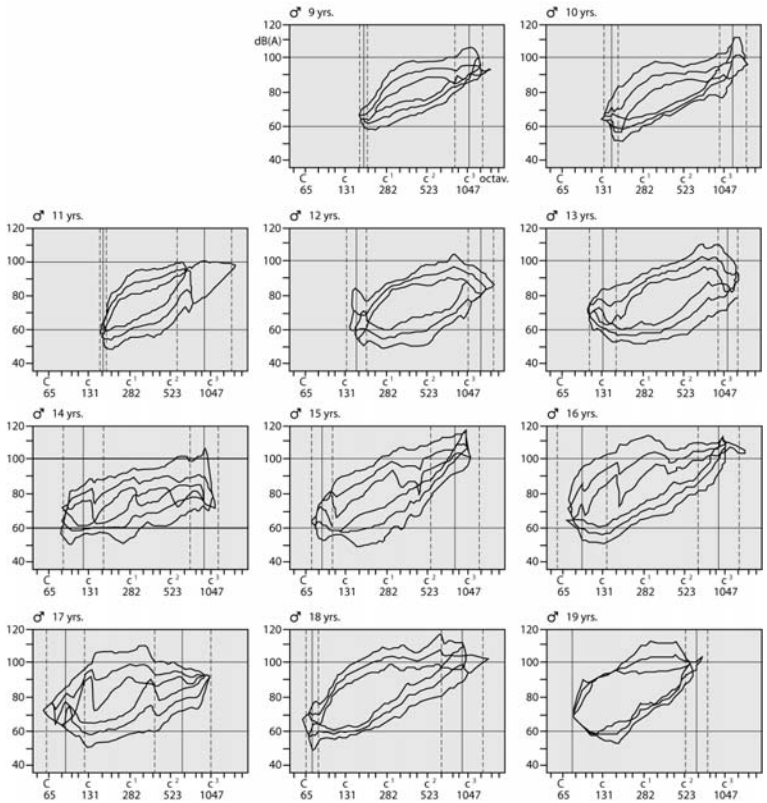

- Average phonetograms for boys with standard deviations, as a function of age.
- The abcissa is divided up into semitones, with the frequency for each octave marked.
- The scale on the ordinate is in dB(A).

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Examples from the book of normal voice development

Examples of pre- and post pubertal phonetograms in a music school of girls and boys

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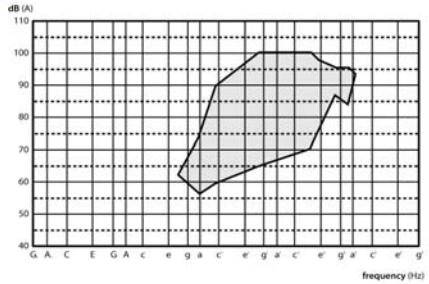
A



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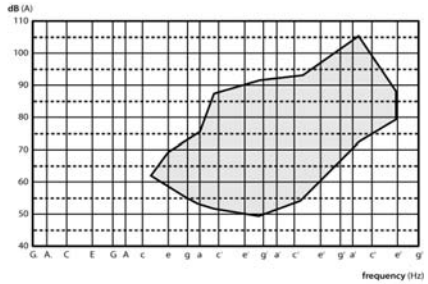

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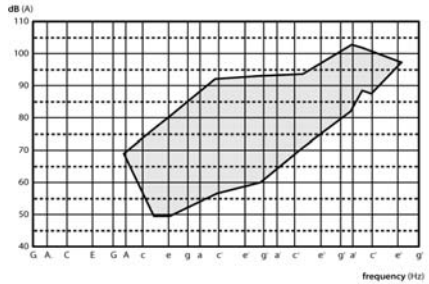

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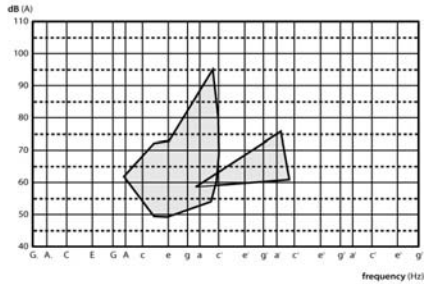

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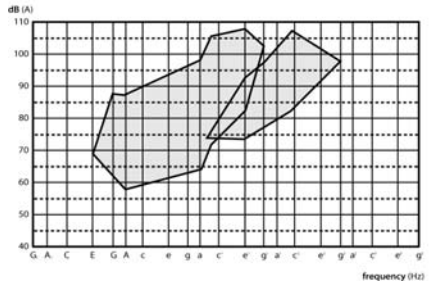

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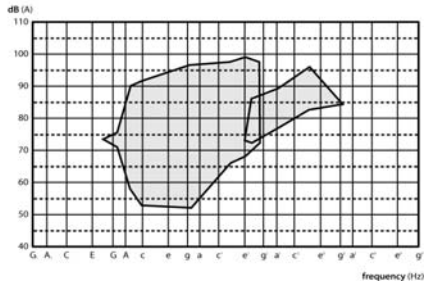

- Phonetograms for boys and young men, depending on voice type. (The voice type was determined by the singing teacher.)

- **A:** Beginner
- **B:** Soprano
- **C:** Alto
- **D:** Voice in puberty
- **E:** Tenor
- **F:** Bass

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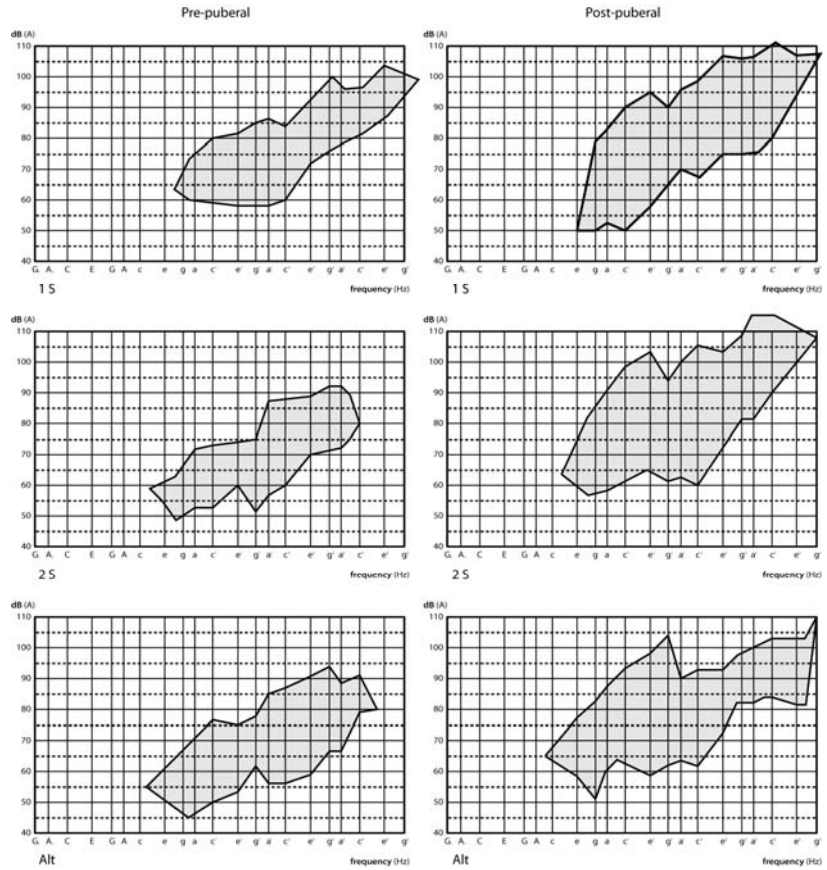

- Phonetograms for girls of the different voices: soprano, mezzo-, alto in hormonal defined pre- and post pubertal choir singers.
- In the upper frequency range, there is a bigger intensity for the sopranos, and in the lower frequency range for the altos.

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Examples from the book of normal voice deveopment in childhood

Development of phonetograms in one boy,

and phonetograms

before and after stop in the choir during the 8th school of 3 boys.

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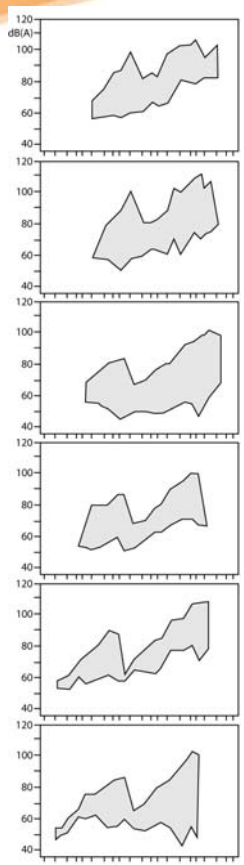
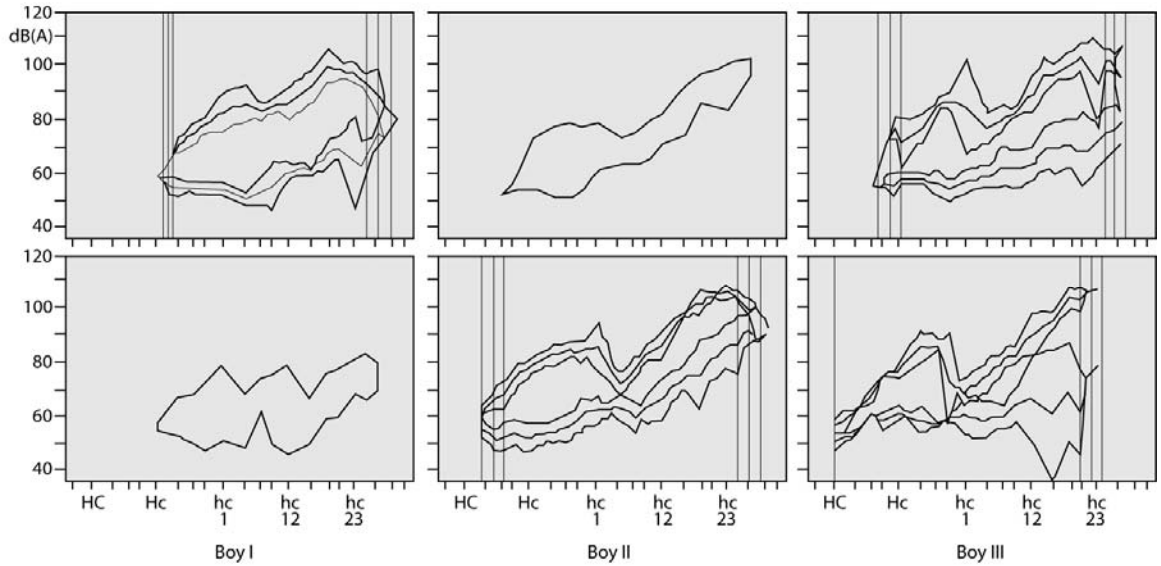


***LEFT**: Phonetograms, measured on a boy at intervals of 2 months (Age 13.7 - 14.6 years). The third phonetogram (December) has the biggest area and shows the smallest irregularities. In January, the boy was suspended from singing in the choir due to the start of the pubertal change of voice (C4 = 262 Hz).*

Average phonetograms and standard deviations for the three choirboys (I – III) involved in the prospective longitudinal study at the 8th school grade level. The phonetograms before and after the change of voice were compared, the hormonal measures were alike the whole material. For test person I and II, only one phonetogram was made in mutation and before mutation respectively. For test person III, three phonetograms were measured before and three during the change of voice.



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Examples from the book of normal voice development

Comparison of 4 computed phonetograms of male sopranos in the Thomaner choir in Leipzig with standard deviations and 4 male sopranos in puberty

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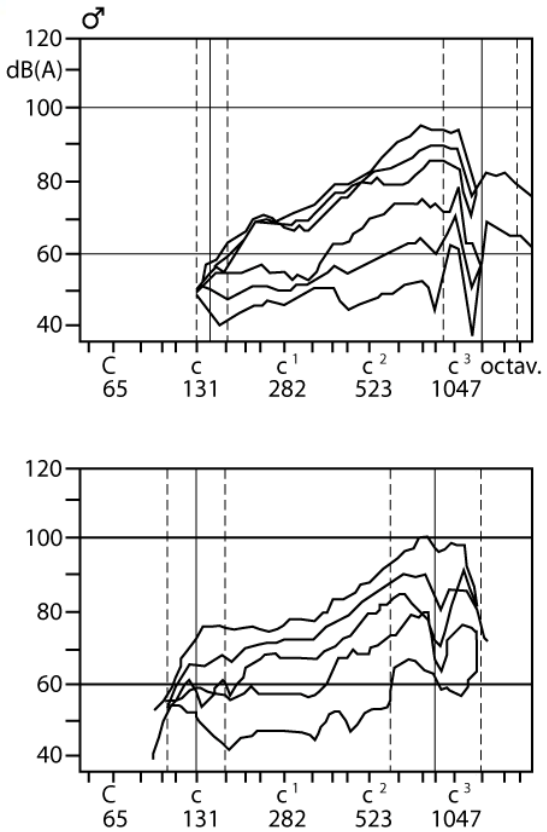

Computed average phonetograms with standard deviation for the cohort of 4 sopranos and of pubertal change groups (4 mutants) from the Leipzig Thomaner choir. The hormonal parameters were similar to those of the Copenhagen boys.

Note the structured register changes in the sopranos

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Examples from the book of normal voice development

Fundamental frequency in running speech in the boys and girls in the stratified study.

There is a

statistical connection to increasing testosterone and oestrogens

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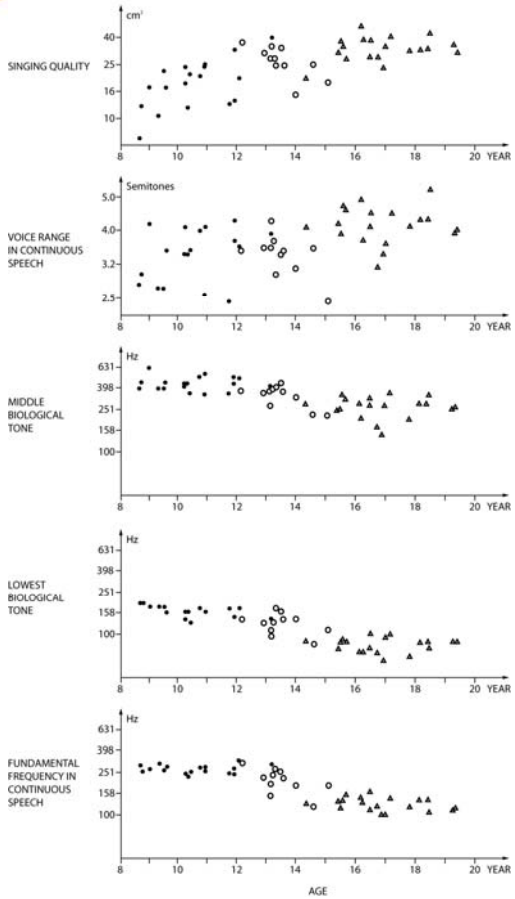

Fundamental frequency in boys related to age

- Graphical representation of:
  - the phonetogram areas
  - the tonal range of the speaking voice
  - the deepest and the mean note in the phonetogram
  - the fundamental frequency of the speaking voice for boys as a function of age (abcissa):
    - (•) 8,7 -12,9 Y
    - (O) 13 - 15,9 Y
    - (Δ) 16 - 19,5 Y

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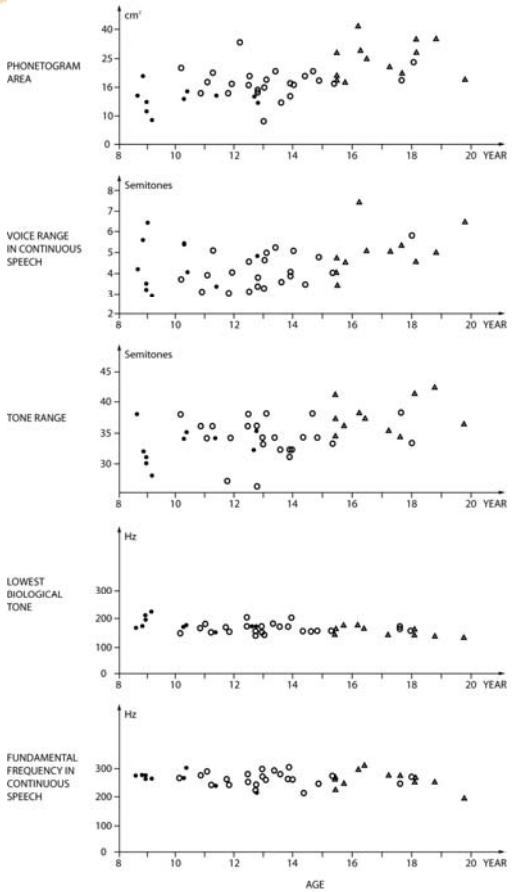
Fundamental frequency and tonal range during reading in girls



- Graphical representation of:
  - vocal parameters of phonetogram areas,
  - tonal range of the speaking voice

  - tonal range of the singing voice
  - deepest note in the phonetogram
  - fundamental frequency of the speaking voice for girls as a function of age (abcissa):
    - (•) Breast development stage 1
    - (O) Breast development stage 2 – 4
    - (Δ) Breast development stage 5 - 6

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Age	(years)	8.7-12.9	13.0-15.9	16.0-19.5	pr yr. % change
No of boys		19	15	14	
Serum testosterone	(n mol/l)	0.54	10.5	18.9	68
Dihydrotestosterone	(n mol/l)	0.18	1.21	1.57	37
Free testosterone	(n mol/l)	0.007	0.14	0.33	77
Sexual hormone binding globulin	(n mol/l)	134	66	45	-16
Delta 4 androstene dione	(n mol/l)	0.54	1.17	2.5	24
Dehydro epi andro sterone sulfate	(n mol/l)	1400	4100	5900	25
Testist volume	(ml)	2.3	13	20	36
Fundamental frequency	(Hz)	237	184	125	-11
Voice range	(semitones)	3.7	4.8	5.0	3.9
Phonetogram area	(cm^2)	19	28	34	9.2
Lowest biological tone	(Hz)	158	104	72	-12

Pubertal stage in boys

- *Geometrical average of hormonal, pubertal and vocal parameters for boys (grouped according to age) and the annual change in these parameters in %.*
- *(Phonetogram area:1 cm2 = 32 semitones x dB(A)).*

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Age	(years)	8.7-12.9	13.0-15.9	16.0-19.8	Significance
Total number		18	12	11	
Oesterone (E1)	pmol	57	104	123	**
Oestradiol (E2)	pmol	73	135	108	
Total testosterone	nmol	0.5	0.76	0.94	
Free testosterone	nmol	0.006	0.037	0.009	
Oesterone sulphate (E1SO4)	pmol	732	1924	2342	**
DHEAS	nmol	3210	3700	7200	**
Androstendione	nmol	1.44	3.28	3.43	*
Sex hormone binding globulin (SHBG)	nmol	153	130	123	
Menarche		+4	+9	+11	
Pubic hair stage		1-4	2-5	4-6	
Mamma development stage		1-4	2-5	5	
Height		18	12	11	
Weight		57	104	123	
Fundamental frequency in continuous speech	Hz	256	248	241	
Tone range in continuous speech	Semitones	3.7	4.2	5.2	**
Tone range in singing	Semitones	23	30	38	
Phonetographic area	cm^2 *	17.3	21.8	28.3	**
Phonetogram lowest tone	Hz	166	156	145	*
Phonetogram middle tone	Hz	429	409	413	
Phonetogram highest tone	Hz	1136	1105	1263	

* cm^2 conversion factor: 1 cm^2 = 32 semitones*dB(a).

Pubertal stage in girls

- *Geometrical means of hormonal, pubertal and vocal parameters for girls (grouped by age). The relative standard deviation lay between 11 and 140%.*
- *(Significance of the differences between the groups: p<0,01 xx; p<0,05 x).*

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Tissue strain

- Tissue strain is focused upon in updated ***micro and – nano-structural experiments*** (Goldberg and Langer 2007, Jia et al. 2006).

- At this level there is still no evidence of how testosterone and oestrone regulate the development of voice even if some theories have been made (Brooks 2005). With the new exact measures (Pedersen 2008), it will be easier to make basic studies to understand the vocal tissue development.

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Pathology of the tissue

- **Pathology of the tissue** can make the singer – and singing teacher less secure of allowing choir children to sing. There are in the larynx, of which the vocal folds are a small part without any special pathology aspects except for the cover of the vocal cords with stratified epithelium, acute and chronic pathological upper airway conditions to be aware of: **genetic-, immunological-, allergologic-, infectious- conditions, swallowing and environmental problems** (Fiorella ML et al. 2004). As in rhinosinusitis (Fokkens W, Lund V, Mullol J. 2007) the teachers need definition of the disorders, description of epidemiology and predisposing factors and the inflammation factors of acute and chronic conditions as bases for diagnoses and management. The pathologies to be treated (Parham P. 2009), in laryngology as in rhinology in many cases include mainly lifestyle correction, antibiotics, antihistamines, steroids and genetic advice. The documentation with phonetograms and fundamental frequencies will show full age related restoration, unfortunately till now without randomised controlled trials.
- **New diagnostic possibilities open up with high speed films as a supplement to videostroboscopies**, differentiating online EGG from the acoustical resonance and giving segmentation of vocal movements in front, centre and rear areas (Pedersen M).

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Cases

- On the following slides, some cases of different individuals are presented. The following parameters are highlighted for the cases:
-
- Case description with diagnosis and treatment, including lifestyle advice
- 2 observations with 2 weeks interval
- Measures include:
  - Highspeed films
  - Segmentation of vocal cords
  - Electroglottography (EGG)
  - Acoustical curves
  - Phonetograms

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Case 1

- *Case description (Page):*
- **Gender**: Male **Age**: 17 years
- **Background**: Sings rock **Symptoms:** Hoarseness
- **Symptom duration:** 6 months
- **Diagnosis**: Mutation, overuse with a laryngitis as result
- **Lab results / microbiological results:** Normal
- **Treatment**: Attempt of upper airways repair: with antihistamins, steroids and ephedrine: Fexofendadine (2 tablets daily of 180 milligrams), budesonide (2-3 inhalations, 1-2 times a day of 200 micrograms), ephedrine tablets (240 mg) when necessary.
- **Instructions given:** Sing carefully in the two low registers
- **Objective findings in the larynx:** Irregular borders of the vocal cords suggesting 4 fundamental areas, slight edema of the surface, especially on the right vocal cord. Injected arytenoids
- **Interesting findings of the analyses:** 4 registers on the phonetograms. A “tuning” of the acoustical curve is shown at 509 Hz and 186 Hz.

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Case 1

cost
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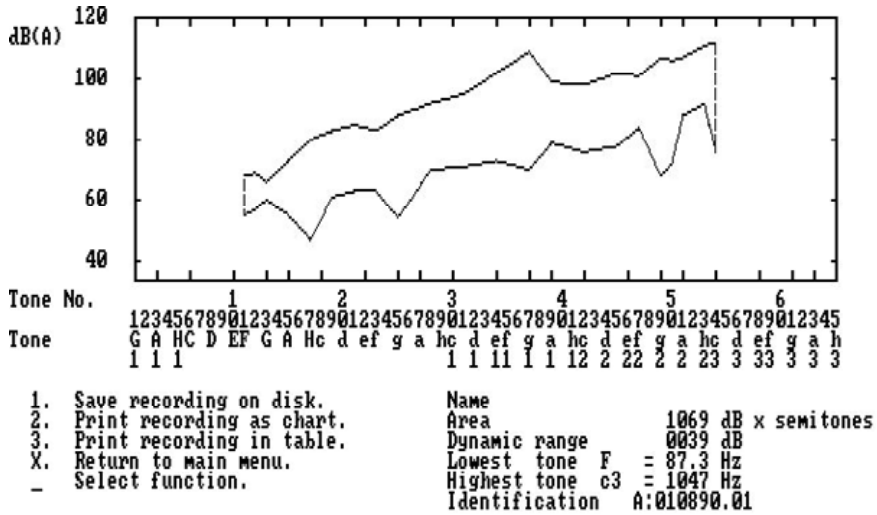
This is a phonetogram of a 17 year old male singer



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Case 1

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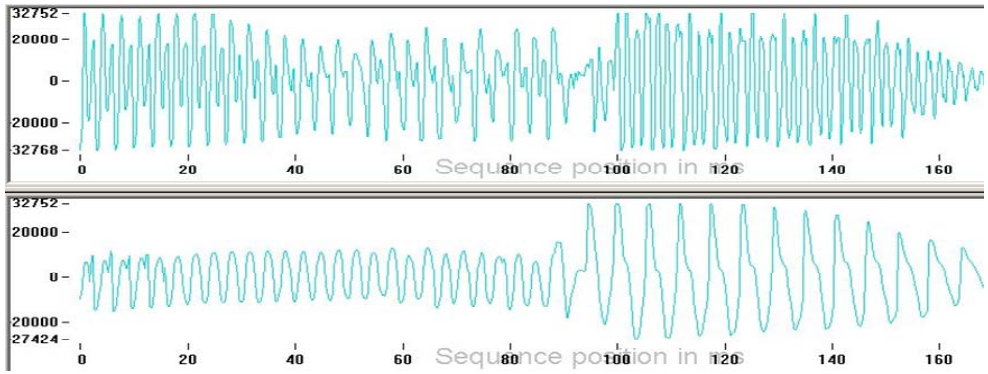
Acoustically around 10 cycles are changed before the electrglottographic register shift.

- The analysis were made in the middle of the vocal cords with 4000 pictures/sec. (Wolf inc.). The acoustical change is related to the tuning of the upper vocal tract.



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Highspeed measures. The analyses was made in the middle of the vocal cords with 4000 pictures / second. The acoustical change is related to the "tuning" of the vocal tracts. The "tuning" was not seen on the EGG at 509 Hz.

Case 1

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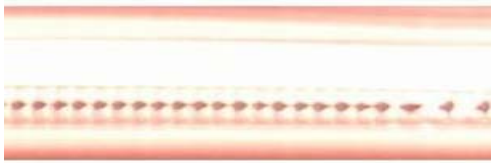
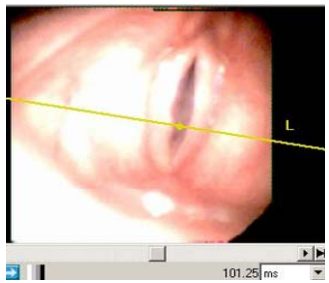
The kymographic film corresponds to the electroglottographical picture.





Kymographic film at the same register change.

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Case 1

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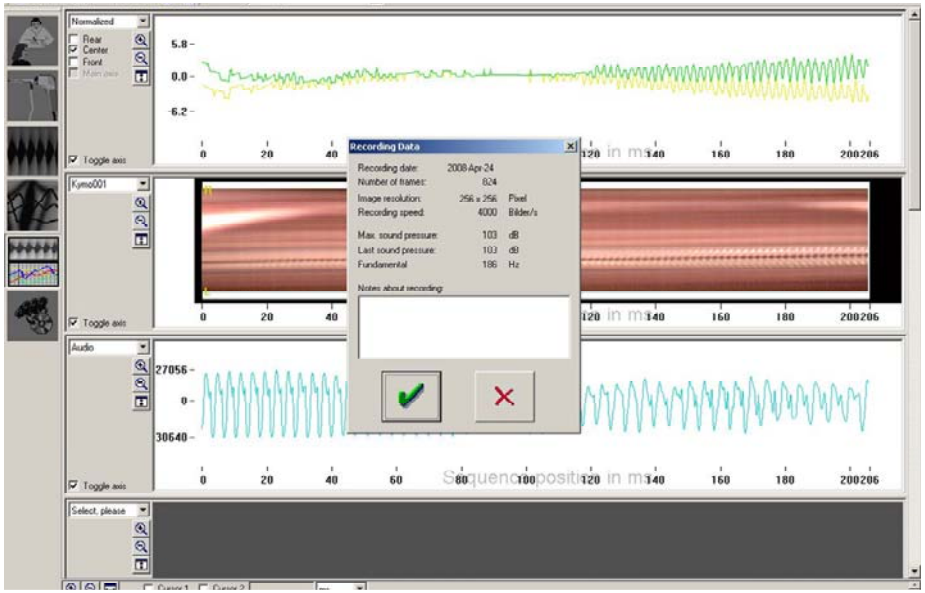

Oscillographic, kymographic and EGG change at <u>186 Hz</u>

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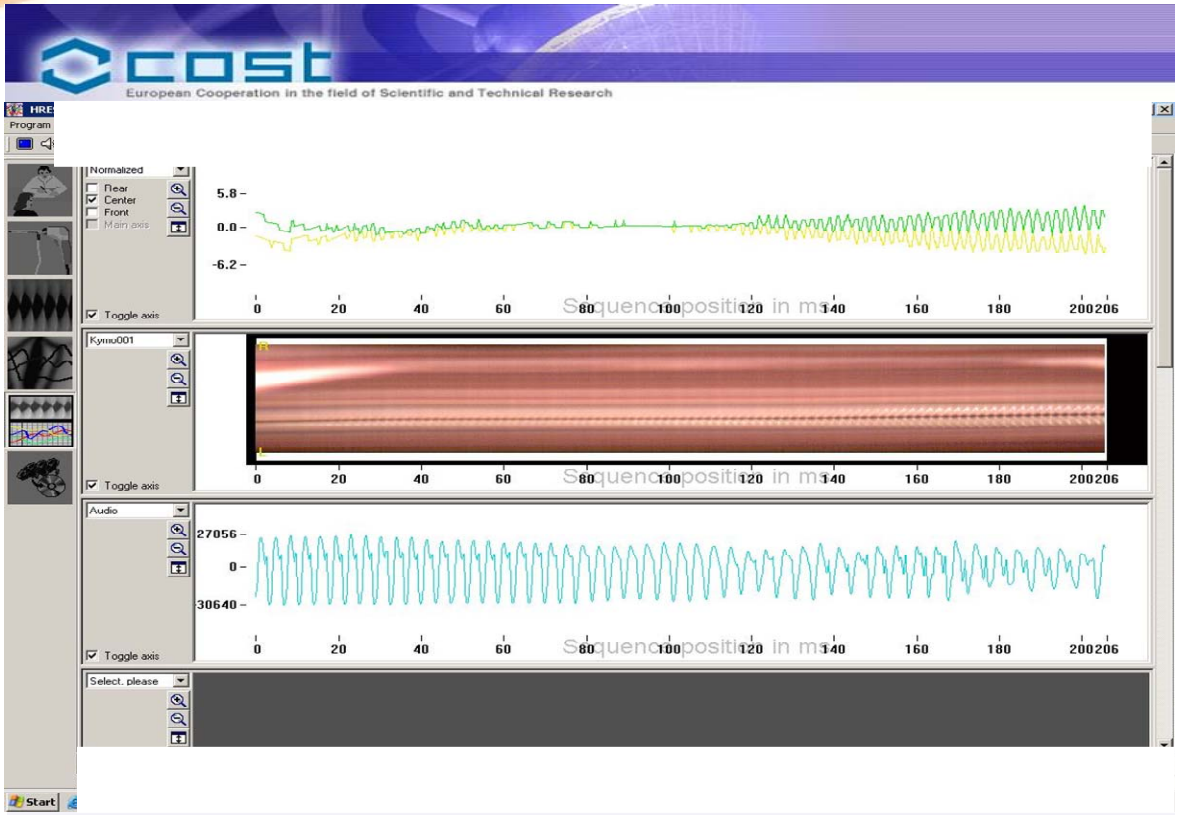
Case 1



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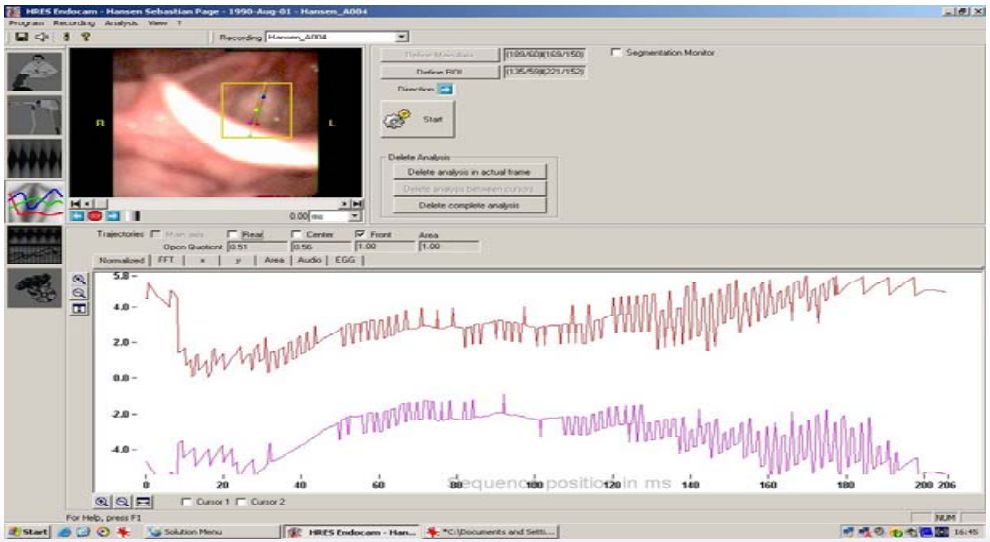
*Overview **at 186 Hz,** showing the movements of vocal cords in the center of the vocal ridge, kymograph, and the acoustic measures*

Case 1

cost
European Cooperation in the field of Scientific and Technical Research

The front part of the high-speed film shows no connection between the vocal chords



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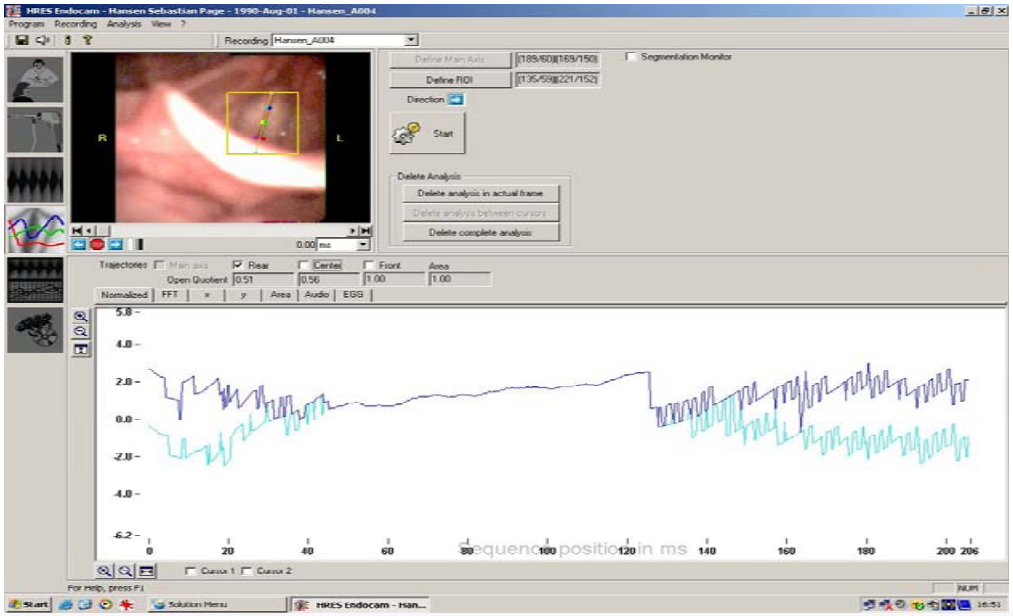
The front part of the highspeed film show no connection between the vocal cords of 186 Hz.

Case 1

European Cooperation in the field of Scientific and Technical Research

The rear part of the high-speed film shows connection between the vocal chords.



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The rear part of the high-speed film shows connection between the vocal cords.

Case 1

Segmentation

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Case 2

Case description (Starling):

- **Gender**: Male **Age**: 13 years
- **Background**: Sings at the Rhythmical Conservatorium in Copenhagen
- **Symptoms:** Cough and a cold
- **Symptom duration:** 1 month
- **Diagnosis**: Chronic laryngitis and rhinitis
- **Lab results / microbiological results:** Normal
- **Treatment**: antibiotic, antihistamin and adrenalin derivate: Azithromycin (250 milligrams daily for 6 days), levocetirizin (5 milligrams), terbutaline (0,5 milligrams)
- **Instructions given:** None (the problem was not technical)
- **Objective findings in the larynx:** Slightly swollen mucosa in the whole larynx

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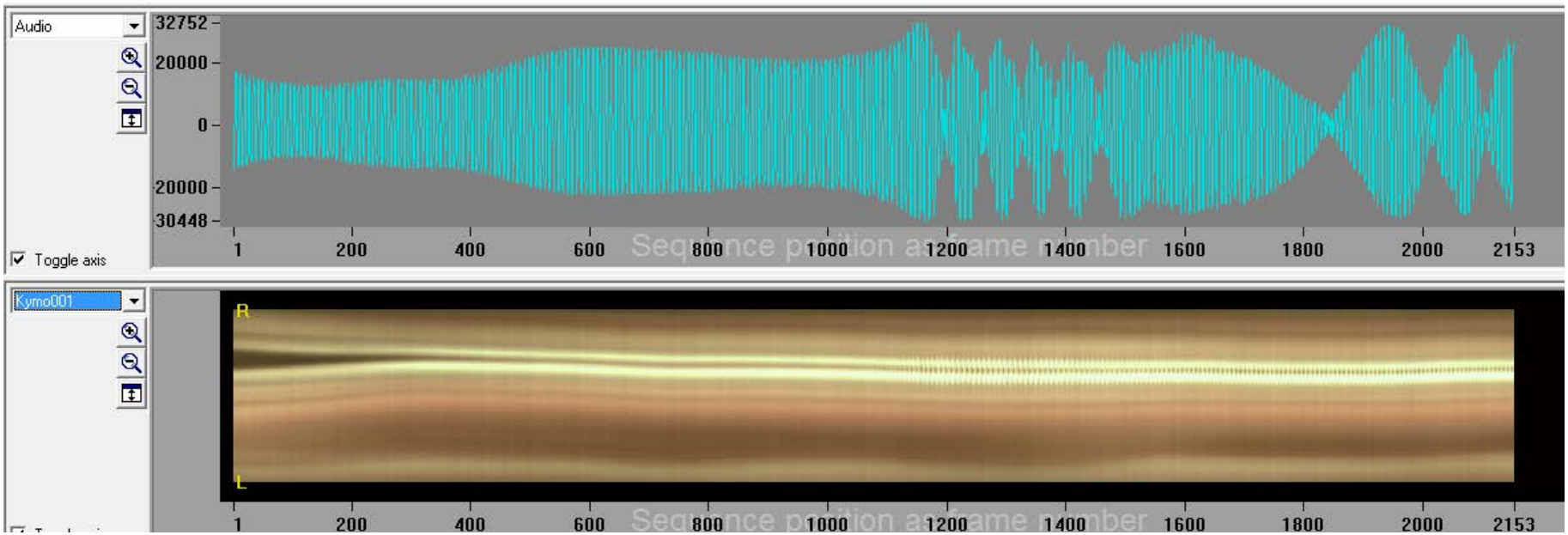
Case 2

- *Acoustical measures and kymograph. Highspeed measures.*



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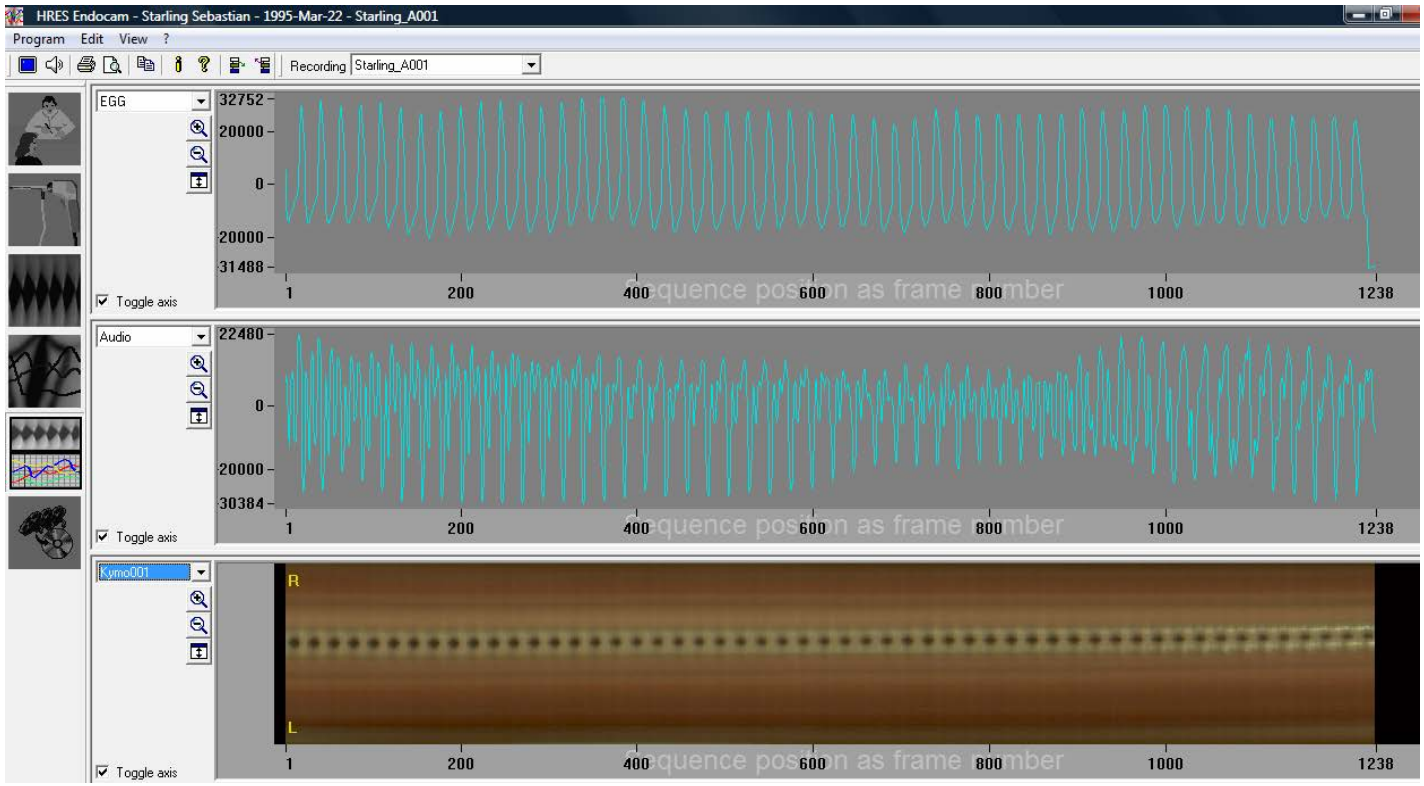
Case 2

EGG, acoustical measures and kymography. High speed measures.



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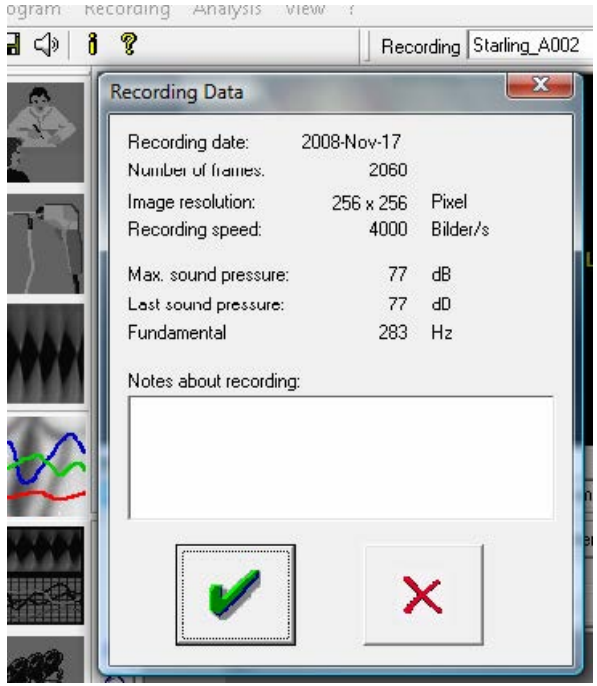
Case 2

Picture from a highspeed film of the larynx.

Fundamental frequency



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Case 3

- *Case description (Skov):*
- **Gender**: Male **Age**: 13 years
- **Background**: Soprano soloist at the Royal Danish Boys' Choir in Copenhagen
- **Symptoms:** Claims of chronic rhino - sinusitis due to the indoor climate in the school and mucous in the throat, has song at several concerts during the period.
- **Symptom duration:** 3 months
- **Diagnosis**: Chronic rhinitis (X-rays of sinuses were normal), chronic laryngitis
- **Lab results / microbiological results:** Vitamin D insufficiency (39 n mol/L)
- **Treatment**: local steroids, antihistamin and antibiotics: Fluticasone drops in the nose (100 micrograms 2-4 times a day), loratidine (10 milligrams once a day), azythromycin (200 milligrams daily for 5 days)
- **Instructions given:** The problem was not technical, but he was advised not to press the voice – which he did!
- **Objective findings in the larynx:** Swollen vocal cords with edematous nodules. Swollen nasal mucosa.
- **Interesting findings on the anlyses:** the highspeed video at adduction and abduction. Phonetogram measure showed a higher dynamic area at the second examination.

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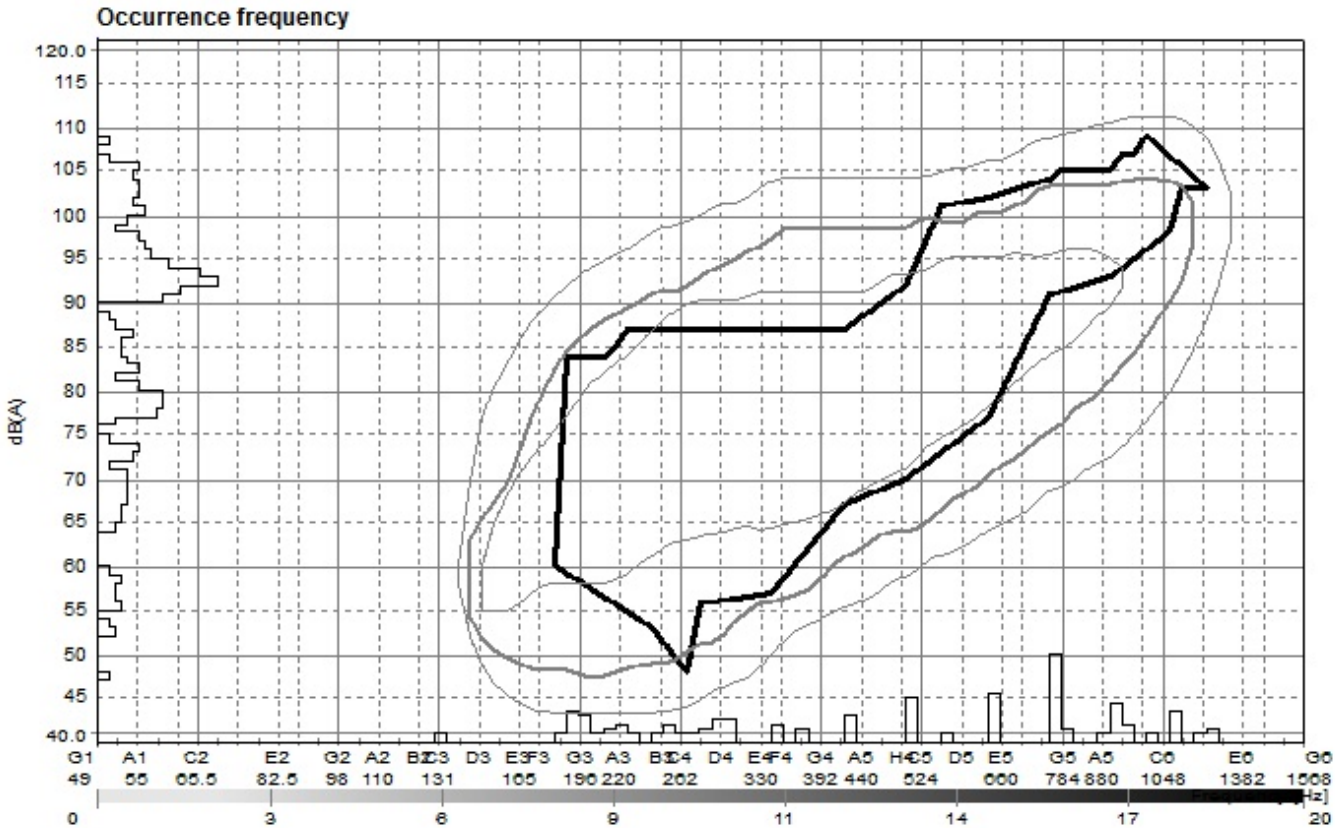
Case 3

The phonetogram at the first examination



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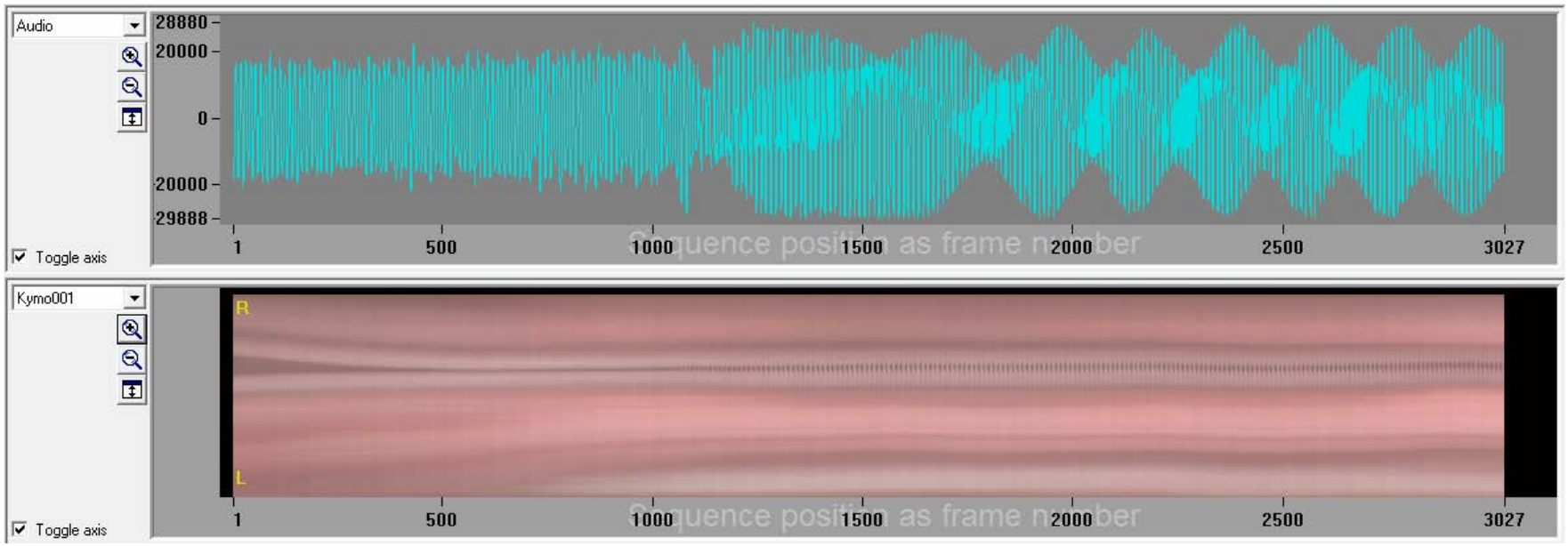
Case 3

Acoustical analyses and kymograph. Highspeed measures at the first examination



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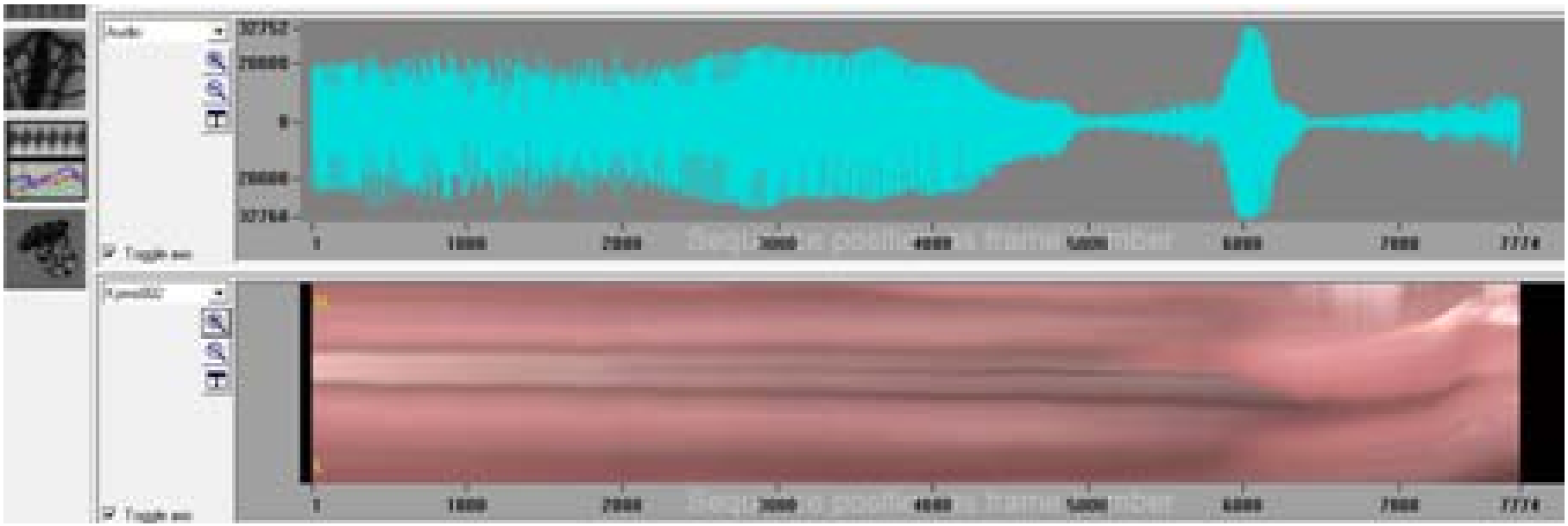
Case 3

Acoustical analyses and kymography showing pressing of voice. High speed measures.



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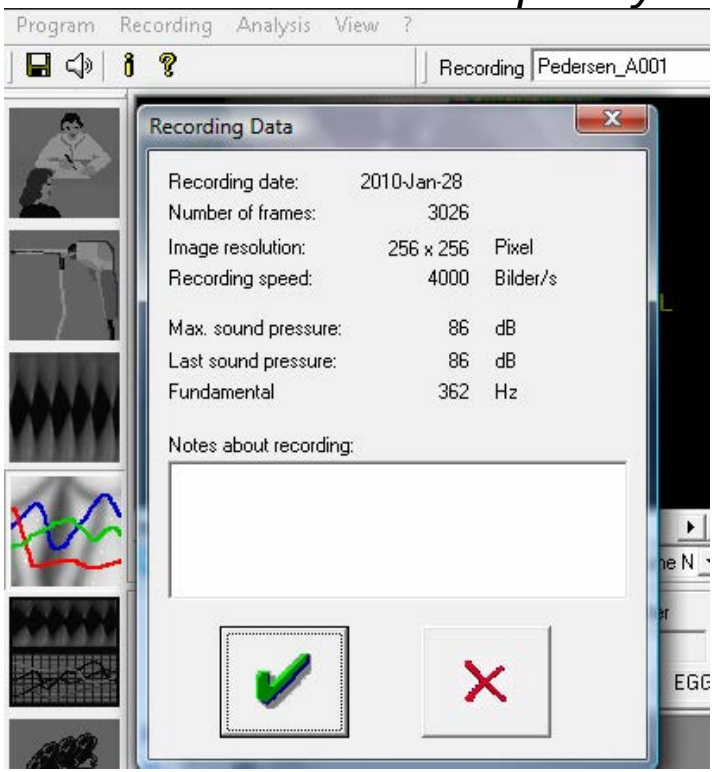
Case 3

Picture from a highspeed film of the larynx.

Fundamental frequency.



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Case 3

Segmentation before treatment

Click to play

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Case 3

Segmentation after treatment

Click to play

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Case 4

- *Case description (Gjerlang):*
- **Gender**: Female **Age**: 14 years
- **Background**: Pupil at the Copenhagen Singing School, sings in the girls' choir.
- **Symptoms:** Sore throat
- **Symptom duration:** 6 weeks
- **Diagnosis**: Tonsillitis (may be provoced by a documented positive Helicobacter bacteria infection)
- **Lab results / microbiological results:** Several allergies (birds, grass, flowers, dogs, cats, wheat, peanuts, soya beans, mould), Helicobacter IGA positive. Eradication of helicobacter when the results of IGA came in after one week.
- **Treatment**: first antihistamine and antibiotics: Fexofenadine (120 milligrams, 1 tablet a day), azythromycin (250 milligrams daily for 6 days) second helicobacter eradication.
- **Instructions given:** Sing with care
- **Interesting findings of the analyses:** The highs peed film showed that the vocal cords moved *with* each other before treatment. After treatment, the high speed film showed that the vocal cord movements was normalized (towards each other). PHONETOGRAM and vibrato were unchanged.

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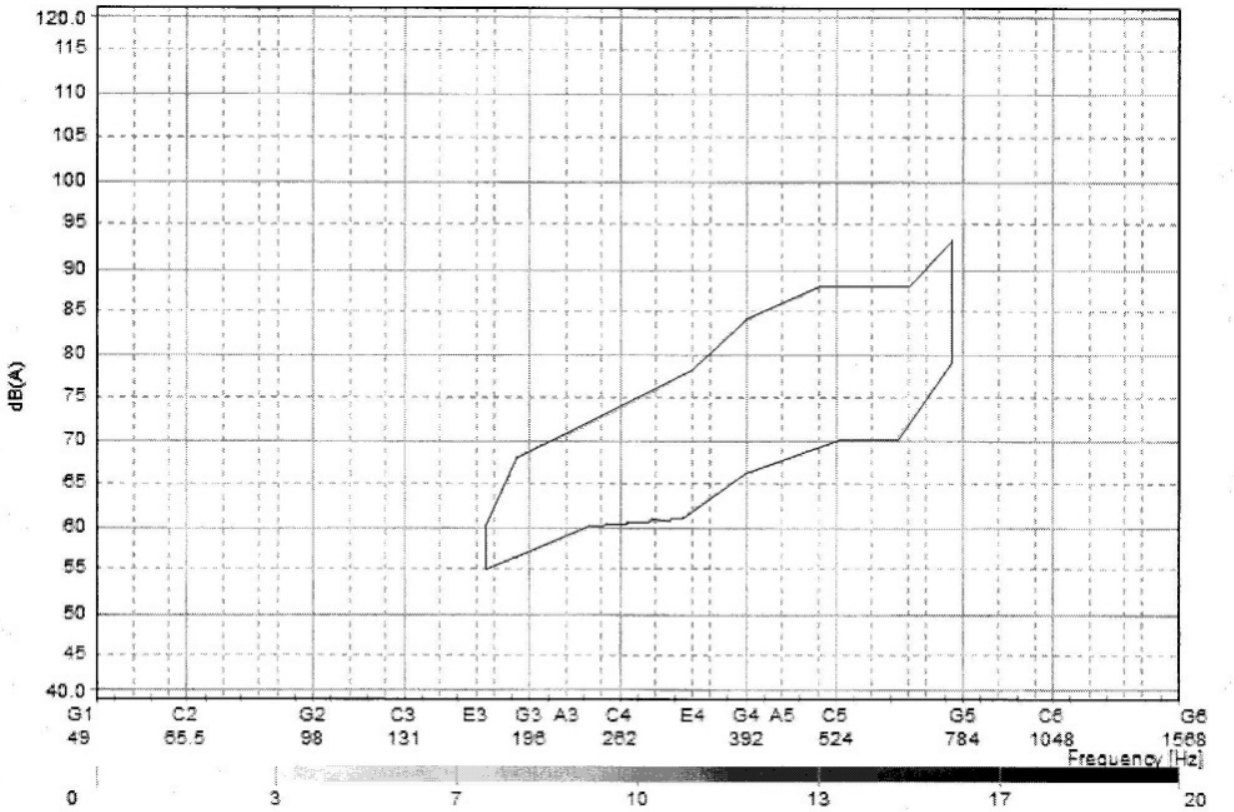
Case 4

- The phonetogram before treatment



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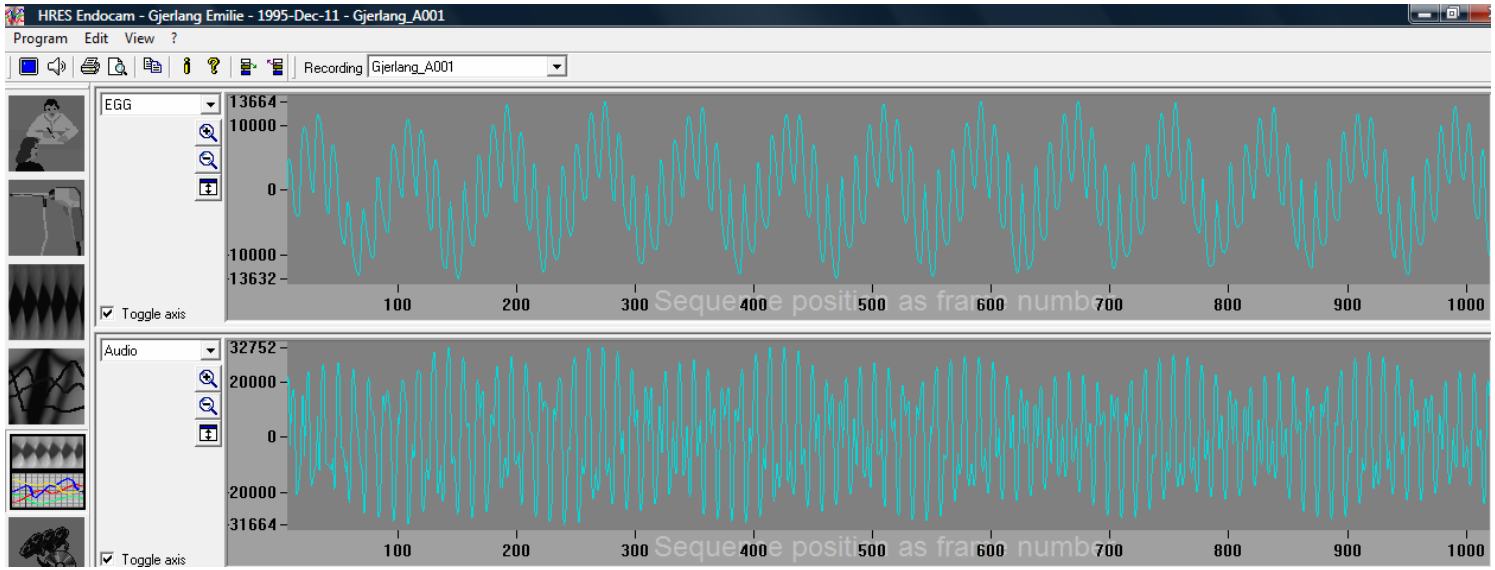
Case 4

The vibrato at the level of the glottis as well as the resonance area.
Highspeed measures of EGG and acoustical analyses before treatment



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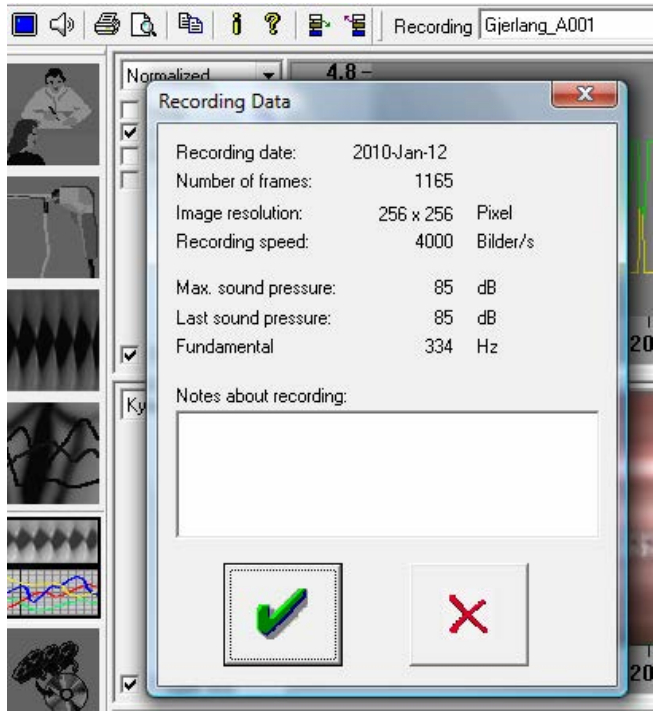
Case 4

Picture of a highspeed film of the larynx, showing edema at the rear part of the larynx.

BEFORE TREATMENT

Fundamental frequency

BEFORE TREATMENT



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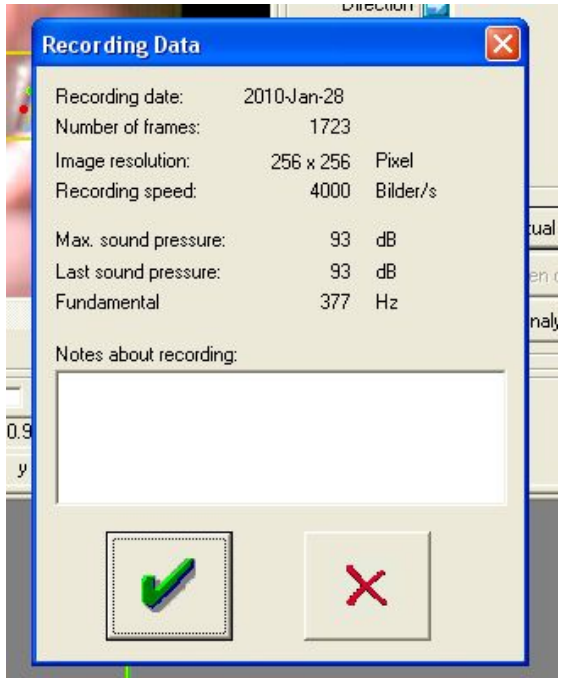
Case 4

Reduction of the edema in the rear part of the larynx after treatment

Fundamental frequency

After treatment



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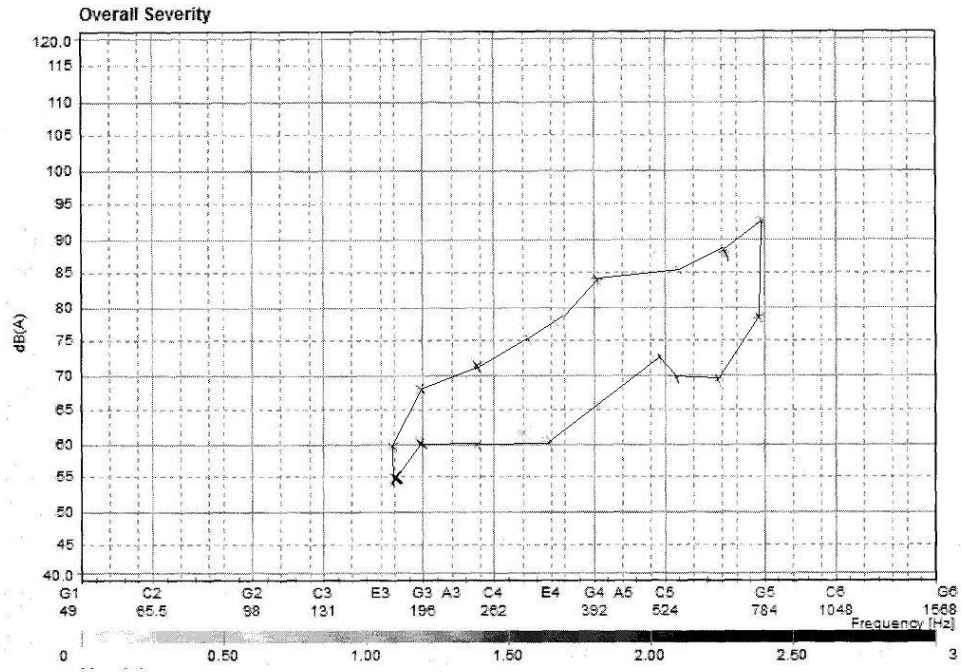
Case 4

- Phonetogram after treatment



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Case 5

- *Case description (Janwell):*
- **Gender**: Female
- **Age**: 17 years
- **Background**: Amateur singer in a rock band
- **Symptoms:** Hoarseness, weak voice
- **Symptom duration:** 2 months
- **Diagnosis**: Hashimotos thyroiditis (and direct trauma during a boattrip in Africa). Ultrasound showed enlargened thyroid gland on the right side, with adenoma-like processes.
- **Lab results / microbiological results:** High TSH (Thyroid Stimulating Hormone) levels (135 MIU), lowered Mannan-Binding Lectin indicating reduced activity of the innate immune system
- **Treatment**: Azythromycin (500 milligrams daily for 3 days), fexofenadine (180 milligrams once a day). Referred to endocrinological department upon arrival of the results.
- **Instructions given:** None
- **Objective findings in the larynx:** Partial recurrent paralysis on the right side, reduced after two weeks

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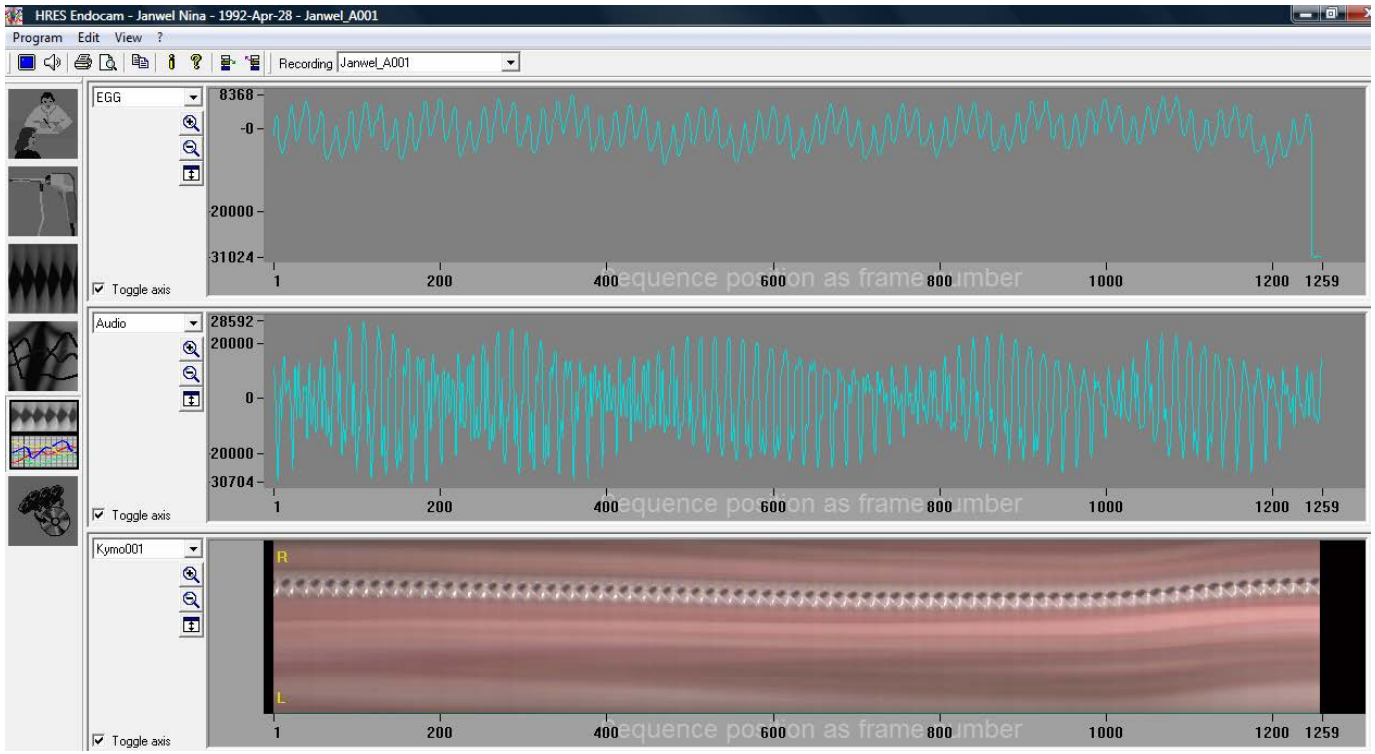
Case 5

EEG, acoustical analyses and kymograph. Highspeed measures



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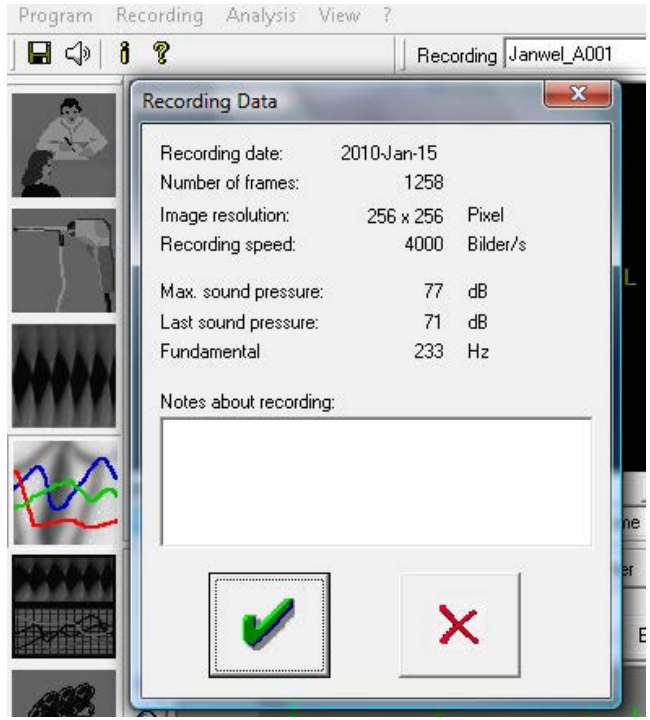
Case 5

Reduced movement of the vocal cord

Fundamental frequency



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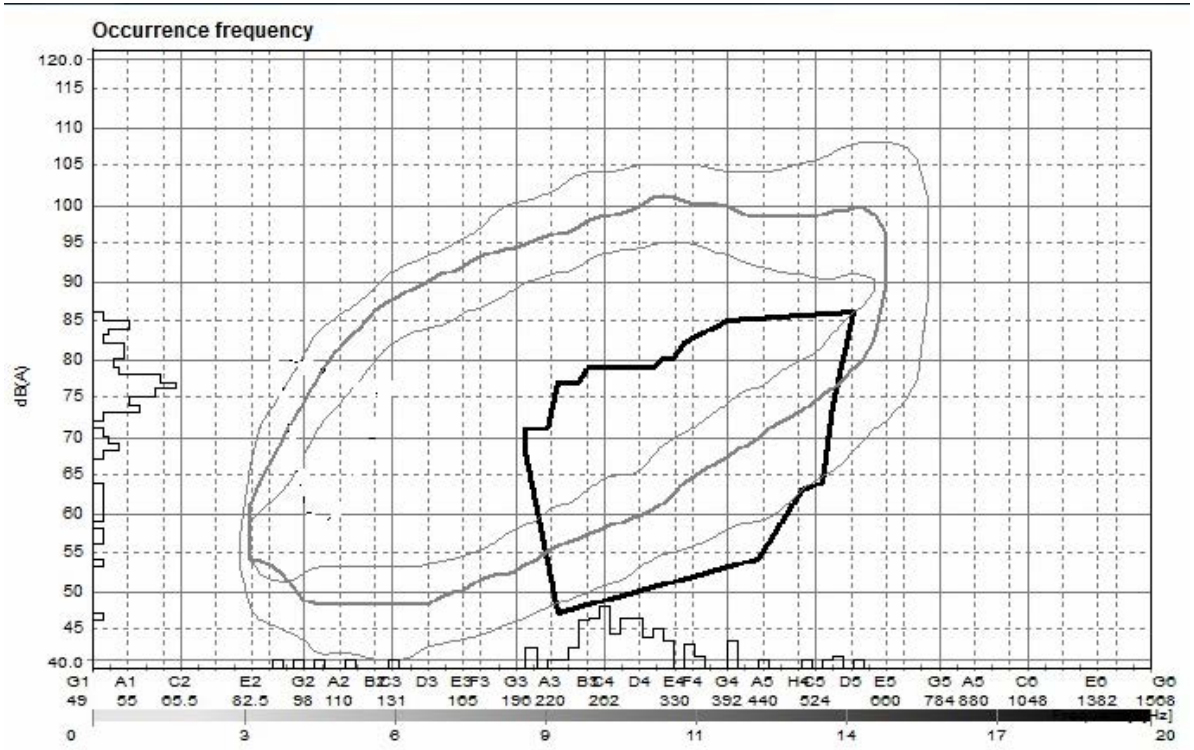
Case 6

- *Case description (Stehr):*
- **Gender**: Female
- **Age**: 16 years
- **Background**: Amateur singer
- **Symptoms:** Glands on the neck. Under treatment for bulimia.
- **Symptom duration:** Pain of the neck lymph nodes for 4 months, treated for bulimia for 2 years
- **Diagnosis**: Ultrasound examination showed several pathological enlarged lymph nodes, the biggest one measuring 3 x 1,3 cm on the left side. CT scan of the sinuses showed edema of the sinus maxillaries, taking up 50% of the volume on both sides.
- **Lab results / microbiological results:** Normal
- **Treatment**: Fluticasone drops in the nose (200 micrograms x 4 a day), first azythromycin (500 milligrams daily for 3 days) fexofenadine (180 milligrams once a day), after results of X ray: clarithromycin (500 milligrams twice a day for 7 days) and amoxicillin (1000 milligrams for 7 days)
- **Instructions given:** None
- **Objective findings in the larynx:** Normal mucosa of the larynx, functional pressure especially of the false vocal cords

Case 6

The computed phonetogram, reduced area



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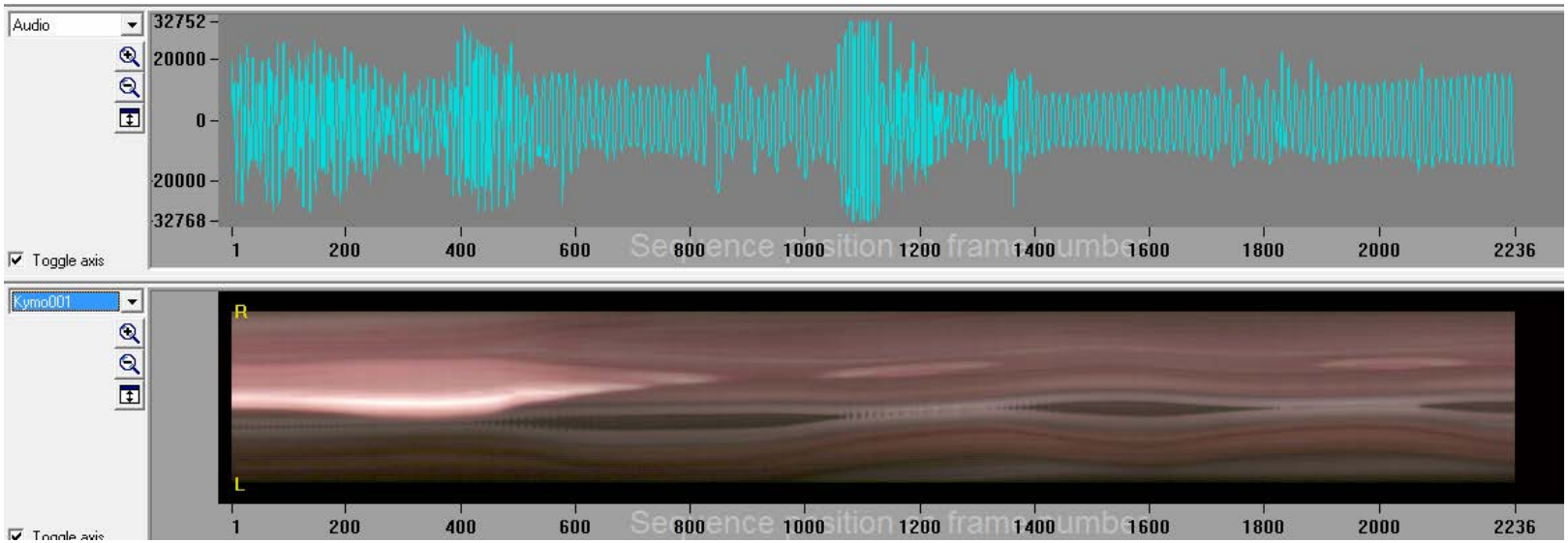
Case 6

The acoustical analysis and kymograph before treatment



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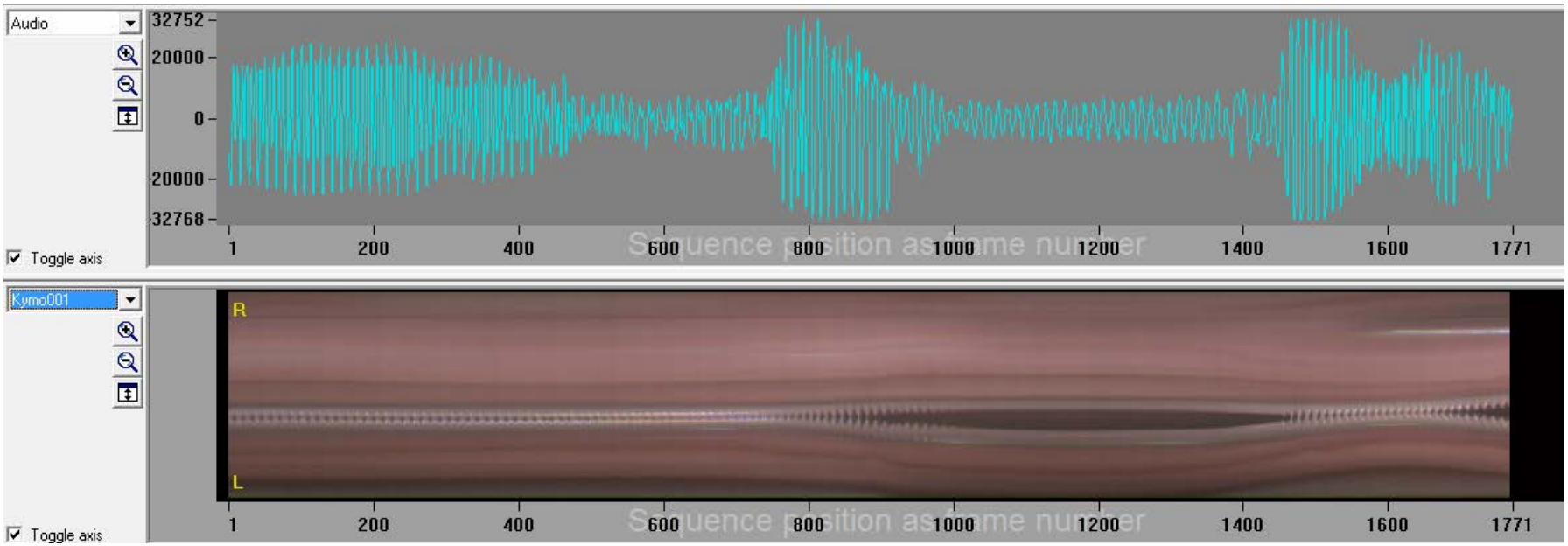
Case 6

The acoustical analysis and kymograph after treatment



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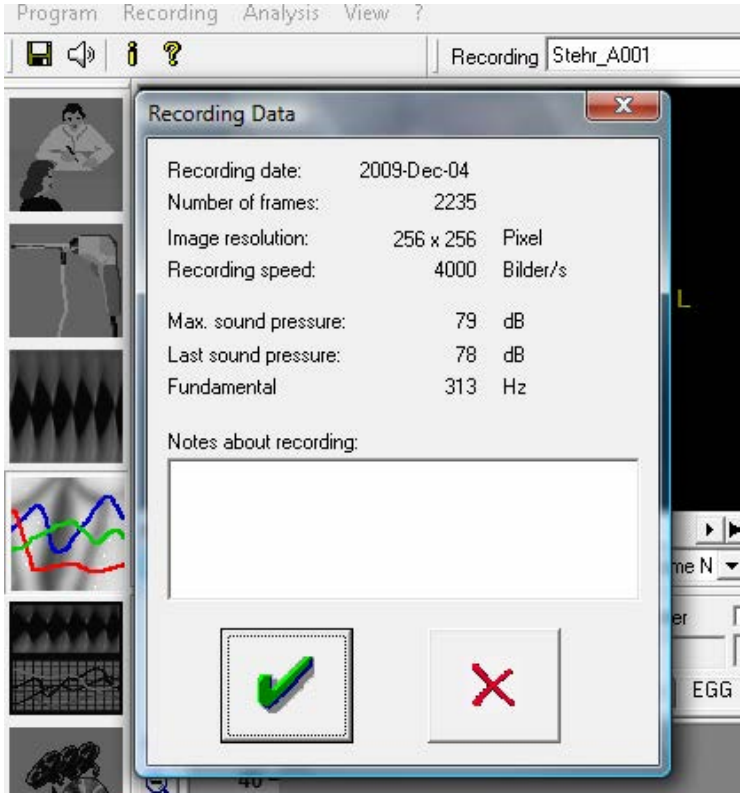
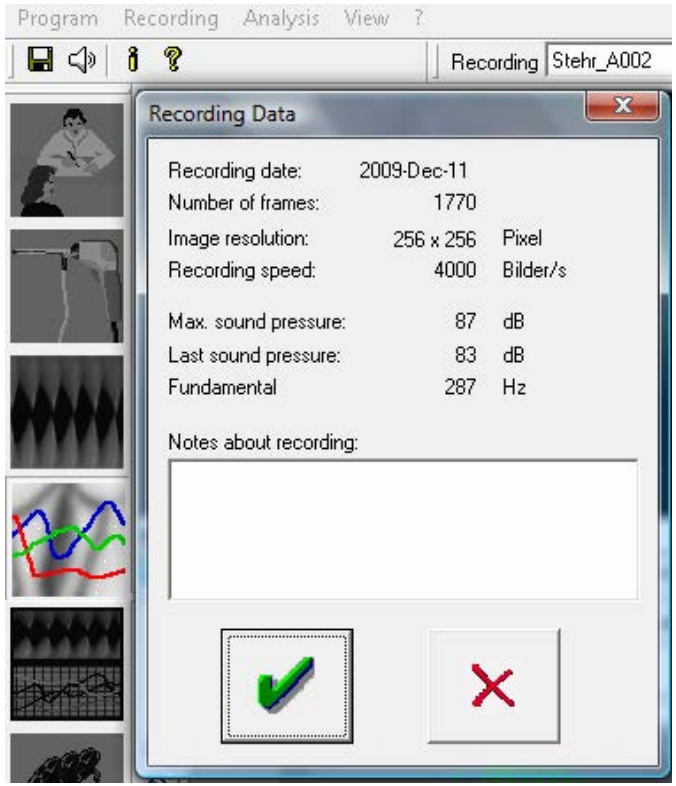
Case 6

Fundamental frequency and intensity before treatment *After treatment*





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Case 6

After treatment

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Conclusion

- ***There are two aspects to prevent damage of the voice in childhood:***
  - ***1.*** to make phonetograms and fundamental frequency measures to secure that the child does not feel tempted or pressed to sing outside the measured area of phonetographic voice function.
  - ***2.*** to take care of diagnostics and treatment of well known, especially mucosal disorders of the upper airway, with focus on the vocal cords, functionally included in the larynx area.

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References

- 1. Pedersen M. Normal Development of Voice in Children. Ed. Springer 2008.
- 2. Higgins JPT, Green S (editors). *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.0.2 [updated September 2009]. The Cochrane Collaboration, 2009. Available from www.cochrane-handbook.org
- 3. LingWAVES Apparatuses. WEVOSYS - Development Center for Voice and Speech Processing, Forchheim.
- 4. Brook's clinical paediatric endocrinology, 5th edition. Edited by Charles Brook, Peter Clayton, Rosalind Brown. Oxford: Blackwell Publishing, 2005.
- 5. Goldberg, M.; Langer, R.; Jia, X. "Nanostructured Materials for Applications in Drug Delivery and Tissue Engineering", J. Biomater. Sci. Polymer. Edn, 2007, 18, 241-268.
- 6. Jia, X.; Yeo, Y.; Clifton, R. J.; Jiao, T.; Kohane, D. S.; Kobler, J. B.; Zeitels, S. M.; Langer, R. "Hyaluronic Acid-Based Microgels and Microgel Networks for Vocal Fold Regeneration" Biomacromolecules, 2006, 7, 3336-3344.
- 7. Fiorella ML, Cassano P, Luperto P, Cassano M, Gelardi M, Fiorella R. Laryngo-pharyngeal reflus in children: clinical evidence and diagnosis. Int. J Paediatric Otorhinolaryngology. (2004); 68:724.
- 8. Fokkens W, Lund V, Mullol J, on behalf of the European Position Paper on Rhinosinusitis and Nasal Polyps group. Rhinology . (2007); 17 (2): 1-139.
- 9. Parham P. The Immune System. Ed. Garland Science, (2009) 3rd. Ed.
- 10. Pedersen M. Register measurements in puberty. Deutsche Gesellschaft für Akustik e.V. 2008 *Congress report 2nd workshop COST 2103 Aachen*.

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