Elastography and elastometry of the lateral nasal wall

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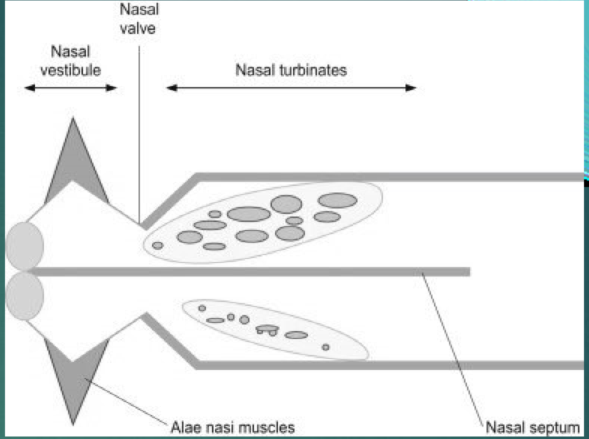
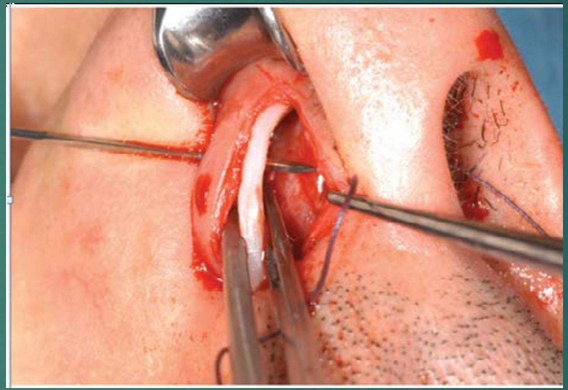
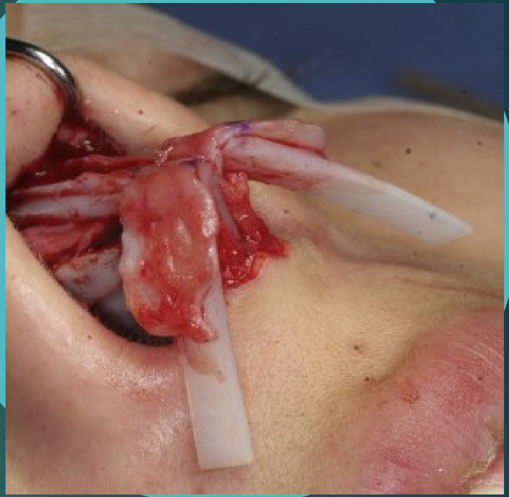
Facts

- Nearly every surgery is affecting the motility of the lateral nasal wall
- No quantitative measurement of the elongation is available
- No information about the mechanical properties of the lateral nasal wall
- „Classic“ rhinomanometry and PNIF skip any information about the influence of the lateral nasal wall as the narrowest part of the entire airway

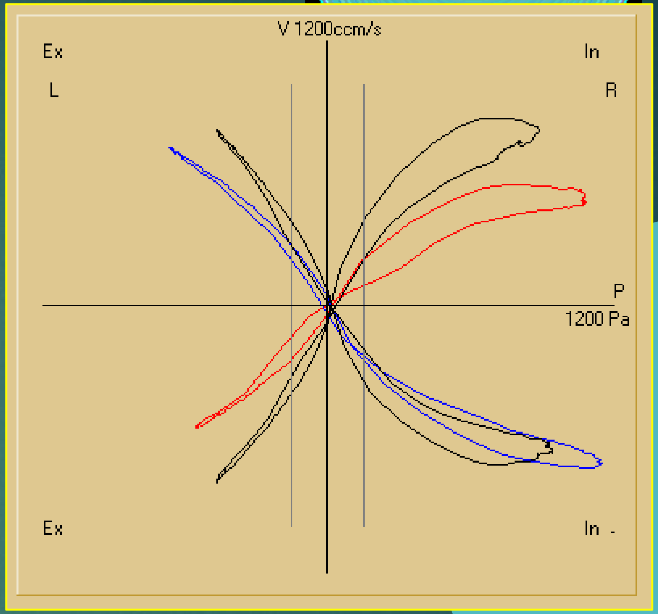


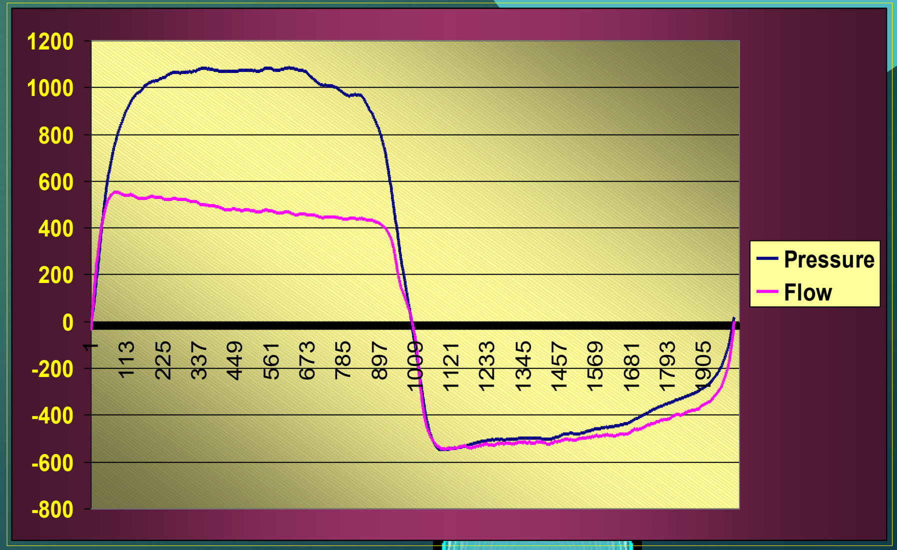




The Aim

- Quantification of the motility of the lateral nasal wall under the influence of breathing
- Verification of loops in 4-phase-rhinomanometry
- Determining the indication for surgical or prosthetic procedures with influence on the nasal valve



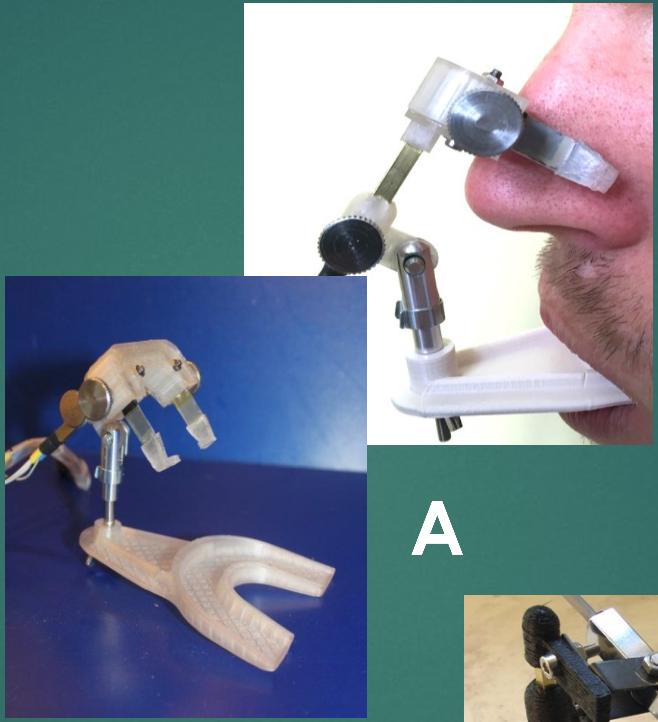


Principles of measuring nasal valve motility

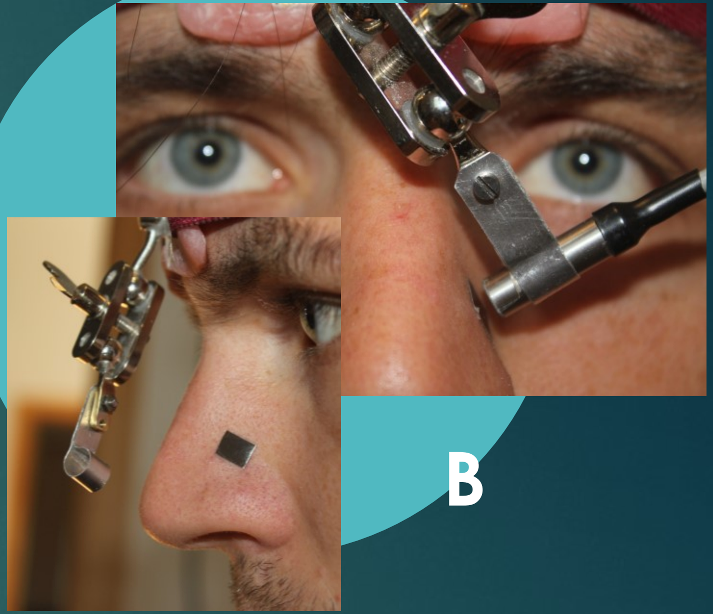
Displacement gauges

- Strain gauges A
- Capacitive sensors B
- Inductive sensors C
- Ultrasonic sensors E
- Optical sensors F

Camera assisted methods



A



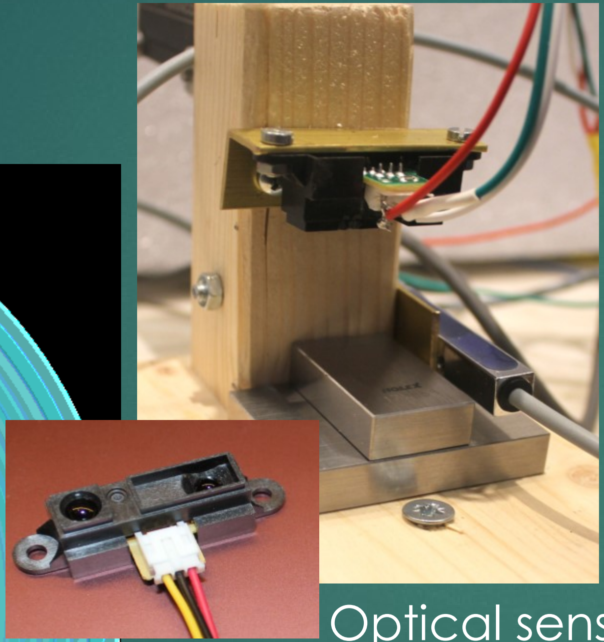
B

C

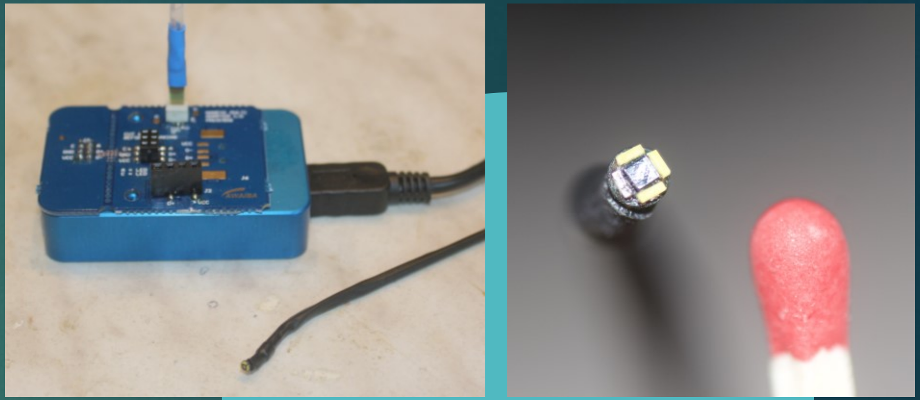
Displacement gauges

Optical sensors
Camera assisted method

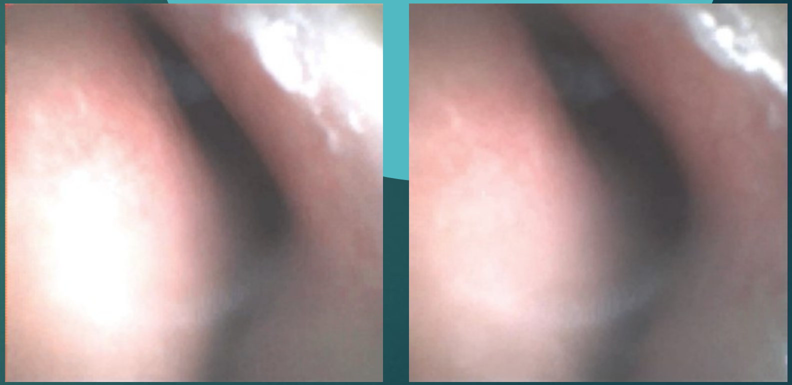
Lasersensor
Microepsilon



Optical sensor (ToF)
Sharp



Nanocamera

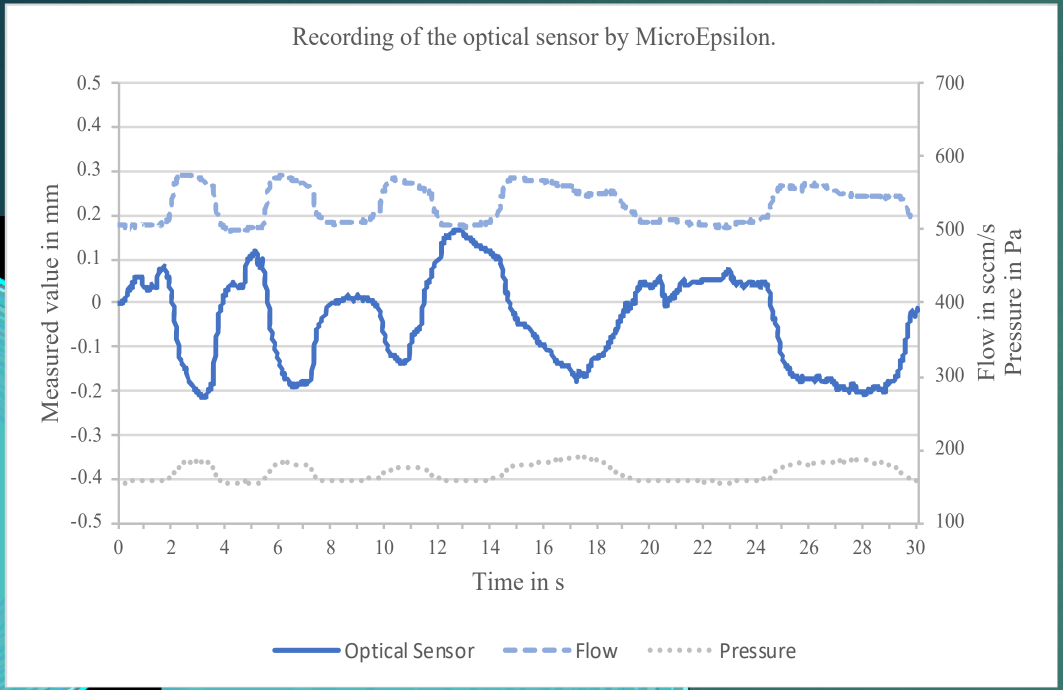


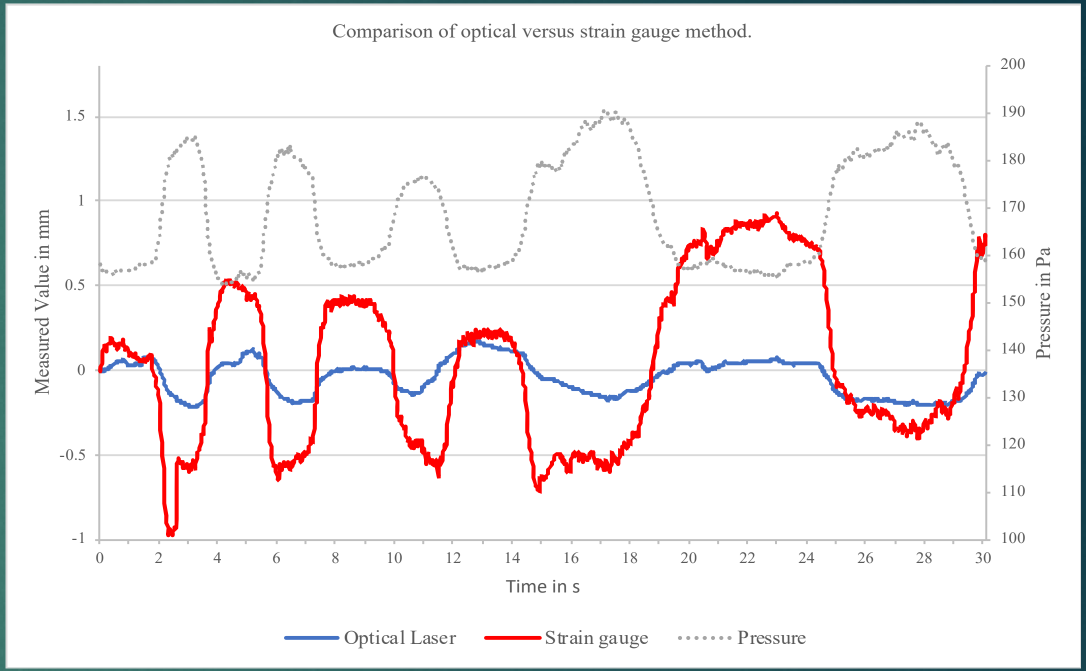
Imaging of left nasal vestibule, forced inspiration and expiration

Measurement in situ

Lasersensor (Micro-Epsilon) with face mask and rhinomanometer 4RHINO

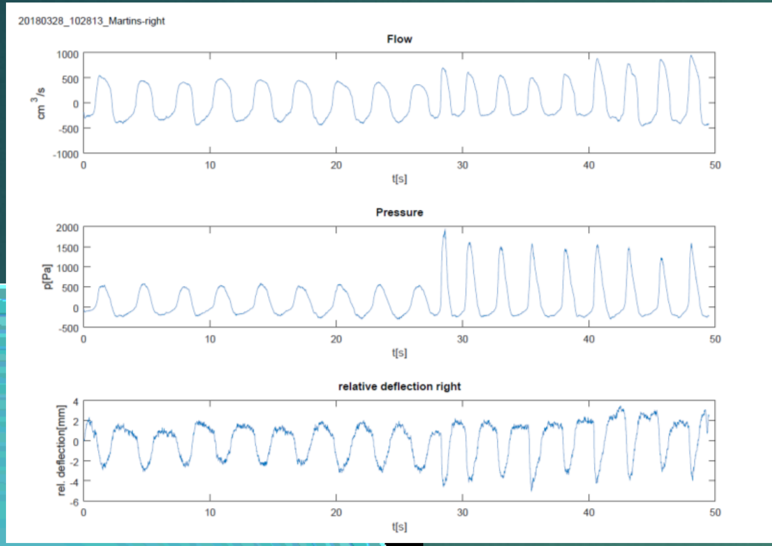
Results (examples)

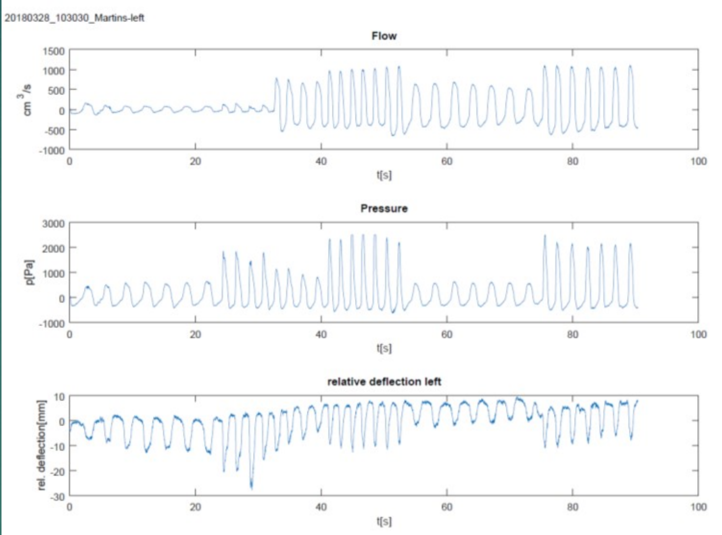


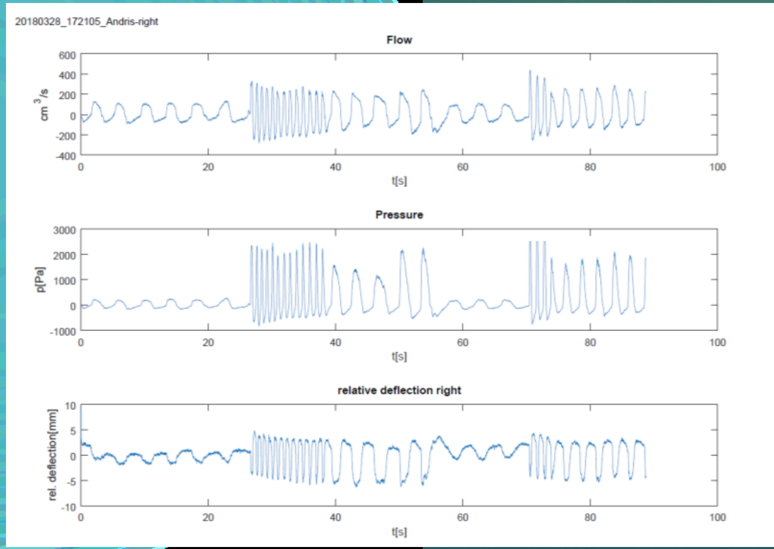


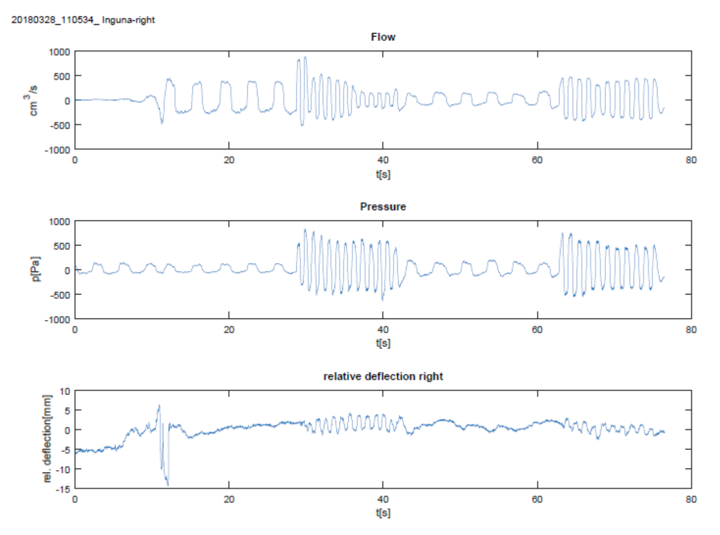
- Laser distance measurements and strain gauge measurements provide reliable results for the dynamic analysis of the nasal valve

Strain gauge measurements :typical examples









Strain gauge measurements: Resultsof 78 measurements

Deflection	Pressure < 200 pa	Flow < 200 ccm/s	Pressure > 200 pa	Flow > 200 ccm/s
No deflection	0	0	0	0
Clear deflection < 2mm	16	11	5	10
High deflection > 2mm	10	16	40	34

Not evaluated because of minor technical errors: 7

Discussion

- The onset of the activity of the nasal valve starts in much lower pressure of flow as up to now suspected.
- **No** nasal breathing without movement of the nasal wing.
- „Valve activity“ can be registred already under in normal physiological breathing conditions

Conclusions 1

- The early onset of valve activity should be considered when planning surgical alterations of the nasal valve. The onset of deflection starts before the feeling of valve activity.
- Valve surgery and prostheses may lead to non-physiological conditions
- A „rigid“ or immotile nasal valve seems to be an exception
- Loops in 4-phase-rhinomanoetry represent the motility of the lateral nasal wall

Conclusions 2

- The nasal valve is ONE physiological unit. „External“ and “internal“ valve are only describing anatomical details
- Strain gauge technique should be developed as Medical Product and can be incorporated in advanced rhinomanometers
- The development of CFD-analysis of the nasal air stream must also consider the motility of the nasal wall („STARLING-resistor“)

Technical and economical considerations

- Laseroptic distance measurements are very precise but expensiv: they should be used as calibration devices for future medical products
- Strain gauge devices are very reliable by the new fixation method with bite-plates. They need experienced personnel to produce. A very long QM-management process is predictable
- Optic measurements can probably solve the problem in an economic way. The practicable application is under development

Elastometrie

- The mechanical properties of the nasal wing are characterized by curvature and position of the anatomical structures
- Thickness and stiffnes of anatomic components
- Angle of all structures with the main air stream (Bernouilli´effect)

Measuring forceps under construction
If both branches are touching the nasal wing outside and inside, electric resistance gets low. The way for possible compression and the force is measured.

Unfortunately, due to corona we cannot present first measurements! Sorry!