Visualization of elastic deformations of the nose by 4-phase rhinomanometry

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High-resolution rhinomanometry – later renamed as 4-phase rhinomanometry – not only avoids the errors of "classical" rhinomanometry, its new logarithmic parameters log Effective Resistance (LReff) and Log Vertex Resistance (LVR) are also significantly correlated to the subjective sense of obstruction. A clinical classification of airflow/obstruction in 5 classes is available. Furthermore the information obtained from the graphical representation in the form of curves enables a rapid visual assessment of nasal valve function.

Fig. 1: 4RHINO – 4-phase rhinomanometer

	Log10R (VR, REFF)	Flow (ccm/s) Inspiration1/ 150 Pa	Obstruction, Resistance
1	<= 0.75	> 500	very low
2	0.75 - 1.00	300 - 500	low
3	1.00 - 1.25	180 - 300	moderate
4	1.25 - 1.50	60 - 180	high
5	> 1.50	< 60	very high

Fig. 2: Grading of nasal obstruction in 4-phase rhinomanometry

Introduction:

A remarkable number of patients complain of nasal obstruction at even slight levels of physical exertion. In some cases such dynamic obstruction may occur unilaterally. Such functional disturbances of the nasal valve can be due to morphological obstruction or Bernoulli-effects which occur after a narrowing of the nasal passage. The resulting negative pressure leads to an aspiration of the nasal valve. The nasal airflow thereby creates the limitation itself through the flow-induced narrowing. In such cases a pathological function of the nasal valve needs to be diagnosed, which can be successfully treated with several alternative methods of minimal invasive surgery. Inspection and endoscopy do not provide the required functional information, but 4-phase rhinomanometry allows a semi quantitative assessment in these cases.

Method:

By using the 4-phase rhinomanometer 4RHINO (Rhinolab GmbH, Freiburg, Germany) the ascending and descending phases of the nasal breath are depicted and analysed. It is strongly advisable not to use any preformed adapters for the coupling of the pressure tube at the nostril in order to preserve its motility during the measurement process. The measurements are carried out in the mode "Active Anterior Rhinomanometry" and can be repeated as a decongestion test to see the valve behaviour after decongestion of the nasal mucosa. A slight opening of the rhinomanometric curve as a loop occurs in many cases spontaneously and has no pathological meaning.

The figures below show typical decongestion tests as mostly applied in rhinomanometry, where the coloured lines show the measurements before decongestion, the black lines depict the measurements after decongestion. As an additional information, fig. 3 shows a typical valve phenomenon before and after decongestion with Xylometazoline on the left side with an opening of the loop outside the axis

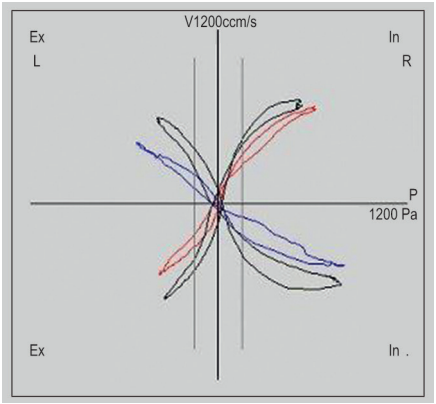

Fig. 3: Decongestion test with disturbed valve function before and after decongestion

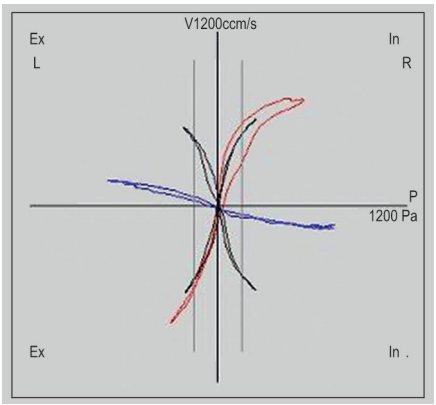

Fig. 4: Valve phenomenon in elevated flow acceleration

intersection, visible as "first view diagnosis". It is the advantage of the new parameters Logarithmic Effective Resistance and Vertex Resistance, that also a numeric result can be obtained. The resistance is lower at the curve vertex than the resistance measured over the entire inspiration cycle. In the blue curve (before decongestion) LogVRin1 = 1.45 and LogReffin2 = 1.69 and in the second black curve LogVRin = 1.06 and LogReffin = 1.14 Pas/ccm.

In a second case (fig. 4) the opening of the loop only occurs at elevated flow acceleration, but it reduces the inspiratory flow by about 50%. However it still remains within the normal range: the normal function of the nasal valve is depicted.

Discussion:

The 4-phase rhinomanometry offers significant advantages: First and foremost, reliable numerical information obtained by the parameters mentioned above (LVR, LReff). Furthermore, 4-phase rhinomanometry provides better insight into the function of the nasal valve by graphical representation. Depicting the breathing cycle in four curve parts is not only the way to avoid the failures of "classic" rhinomanometry, it also provides extended diagnostic information. Plus, the new parameters are the first parameters statistically evaluated in a large population and with a significant correlation between objective findings and patients' subjective sensation of obstruction.

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Featured Product

RH 4040 – 4RHINO with Starterset and Software

Qty.	REF	Description
1	RH2000	4RHINO – 4-phase rhinomanometer, complete
100	RH4001	Pressure-tube adaptor, single use
12	RH4002	Tape, Microfoam
100	RH4003	Pressure tube, single-use
100	RH4004	Filter insert, single-use
1	RH4005	Filter casing
1	RH4006	Reference tube, single-use
1	RH4007	Mask connector
1	RH4008	Face mask for young adults size 3/4
1	RH4009	Face mask for adults size 5
1	RH4010	Calibration tube
1	RH4030	Storagetray
1	RH3000	Software

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