Normal Development of Voice in Children, Advances in Evidence-Based Standards

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The presenter

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Abstract

- Introduction:
  In relation to vocal learning and teaching in general schools, it is imperative to understand the effects and strain of the child voice. Register shifts in youngsters during puberty have earlier been difficult to measure, but this is now possible in normal and pathological cases, using software for phonetograms and fundamental frequencies. Especially in the pubertal transition period, the change of voice can cause severe strain. This means that informing about the dangers even before the problem arises is of great benefit, also in child choirs.

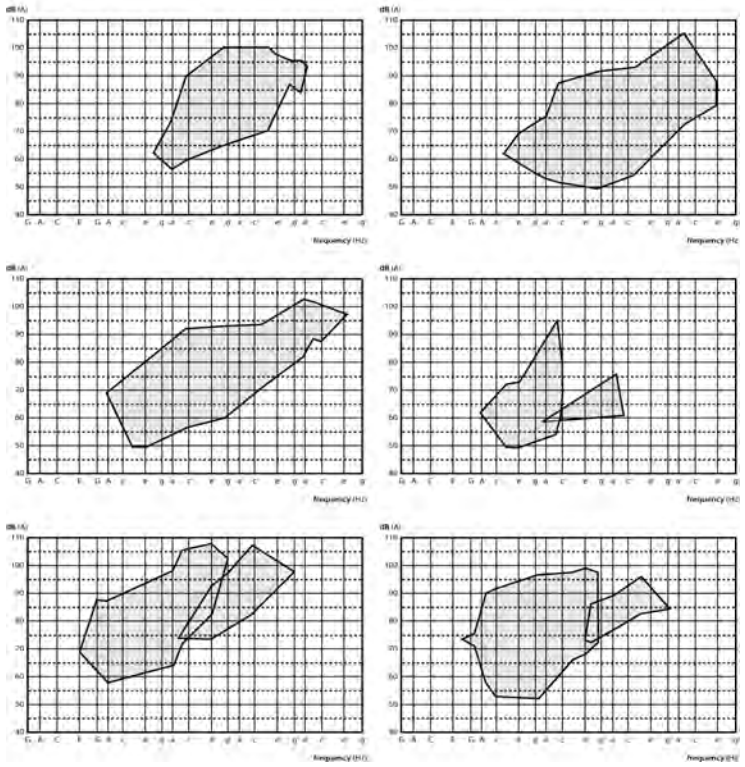
  Material and method:
  A book has earlier been made: Normal Development of Voice in Childhood (1). 8 cases of pathological adolescent voices have now been compared with this normal population especially in adolescence. A supplemental evaluation of pathology was made with high speed films.

- Results:
  It is now possible to differentiate between normal voice development and pathological voices in youngsters. Normal development shows well-defined changes per year in phonetograms and also in singing categories. With high speed films compared with phonetograms, the pathological mucosa of the larynx is seen and can be visually compared online with eletroglottograms, acoustical curves and movement of the vocal cords. The treatment of pathology of the vocal cords during childhood is discussed also in singers. Prophylactic courses in vocal understanding and the awareness of boundaries within register-shifts should be considered. The strain of child voice often has its roots in wrong vocal technique.

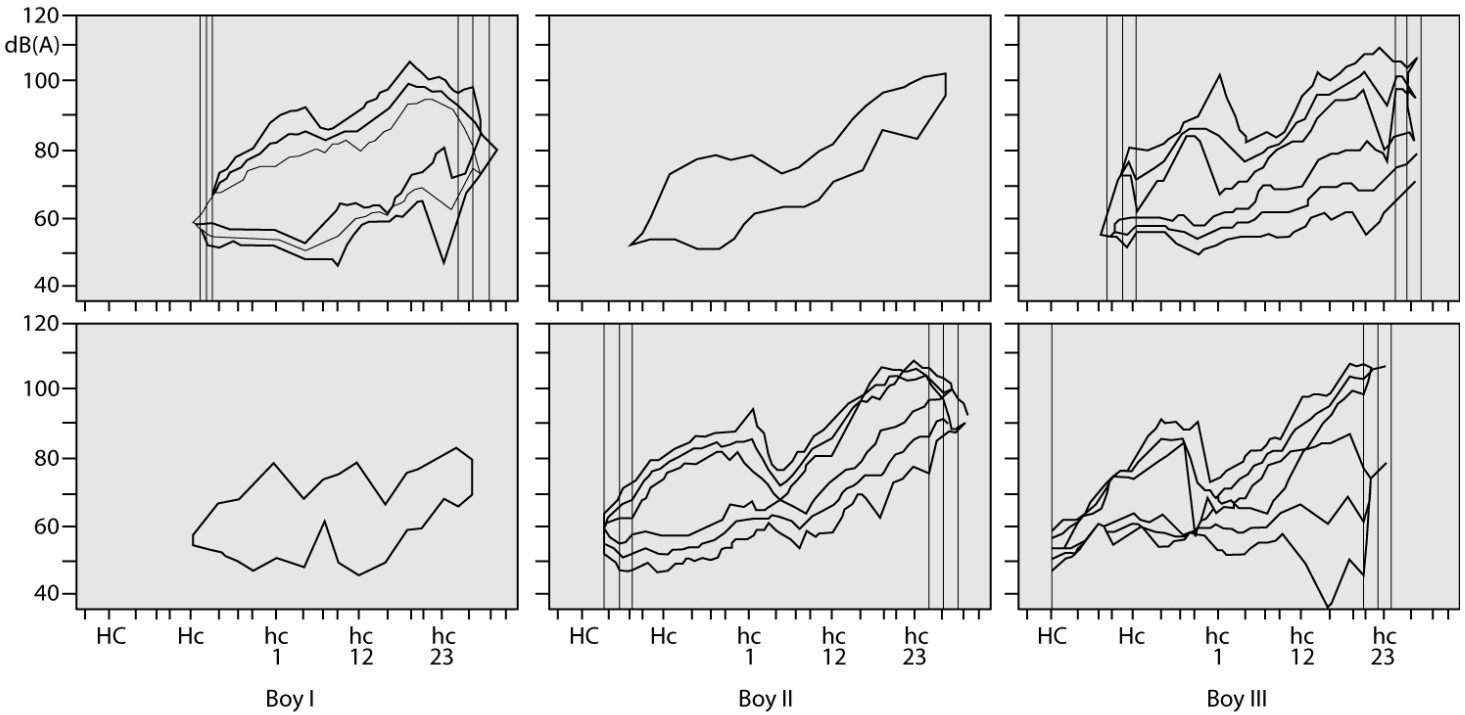
  Keywords: High speed, phonetogram, voice, adolescence

  Reference:
  (1) Book: Pedersen M. 2008. Normal Development of Voice in Children (www.books.google.com)

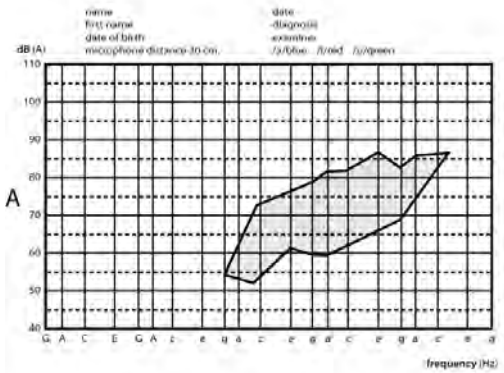
Phonetogram of a boy during puberty

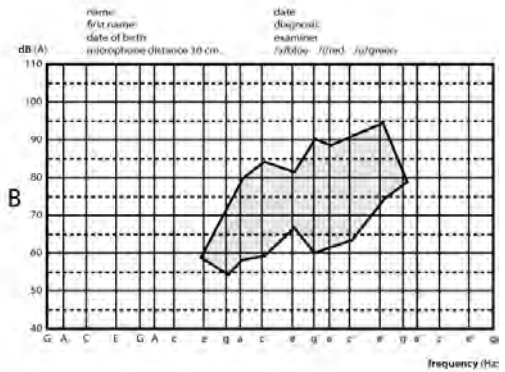


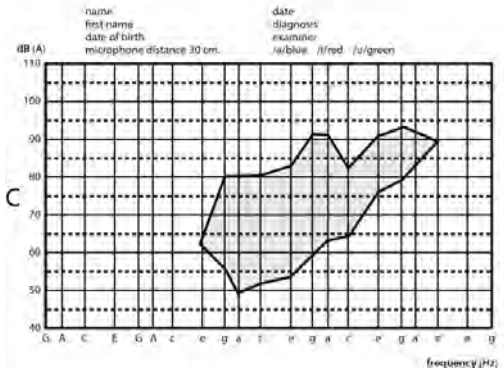
- 3 boys during puberty

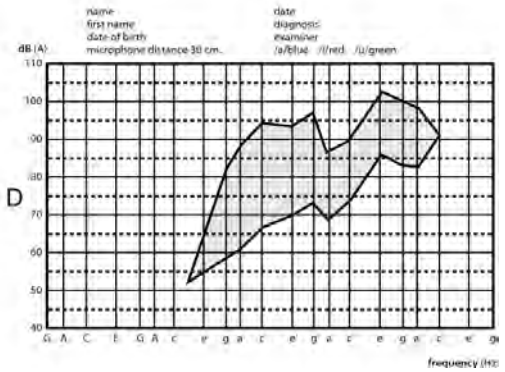


- One girl phonetogram during development

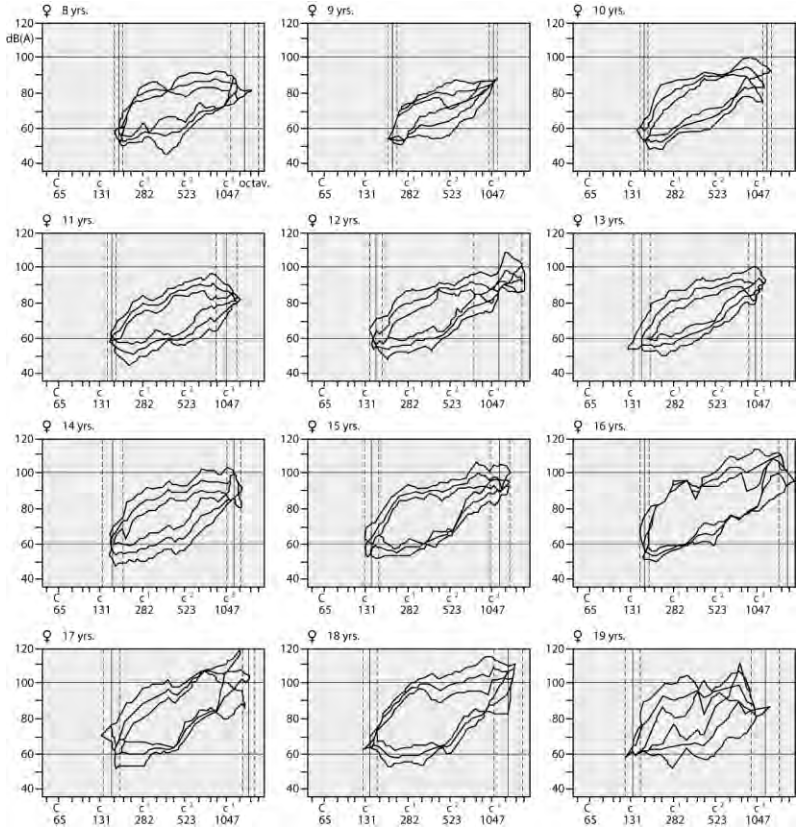




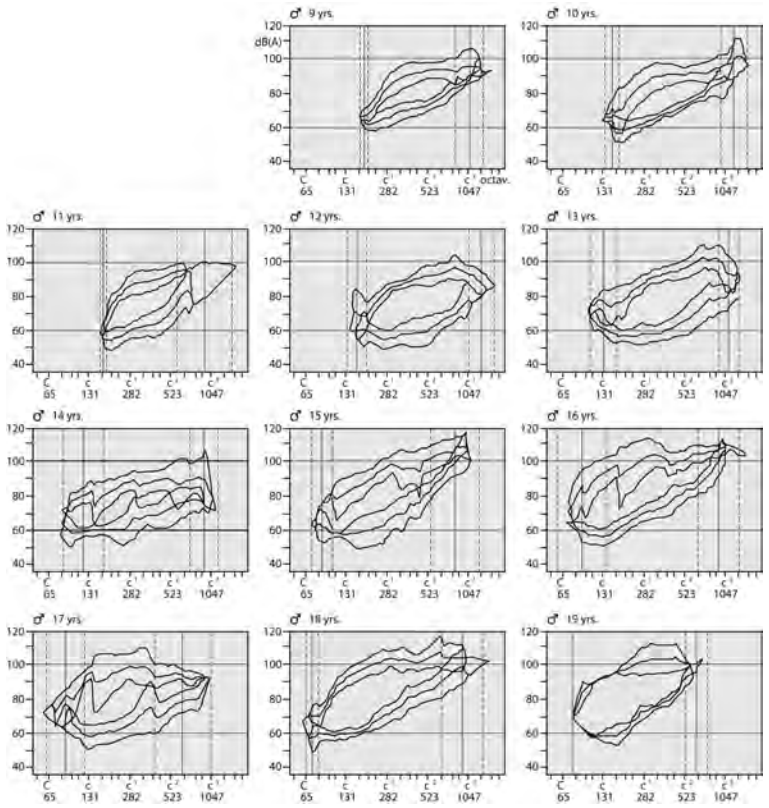




- Averaged phonetograms of girls during development



- Averaged phonetograms of boys during development



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 antihistamines, 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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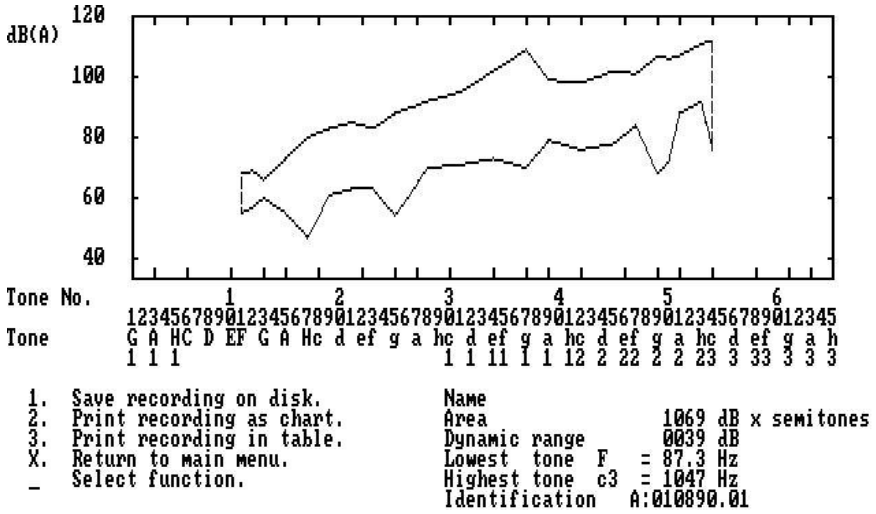
Case 1

cost
European Cooperation in the field of Scientific and Technical Research

This is a phonetogram of a 17 year old male singer



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Case 1

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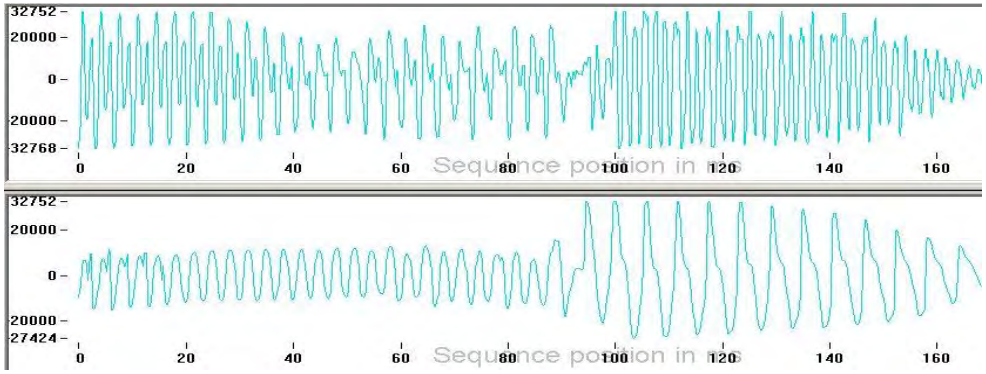
Acoustically around 10 cycles are changed before the electrglottographic register shift.

- 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 were 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

cost
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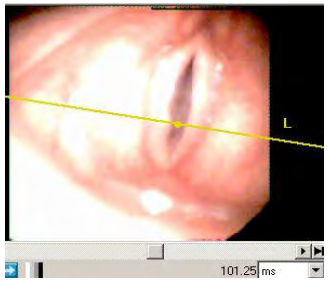
The kymographic film corresponds to the electroglottographical picture.



Kymographic film at the same register change.

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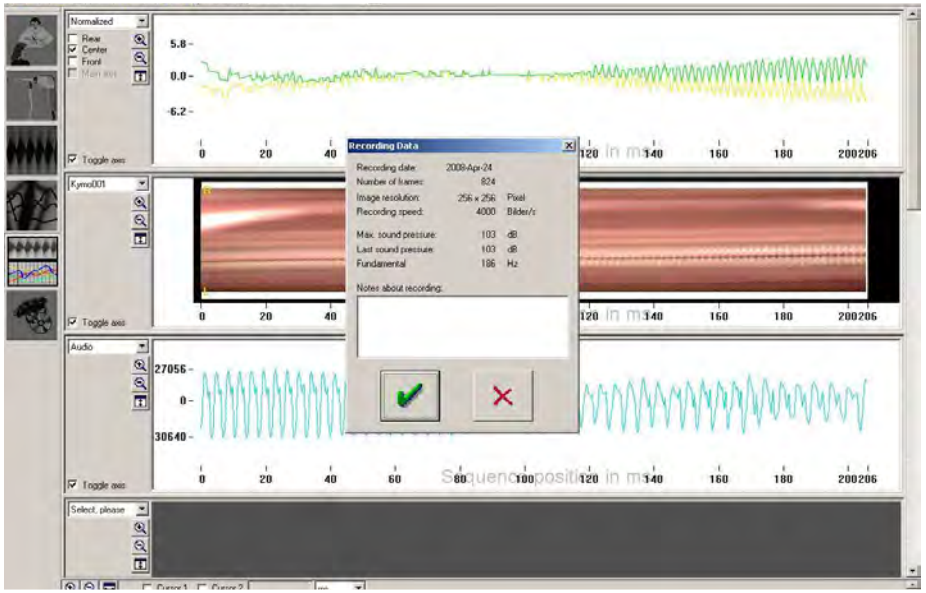

Oscillographic, kymographic and EGG change at 186 Hz

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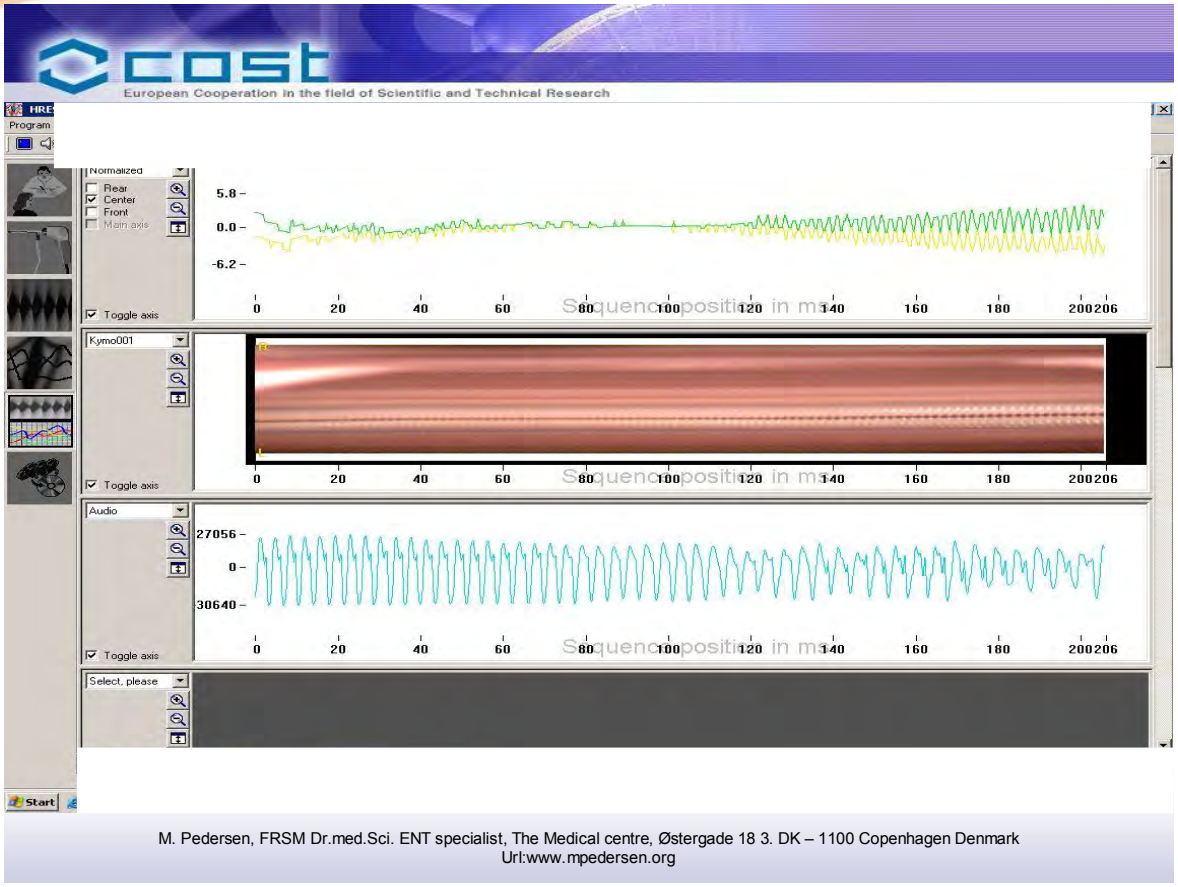
Case 1



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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

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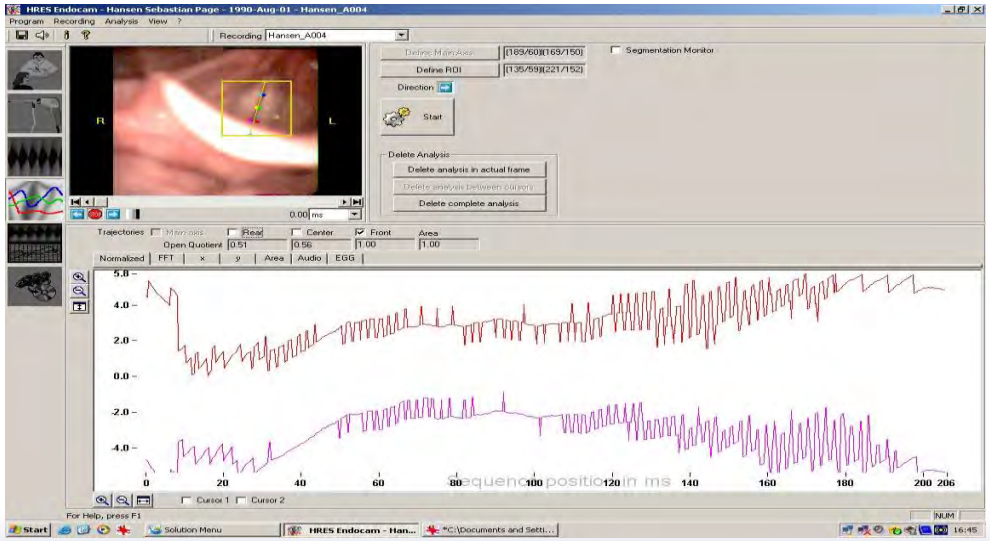
The front part of the high-speed film shows no connection between the vocal chords



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

Case 1

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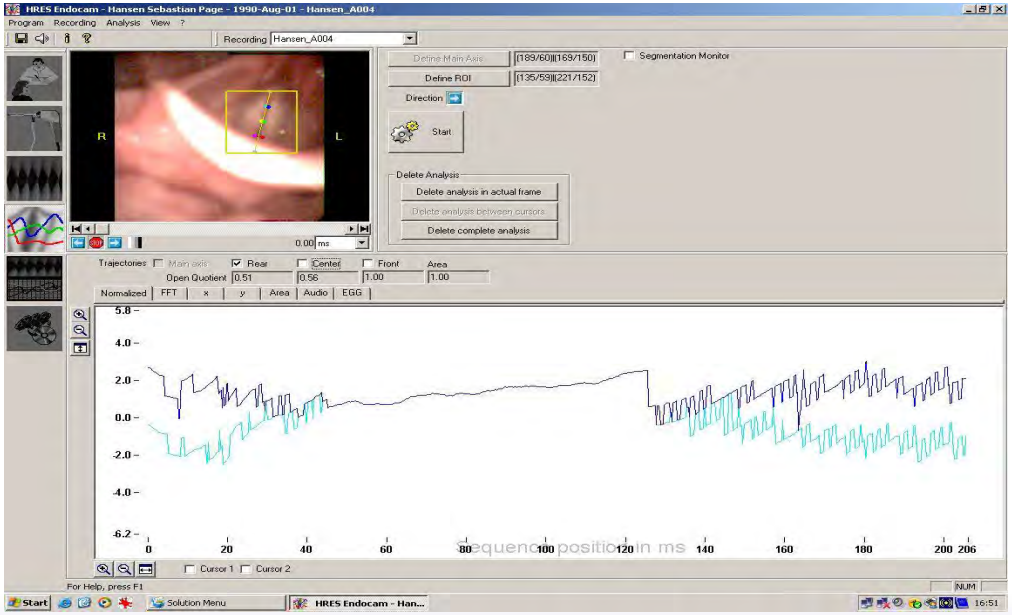
The rear part of the high-speed film shows connection between the vocal chords.



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

Case 1

Segmentation

Click to play

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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**: Antibiotics, antihistamines 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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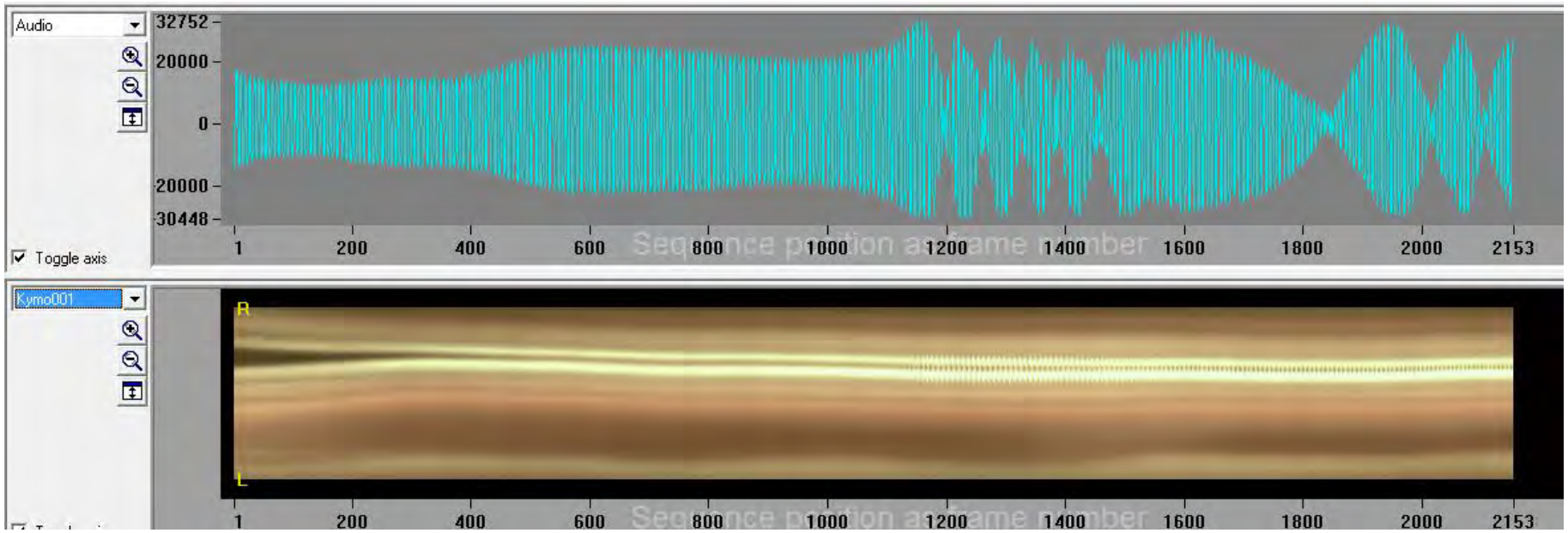
Case 2

- *Acoustical measures and kymograph. High speed measures.*



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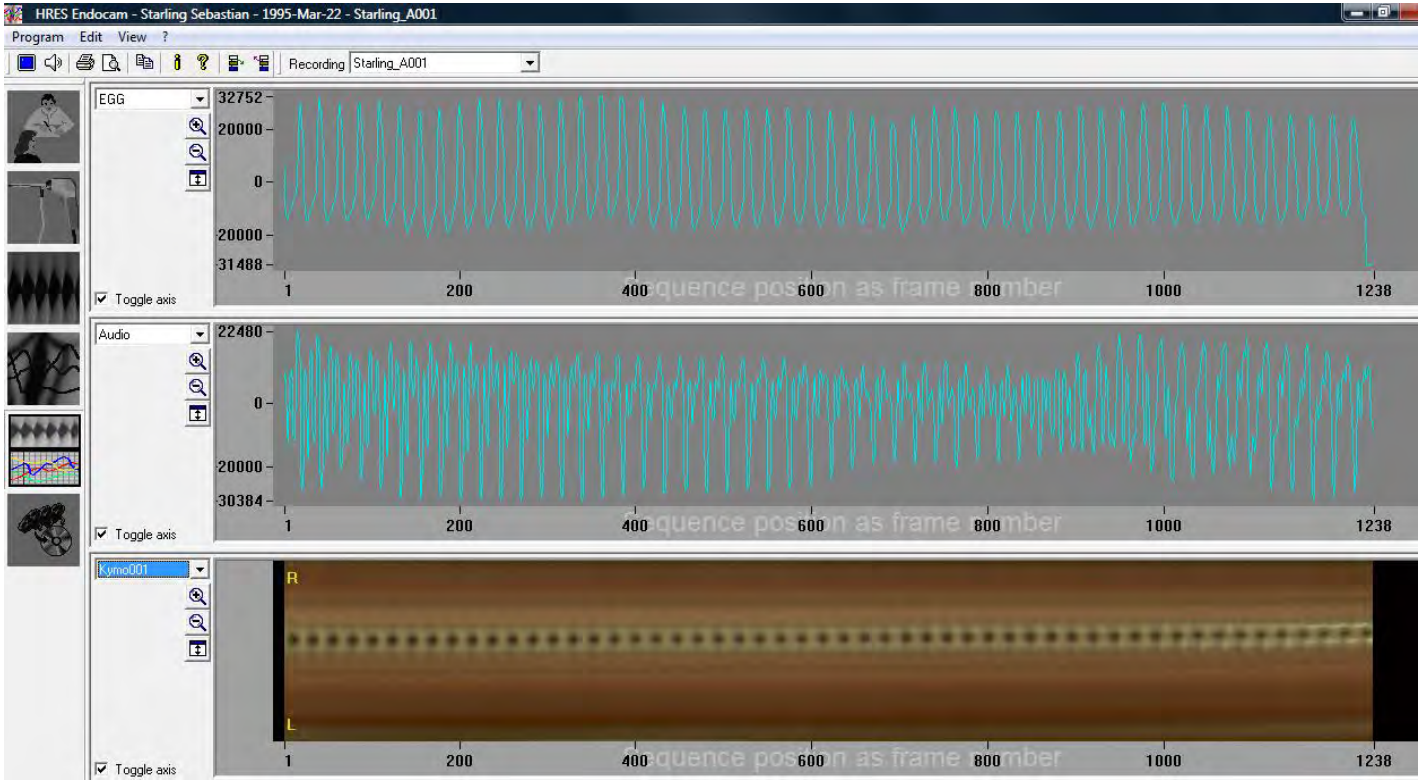
Case 2

EGG, acoustical measures and kymography. High speed measures.



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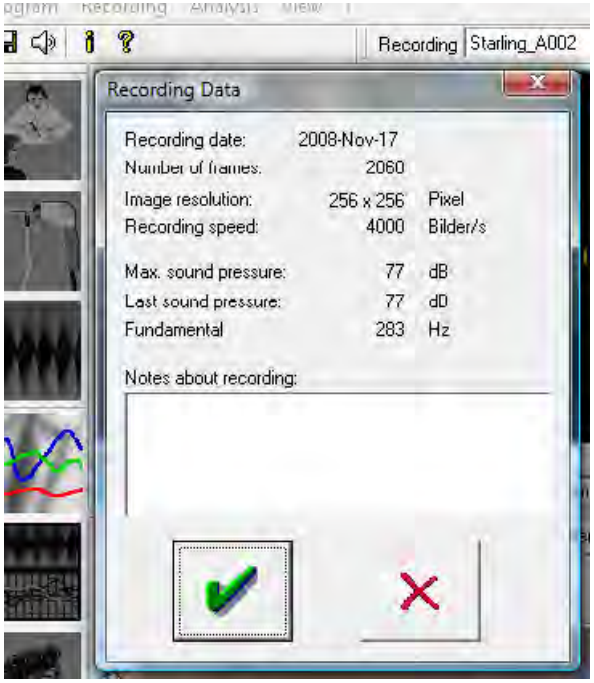
Case 2

Picture from a high speed 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 high speed video at adduction and abduction. Phonetogram measure showed a higher dynamic area at the second examination.

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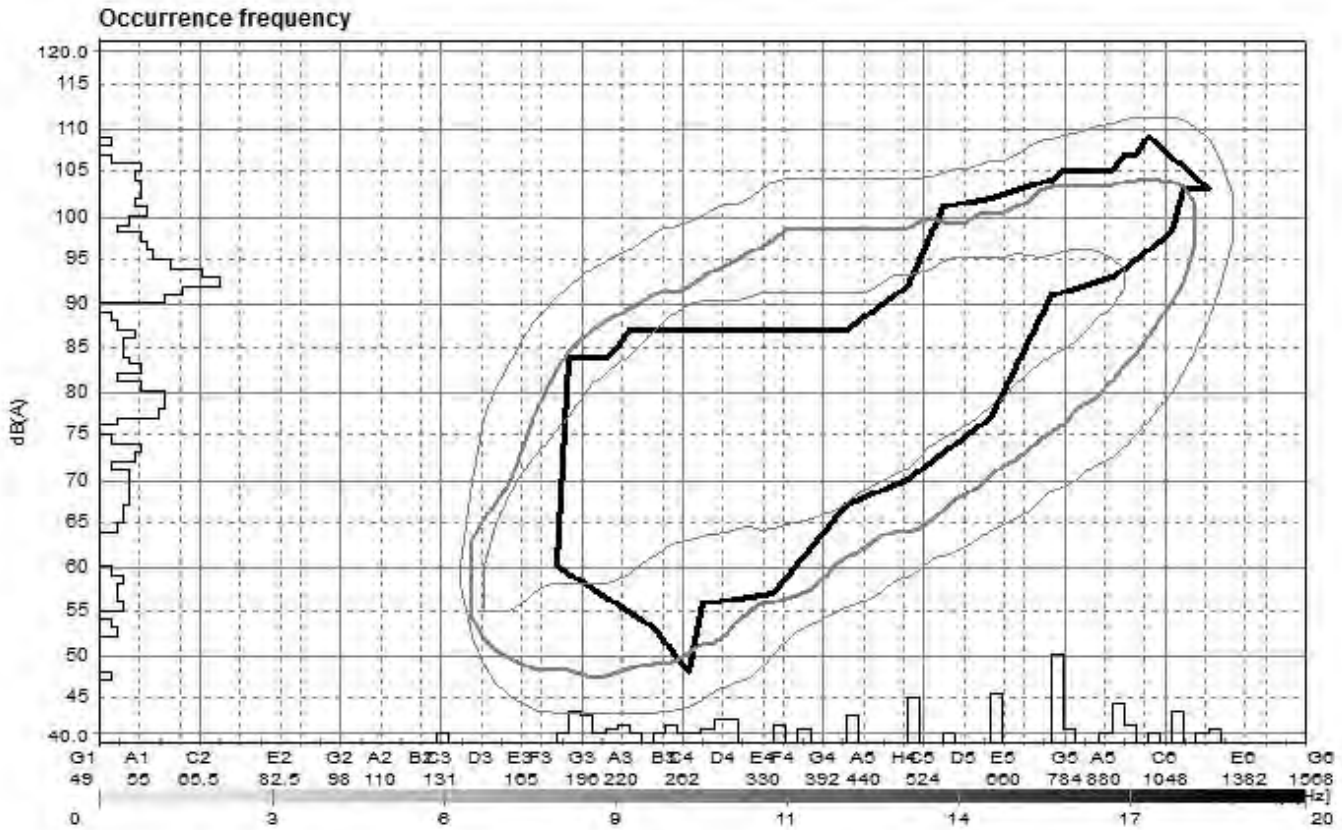
Case 3

The phonetogram at the first examination



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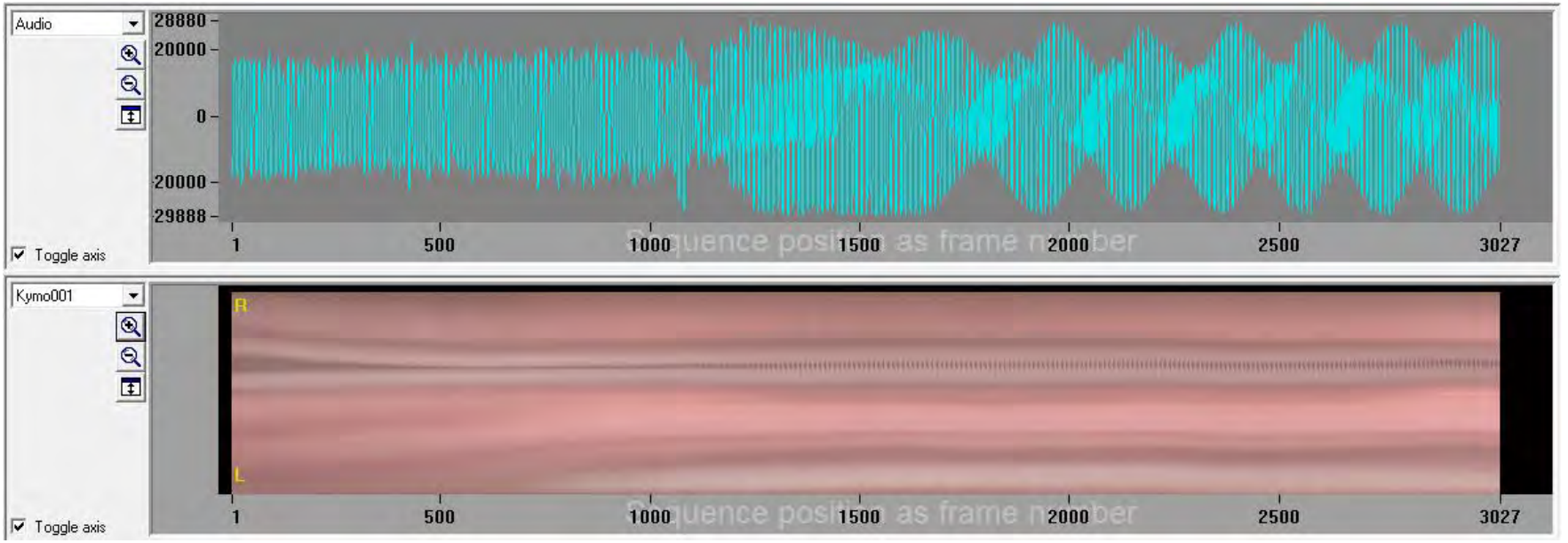
Case 3

Acoustical analyses and kymograph. High speed measures at the first examination



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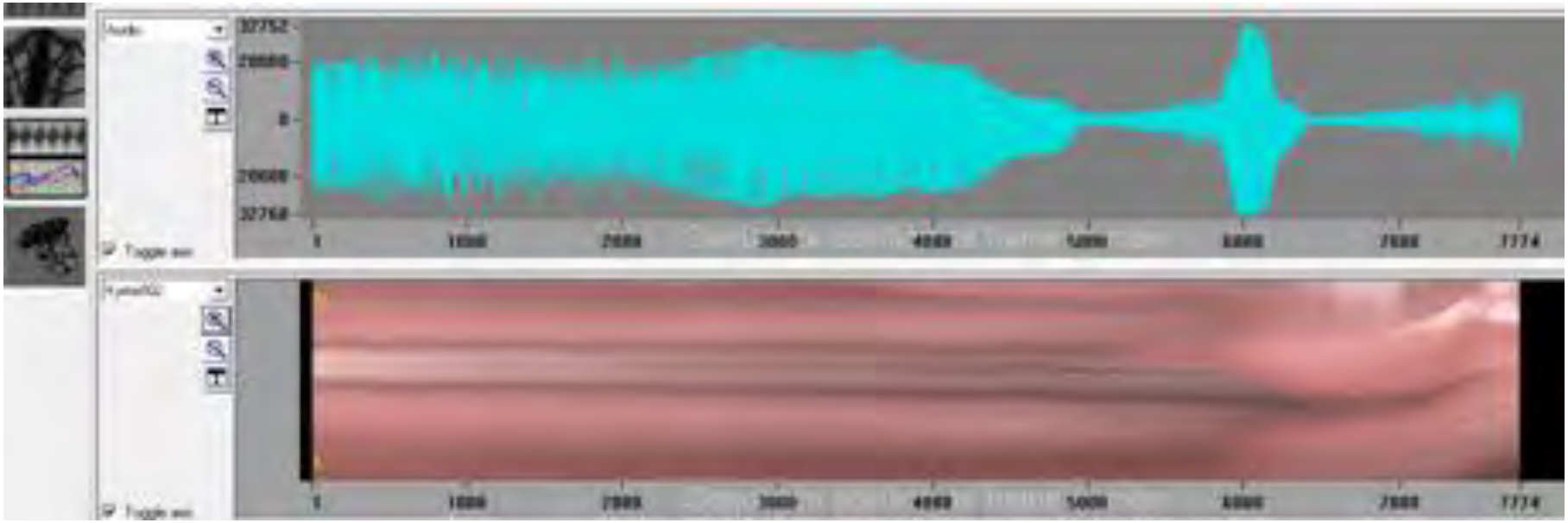
Case 3

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



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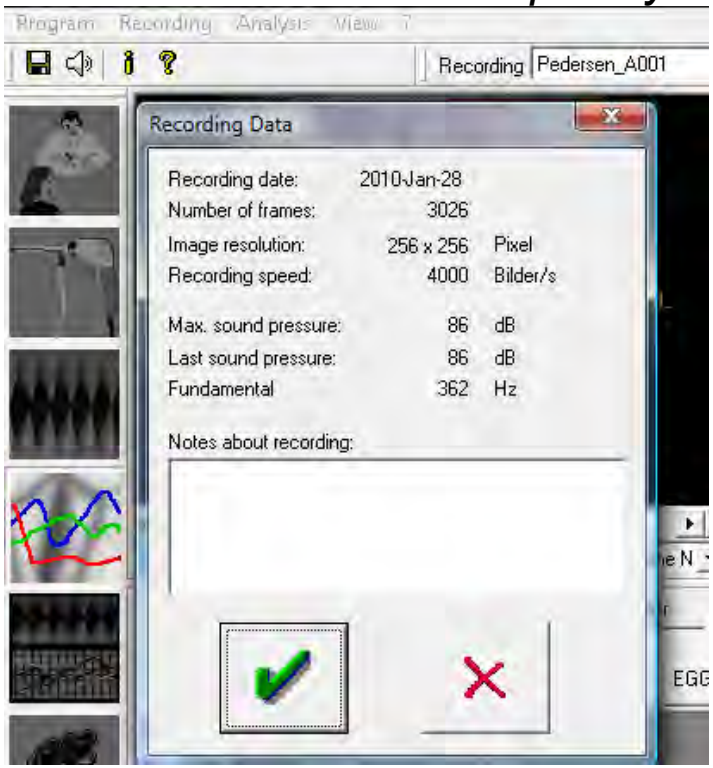
Case 3

Picture from a high speed 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 high speed 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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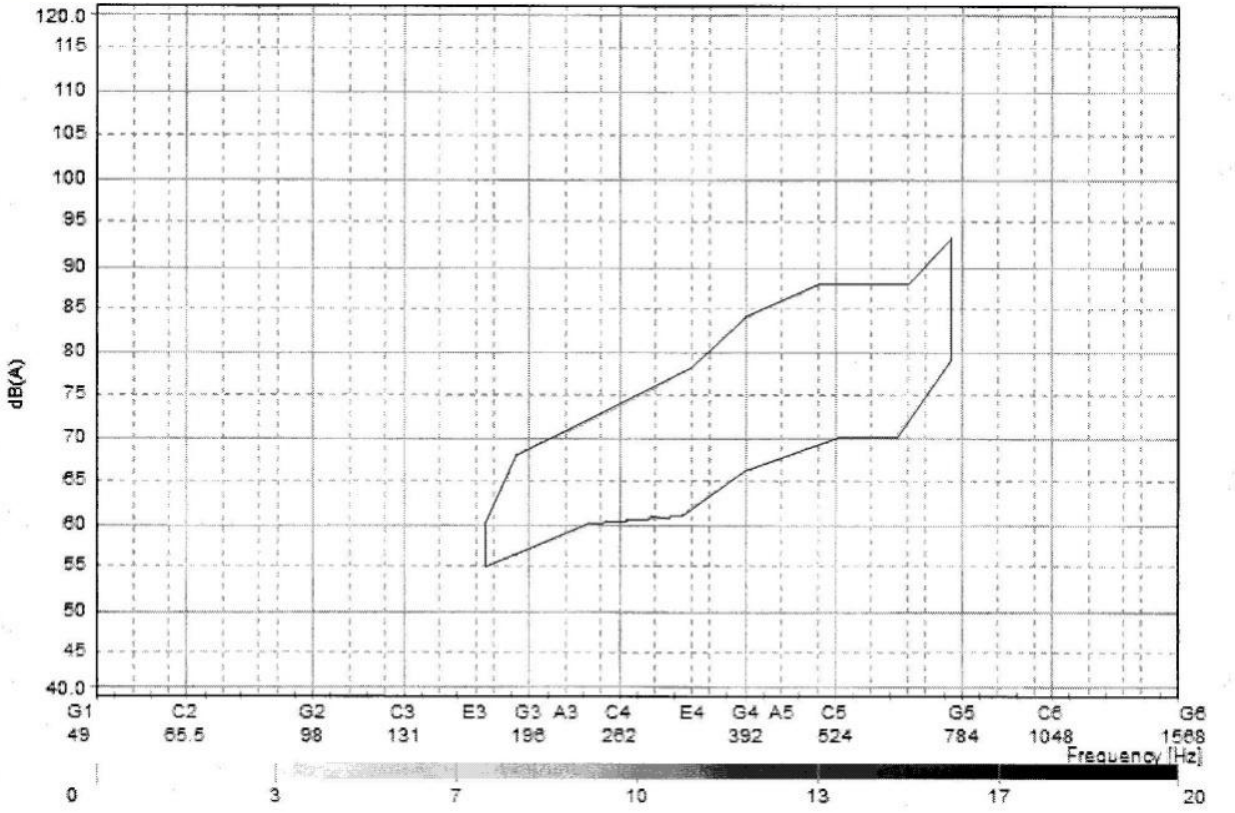
Case 4

- The phonetogram before treatment



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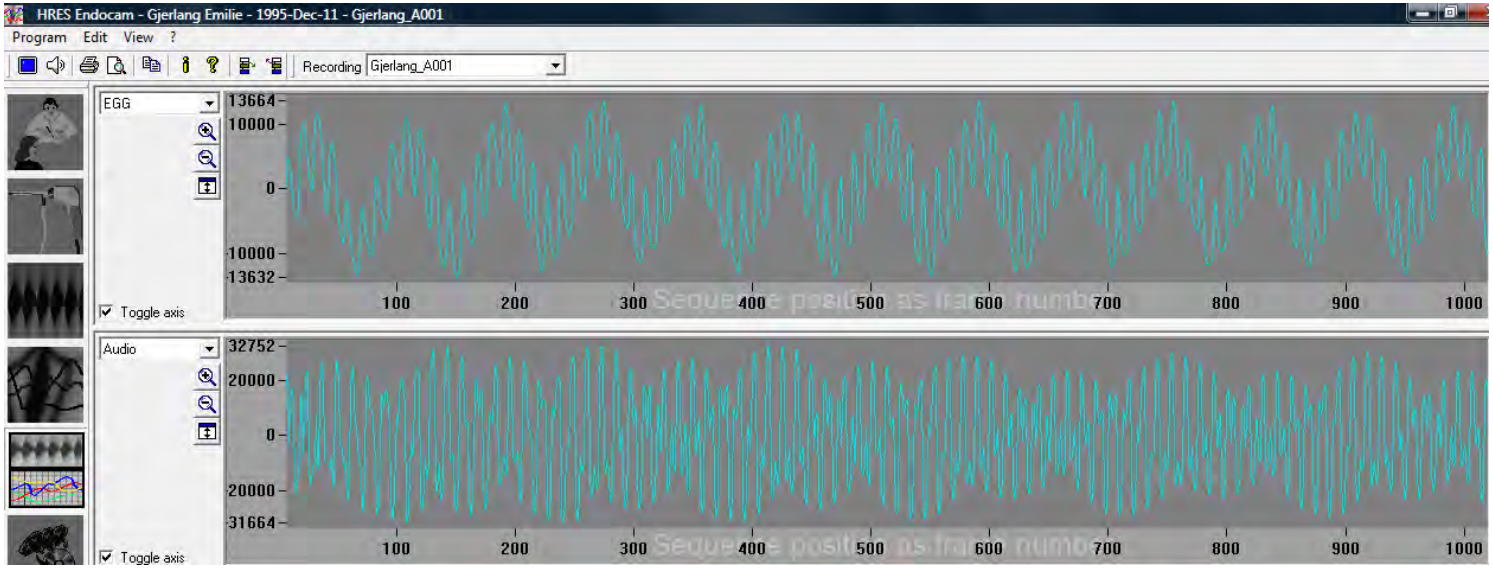
Case 4

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



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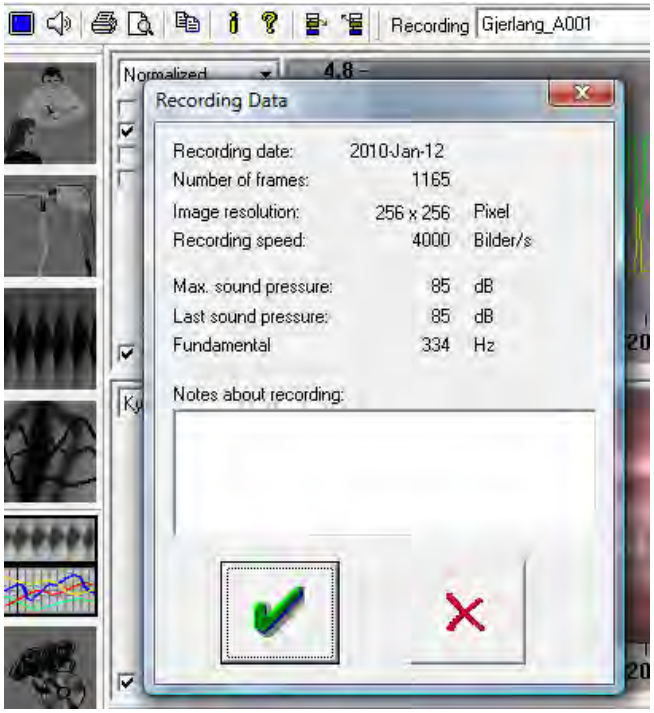
Case 4

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

BEFORE TREATMENT

Fundamental frequency

BEFORE TREATMENT



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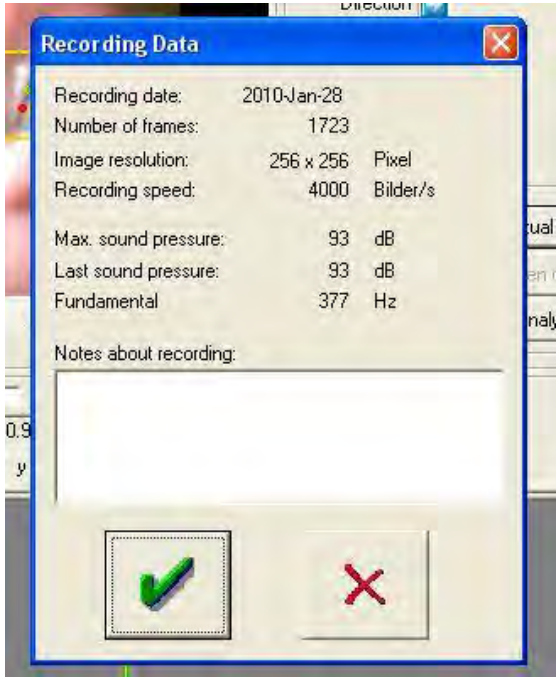
Case 4

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

Fundamental frequency

After treatment



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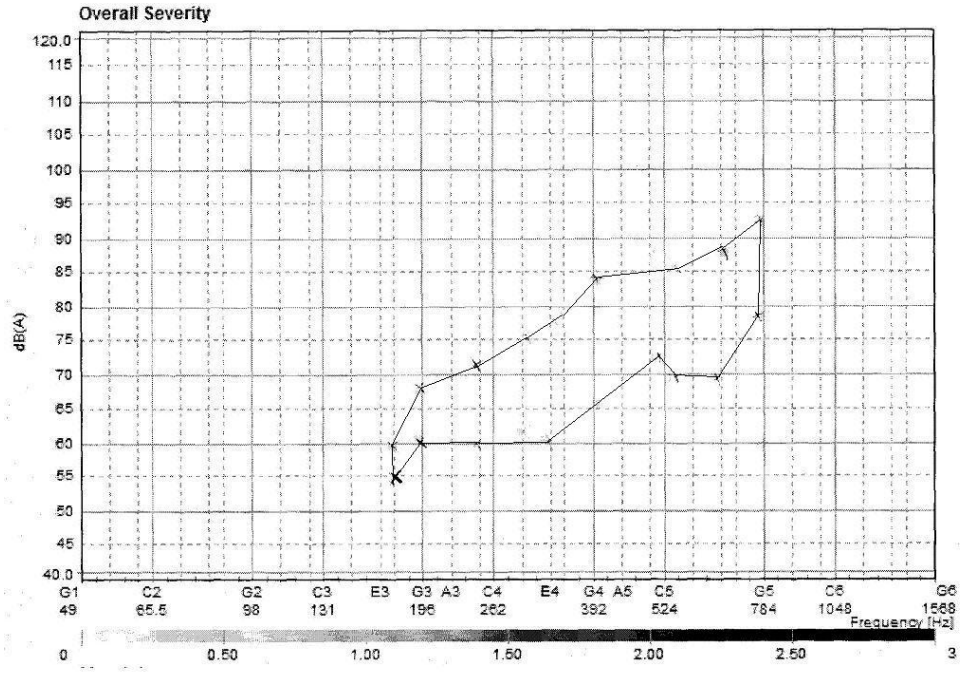
Case 4

- 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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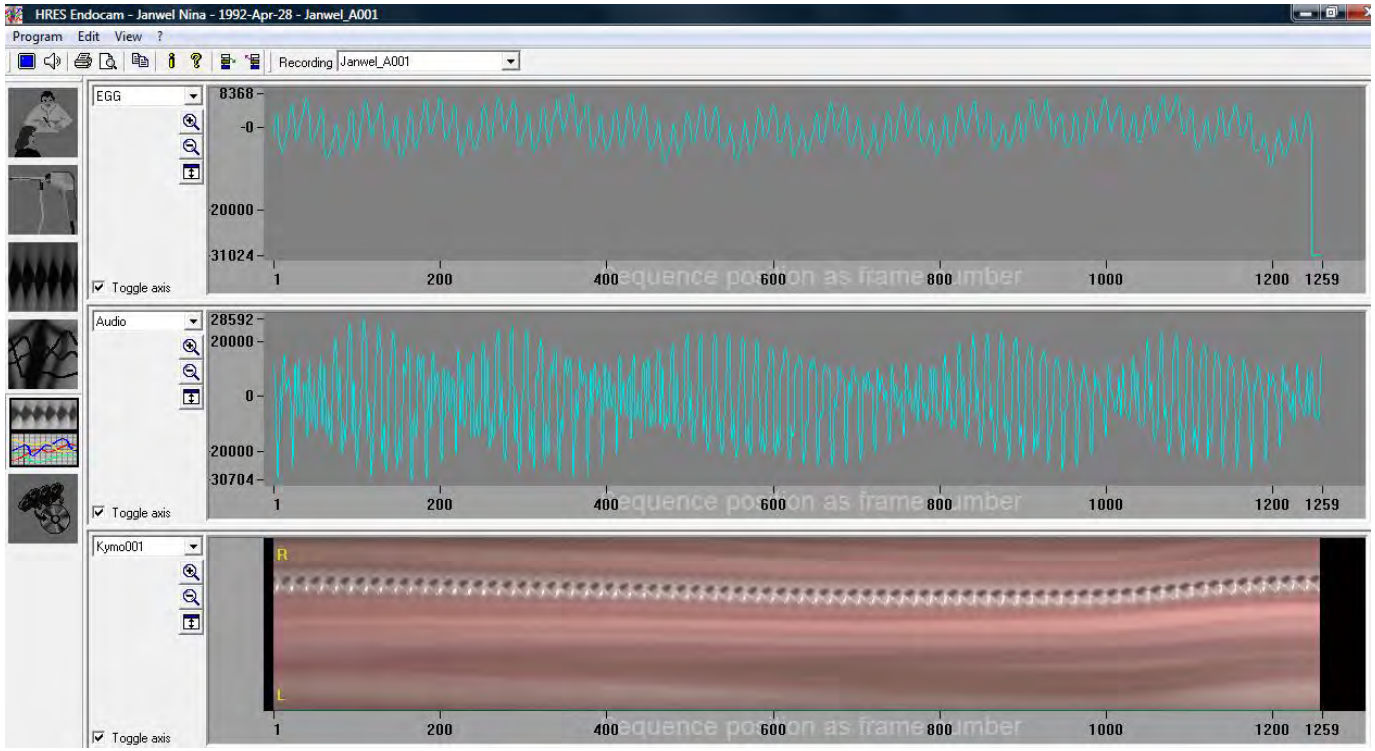
Case 5

EEG, acoustical analyses and kymograph. High speed measures



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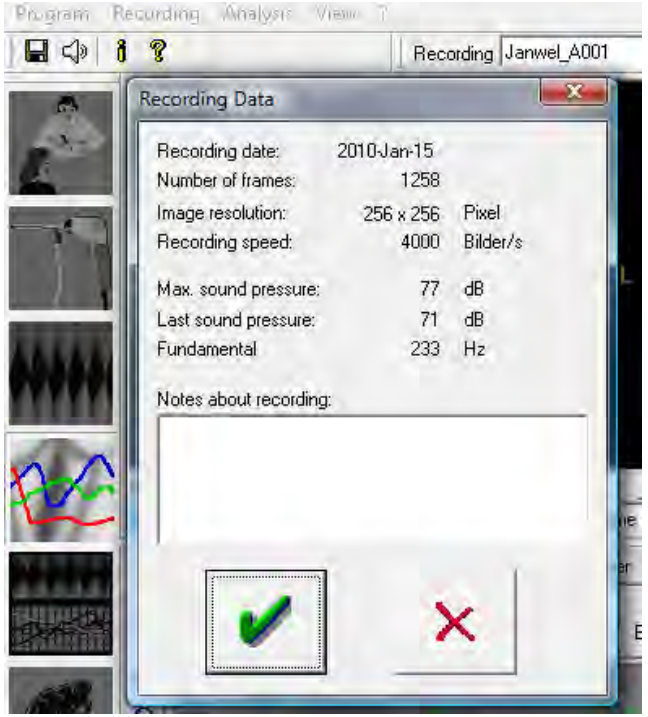
Case 5

Reduced movement of the vocal cord

Fundamental frequency



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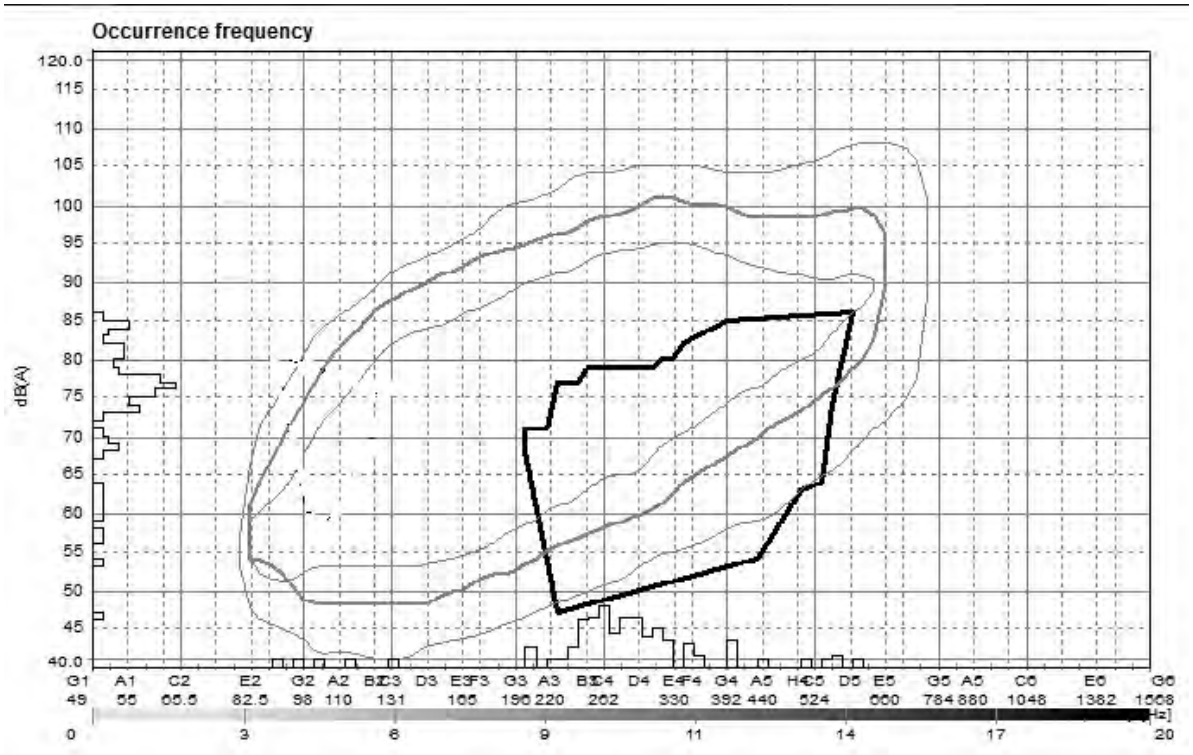
Case 6

- *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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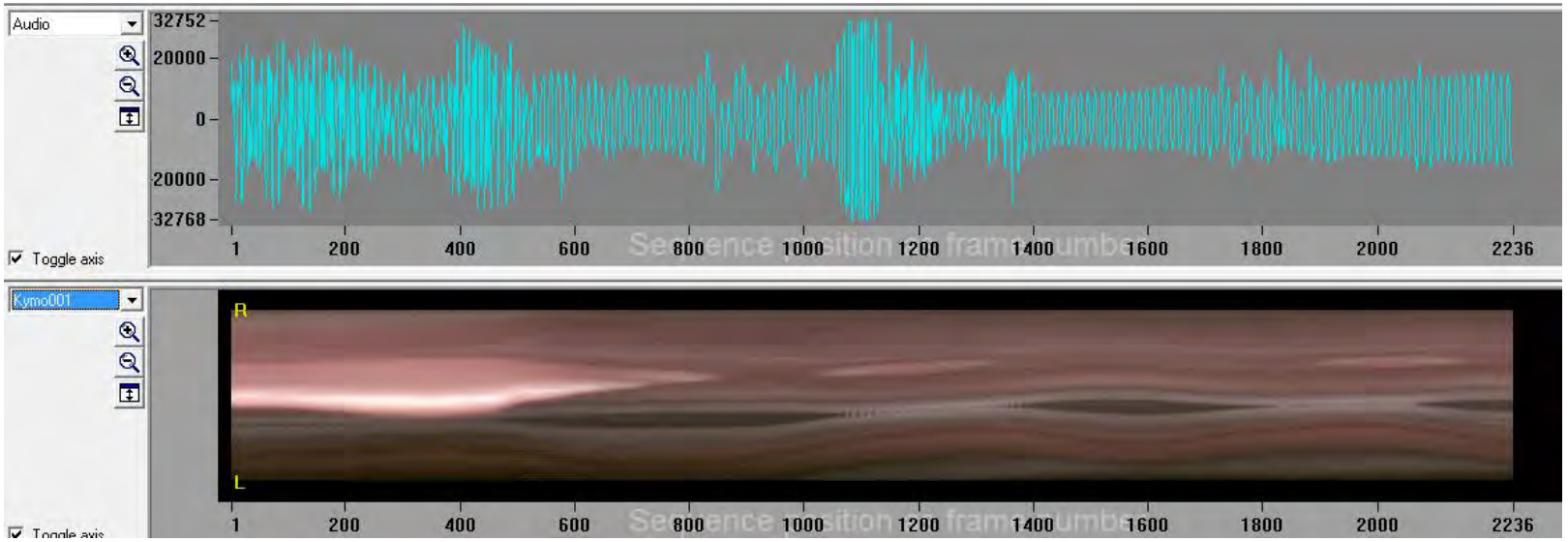
Case 6

The acoustical analysis and kymograph before treatment



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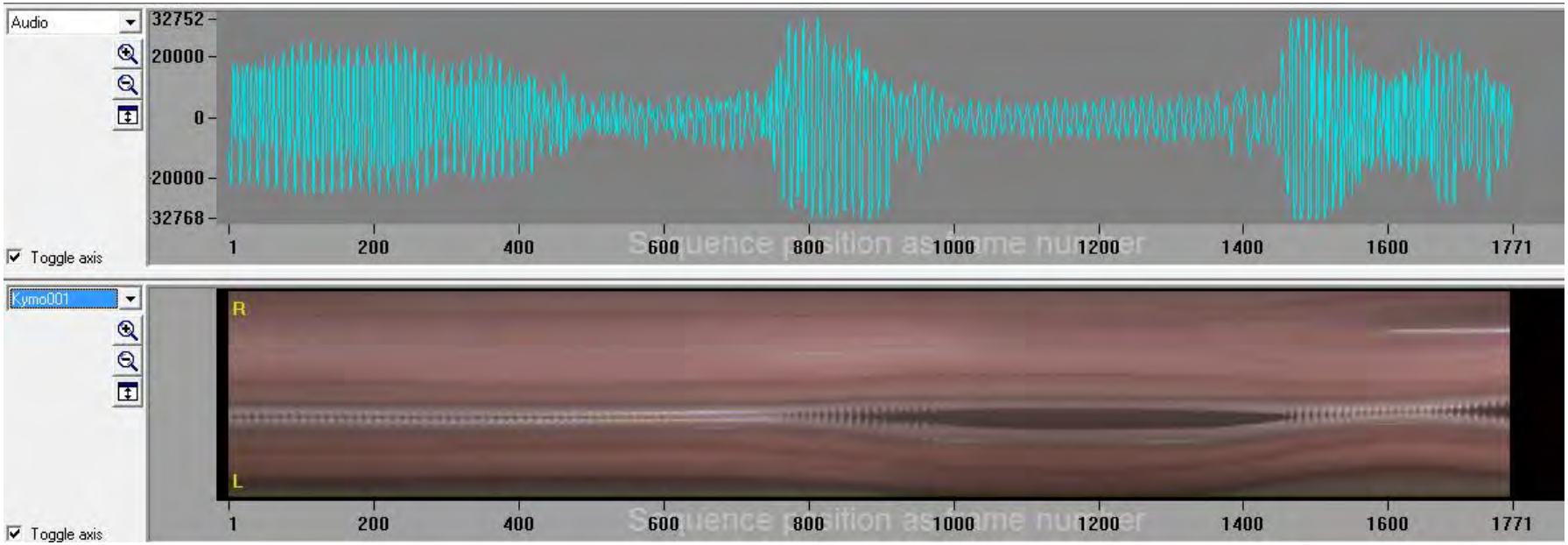
Case 6

The acoustical analysis and kymograph after treatment



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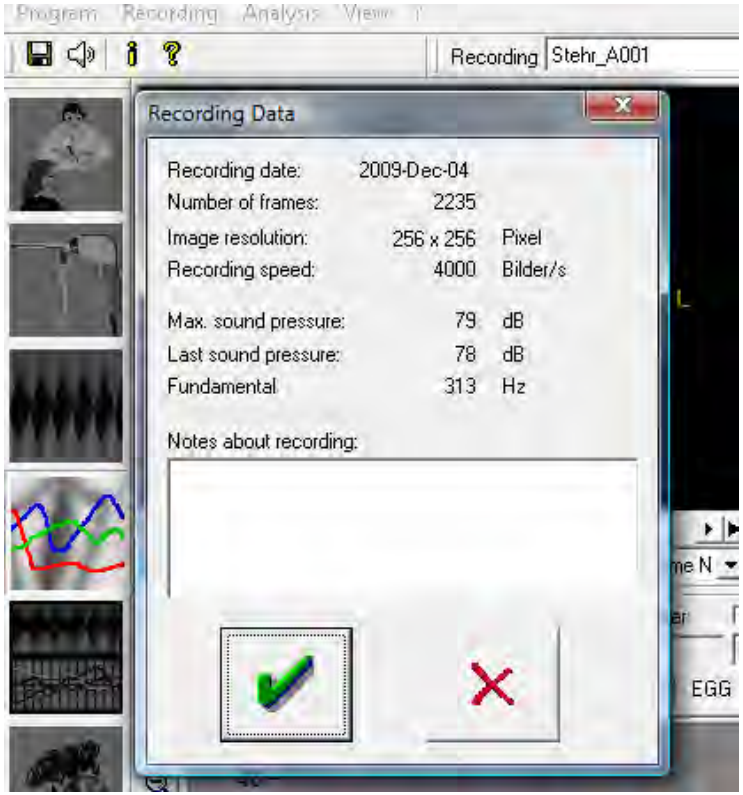
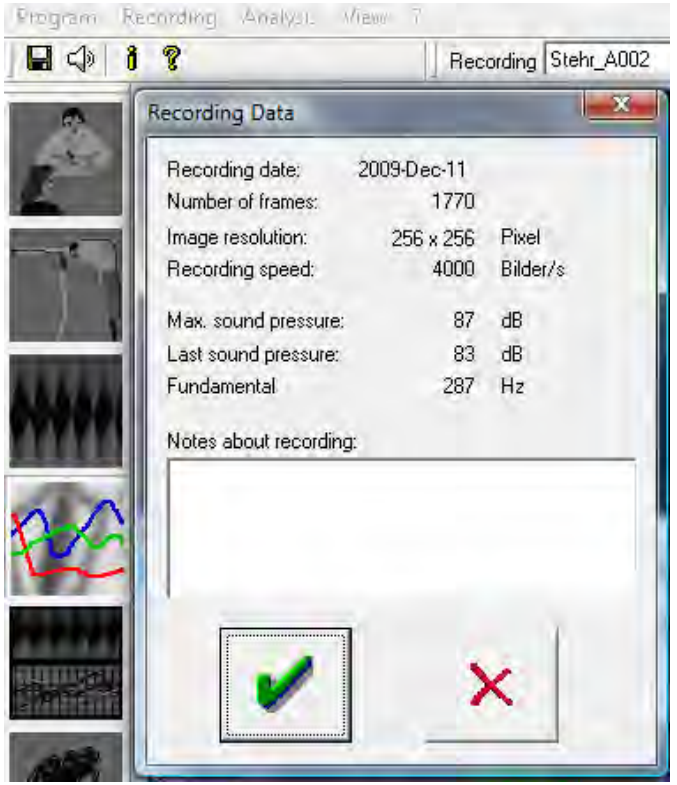
Case 6

Fundamental frequency and intensity before treatment *After treatment*





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Case 6

After treatment

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- In the classic Danish boys' choirs the treatment options should be better, so that the soloists do not want to quit singing as adults.
- How is this done?
- Probably by focusing on international ”non-classic” approaches

- Testing and advice must involve

- Musical gifts
- Personal ambitions
- Intellectual resources

- In conclusion
- We now have a tool to help the pupils – and singing teachers to define vocal possibilities.
- Phonetograms give the frequency and intensity borders
- High speed films illustrate online pathology

- Thanks to the audience and the whole clinic alongside coworkers