Rhinomanometry as an additional diagnostic method in cases of the Obstructive sleep apnea and snoring syndrome

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Abstract

Background:
In recent decades, diagnostic methods in otorhinolaryngology and sleep medicine have been developing and improving at an extremely rapid pace. On a global scale, the problem of timely and correct diagnosis of the Syndrome of Obstructive Sleep Apnea and Snoring Syndrome (SOSAS) is relevant, since SOSAS affects the quality of life of patients. Nowadays, the most widely used method for diagnosing OSA is polysomnography. For even more precise diagnosis and timely correct treatment in patients with nasal obstruction and SOSAS, it is recommended to apply the methods of rhinomanometry.
The aim of the following article is to research the role of rhinomanometry as an additional diagnostic method in cases of the Obstructive sleep apnea and snoring syndrome.

Methods:
In the period November 2023 – March 2025, a scientific study was conducted in the facility of the Medical University – Varna, in the Sector „Audiovestibular Medicine and Sleep Medicine". The scientific study was approved by the Ethics Committee of the Medical University – Varna (No. 131 / 11.05.2023). A total of 70 participants took part in the scientific study, of which 50 were male and 20 were female, examined by the same ENT-specialist. All patients studied gave their voluntary written informed consent to participate in the scientific study. All participants included in the study underwent a complete otorhinolaryngological examination with devices (Interacoustics®, Dennmark), Home sleep apnea test (HSAT) (Weinmann® Somnocheck micro cardio) and rhinomanometry (Atmos® Rhino 31, Germany). For the purposes of the study, the anterior measurement methods were used when performing rhinomanometric examinations.

Results and discussion:
When conducting the rhinomanometric examination in all patients, the anterior measurement method was used. After relaxing for at least 20 minutes, in one nostril at a time, all patients were examined using the active anterior rhinometry method in a sitting position. After a complete otorhinolaryngological examination, only 20% of the participants (14 participants) were not diagnosed with any ENT-disease. Among the remaining, allergic rhinitis, chronic rhinogenic and odontogenic sinusitis, chronic pharyngitis were observed, and patients with more than one of the indicated diseases combined were described. The most frequently placed diagnosis was the chronic allergic rhinitis (more than 40% of the cases), often combined with nasal polyposis. SOSAS cases were diagnosed in 50 out of the 56 patients with an ENT-disorder. All patients with a SOSAS case were diagnosed with a nasal obstruction of a different degree. Authors re-tested the sleep quality and quantity of all SOSAS patients, after treating the nasal obstruction condition and found out that AHI tends to reduce. Symptoms of OSA were alleviated.

Conclusions:
It can be concluded that early detection of altered pressure, volumetric airflow and nasal resistance using rhinomanometry can prevent or delay the development of the syndrome of obstructive sleep apnea and snoring. The results of the scientific study show that rhinomanometry is an effective clinical diagnostic method for measuring, assessing and diagnosing nasal breathing. Timely diagnosis of SOSAS is the key to successful and correct treatment of patients and improving their quality of life. Treating the nasal obstruction alleviates the symptoms of OSA.

Key words:
rhinomanometry, SOSAS, nasal resistance, nasal obstruction.

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Background

In recent decades, diagnostic methods in otorhinolaryngology and sleep medicine have been developing and improving at an extremely rapid pace. On a global scale, the problem of timely and correct diagnosis of the Syndrome of Obstructive Sleep Apnea and Snoring Syndrome (SOSAS) is relevant, since SOSAS affects the quality of life (QoL) of patients. SOSAS consists of repeated episodes of upper airway obstruction due to anatomical and functional abnormalities of the upper airway. Nowadays, the most widely used method for diagnosing OSA is the conventional polysomnography (PSG), which the American Sleep Medicine Association describes as the gold standard in the diagnosis of sleep disorders. (1,2) For even more precise diagnosis and timely correct treatment in patients with nasal obstruction and SOSAS, it is recommended to apply rhinomanometry methods. Reduced nasal airflow may be a barrier to CPAP (continuous positive aireay pressure) use, which clinicians in the field describe as the gold standard for SOSAS treatment. (3,4,5) Rhinomanometry is a dynamic quantitative clinical method for visualizing and quantifying nasal resistance. Authors describe a positive correlation between nasal resistance measured by active anterior rhinomanometry in the sitting position and the positive pressure used in CPAP treatment of patients with SOSAS. (6,7)

The **aim** of the following article is to research the role of rhinomanometry as an additional diagnostic method in cases of the Obstructive sleep apnea and snoring syndrome.

Methods

In the period November 2023 – March 2025, a scientific study was conducted on the territory of Medical University – Varna, in the Sector „Audio-vestibular and Sleep Medicine“. The scientific study was approved by the Ethics Committee of the Medical University – Varna (No. 131 / 11.05.2023). A total of 70 participants took part in the study and were examined by the same ENT-specialist, with more than 20 years of clinical practice. All patients studied gave their voluntary written informed consent to participate in the study. All participants included underwent a complete otorhinolaryngological physical examination was done, apart from which specialized devices for otoscopy, tympanometry, audiometry (Interacoustics®, Denmark) and rhinomanometry (Atmos® Rhino 31, Germany) were used (Fig. 1). The anterior measurement method with nose olives was used when performing the rhinomanometric examinations.

Fig. 1. *Rhinomanometer, Atmos® Rhino 31, Germany*

The ENT-specialist filled specialized, specifically developed for the purposes of the studies patient files (Fig. 2). Patients filled forms to share information for their general health status (present general diseases such as cardio-vascular diseases, diabetes mellitis type 1 or 2, hypertension, neurologic diseases, allergies), medications intake, past diseases and surgical interventions in the head and neck area, present symptoms of snoring, excessive daytime sleepiness, fatigue, morning headache, nasal obstruction, dizziness, vertigo, tinnitus, reduced hearing capabilities (Fig. 3).

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ОБХОДНА КАРТА – УНГ

Три имена на пациента:
Адрес:
Телефонен номер / GSM:
E-mail:
Общи заболявания:
Оперативни интервенции в областта на главата и шията:
Алергии:
Име и телефонен номер на личен лекар:

Анамнеза:

Статус:

Изследване	Резултат / Находка
1. Отоскопия	
2. Предна риноскопия	
3. Задна риноскопия	
4. Мезофарингоскопия	
5. Ендоскопско изследване	
6. Индиректна ларингоскопия	
7. (видео) Ларингостробоскопия	
8. Риноманометрия	
9. Краниомандибуларна и шийна палпация	
10. Аудиометрия	
11. Високочестотна аудиометрия	
12. Тимпанометрия	
13. Тубо-импедансметрия	
14. Видеонистагмография (VNG)	
15. vHIT	
16. Виртуална реалност (SVV)	
17. SERA	
18. ASSR	
19. EoCoGr	
20. OAE – TOAE / DOAE	
21. cVEMP	
22. oVEMP	
23. Стабилометрия (постурография)	
24. Рентгенография / ОПГ / КТ / CBCT / ЯМР	
25. Полиграфско изследване на сън	
26. Изследване на сън със сонда	
27. Полисомнография	
28. Epworth Sleepiness Scale	
29. Берлински въпросник	
30. PSQI-индекс	

Диагноза:
Заключение:

Дата: Лекар:

Fig. 2. *Patients' examination form, filled by the ENT-specialist*

Университетски медико-дентален център,
Медицински университет – Варна,
Сектор „Аудио-вестибуларна медицина“

Моля, попълнете тази информация преди извършването на преглед и изследвания.

Имена на пациента:
Име на придружаващ:
Подпис:
Име на личен лекар:
Телефон:
Работно място:

Моля, отговорете на следните въпроси:
Страдате ли от?

- Сърдечно съдови заболявания и белодробни заболявания да не
- Алергии да не
- Високо артериално кръвно налягане да не
- Неврологични заболявания да не
- Диабет да не

Име на медикамент (и), които приемате: .....

Имали ли сте заболявания в областта на ушите, носа, гърлото? да не
Опериран/а ли сте в областта на уши, носа, гърлото, шията? да не

Имате ли следните симптоми?
Замаяност, световъртеж, нестабилност, шум в ушите, намален слух, сутрешно главоболие, дневна умора, хъркане, затруднено носно дишане. (моля, подчертайте наличните)

Съгласен съм / съгласна съм да бъда прегледан/а и да ми бъдат направени необходимите лабораторни изследвания на: слуха и/или вестибуларни проби и /или изследване на съня и/или носното дишане.

Дата: ..... Подпис пациент:.....

Fig. 3. *Participants' subjective symptoms form, filled in by themselves*

The quality and quantity of the sleep was studied with the method of polygraphy – home sleep apnea test (HSAT) with Weinmann® Somnocheck micro cardio device (Fig. 4).

All patients filled standardized sleep questionnaires (Epworth Sleepiness Scale, ESS; Berlin Questionnaire) assessing their subjective symptoms and the quantity and quality of their sleep (Fig. 5, Fig. 6).

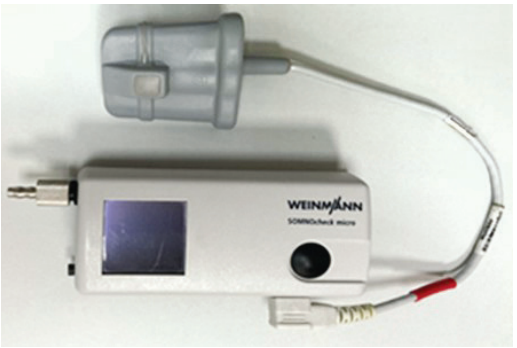


Fig. 4. *Weinmann® Somnocheck micro cardio device for Home Sleep Apnea test (HSAT), implementing the method of polygraphy.*

EPWORTH Sleepiness Scale

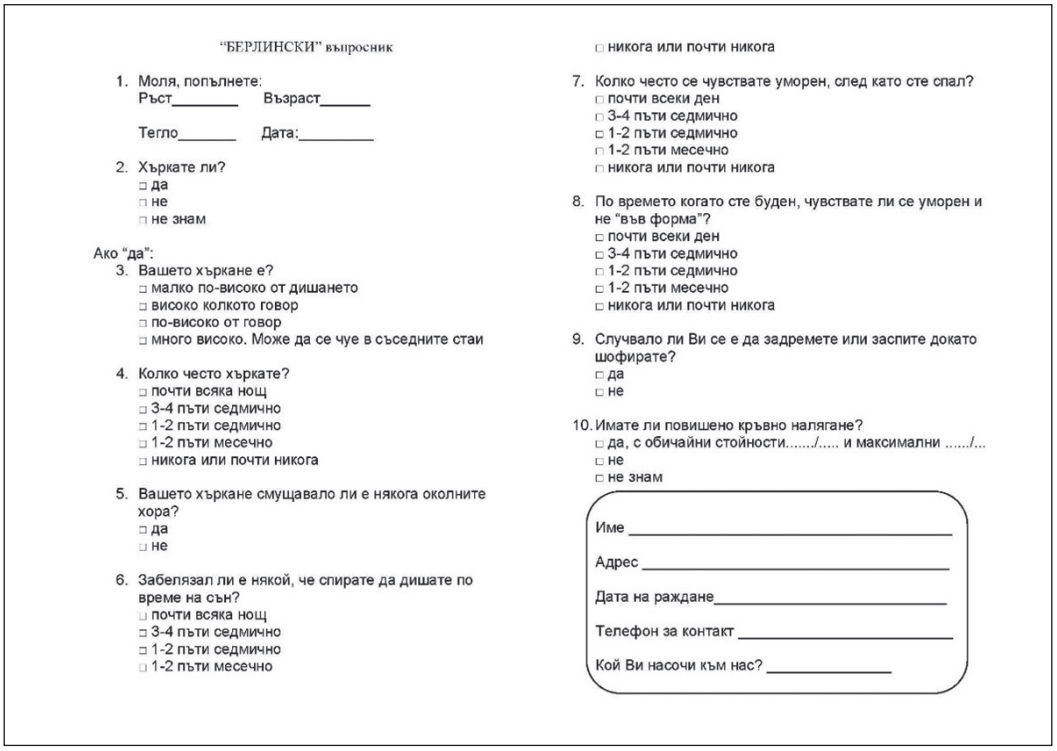
Като използвате следната скала за оценка на състоянието Ви:

0 = не задрямвам
1 = понякога задрямвам
2 = често задрямвам
3 = винаги задрямвам

Моля, оградете цифрата, която най-точно според Вас определя вероятността да задремете в следните ситуации:

Ситуация	***Вероятност за задрямване***			
	никога	понякога	често	винаги
1. Седя и чета	0	1	2	3
2. Гледам телевизия	0	1	2	3
3. Седя спокойно на публично място, например в театър или събрание	0	1	2	3
4. Ако ме возят в кола за един час, без прекъсване	0	1	2	3
5. Полегнал съм да си почина след обяд	0	1	2	3
6. Седя и говоря с някого	0	1	2	3
7. Седя спокойно след обяд (без употреба на алкохол)	0	1	2	3
8. В спряла поради улично задръстване кола	0	1	2	3

Fig. 5. *Epworth Sleepiness Scale (ESS) questionnaire, filled in by the participants in the study*



"БЕРЛИНСКИ" въпросник

1. Моля, попълнете:
   Ръст_____ Възраст_____
   Тегло_____ Дата:_____
2. Хъркате ли?
   □ да
   □ не
   □ не знам

Ако "да":

3. Вашето хъркане е?
   □ малко по-високо от дишането
   □ високо колкото говор
   □ по-високо от говор
   □ много високо. Може да се чуе в съседните стаи
4. Колко често хъркате?
   □ почти всяка нощ
   □ 3-4 пъти седмично
   □ 1-2 пъти седмично
   □ 1-2 пъти месечно
   □ никога или почти никога
5. Вашето хъркане смущавало ли е някога околните хора?
   □ да
   □ не
6. Забелязал ли е някой, че спирате да дишате по време на сън?
   □ почти всяка нощ
   □ 3-4 пъти седмично
   □ 1-2 пъти седмично
   □ 1-2 пъти месечно
   □ никога или почти никога
7. Колко често се чувствате уморен, след като сте спал?
   □ почти всеки ден
   □ 3-4 пъти седмично
   □ 1-2 пъти седмично
   □ 1-2 пъти месечно
   □ никога или почти никога
8. По времето когато сте буден, чувствате ли се уморен и не "във форма"?
   □ почти всеки ден
   □ 3-4 пъти седмично
   □ 1-2 пъти седмично
   □ 1-2 пъти месечно
   □ никога или почти никога
9. Случвало ли Ви се е да задремете или заспите докато шофирате?
   □ да
   □ не
10. Имате ли повишено кръвно налягане?
    □ да, с обичайни стойности...../..... и максимални ...../...
    □ не
    □ не знам

Име _____

Адрес _____

Дата на раждане_____

Телефон за контакт _____

Кой Ви насочи към нас? _____

Fig. 6. *Berlin sleep questionnaire, filled in by the participants in the study*

Results and discussion

A total of 70 participants took part in the study conducted in the Sector „Audio-vestibular and Sleep Medicine", Medical University „Prof. Dr. Paraskev Stoyanov" – Varna, of whom 50 were male and 20 were female, with a percentage ratio of 29% female to 71% male, respectively (Fig. 7).

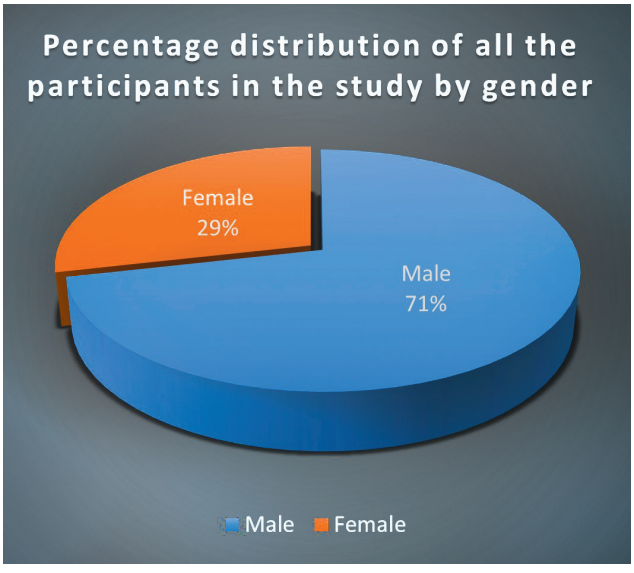


Fig. 7. *Percentage distribution of all the participants in the study by gender*

When conducting the rhinomanometric examination, the anterior measurement method was implemented on all patients. After relaxing for at least 20 minutes, in sitting position, in one nostril at a time, all patients were examined using the active anterior rhinometry method.

After a complete otorhinolaryngological examination, only 20 % of the participants (14 participants, 7 male and 7 female) were not diagnosed with any ENT-disease. Among the remaining, allergic rhinitis, chronic rhinogenic and odontogenic sinusitis, chronic pharyngitis were observed, and patients with more than one of the indicated diseases combined were described. The most frequently placed diagnosis was the chronic allergic rhinitis (more than 40% of the cases), often combined with nasal polyposis. More than 80% of the patients with the diagnosis of sinusitis, authors came to the conclusion it was of rhinogenic type. In patients with allergic rhinitis, when applying the anterior rhinometry method, a curve is generated in the red area, and a visible change in nasal patency and clear indicators of obstruction are observed on the rhinomanometric report.

On Fig. 8 and Fig. 9, a normal and abnormal rhinomanometry are shown (Fig.8, Fig. 9).

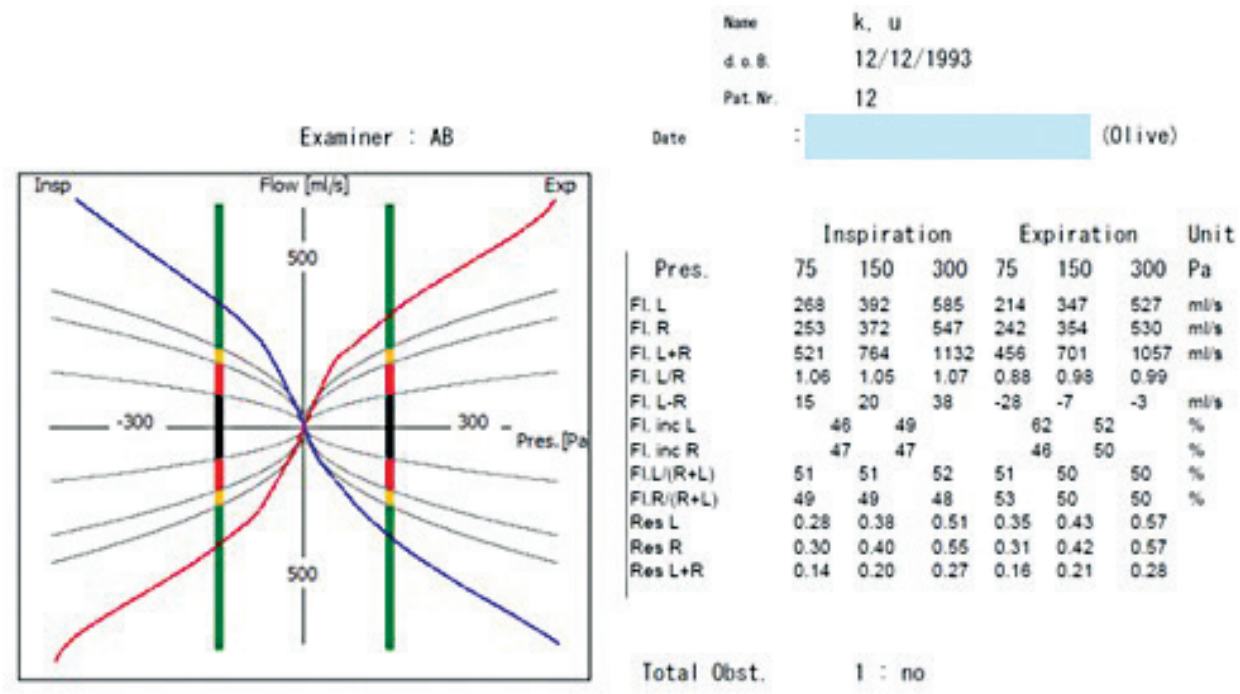


Fig. 8. *A normal rhinomanometry*

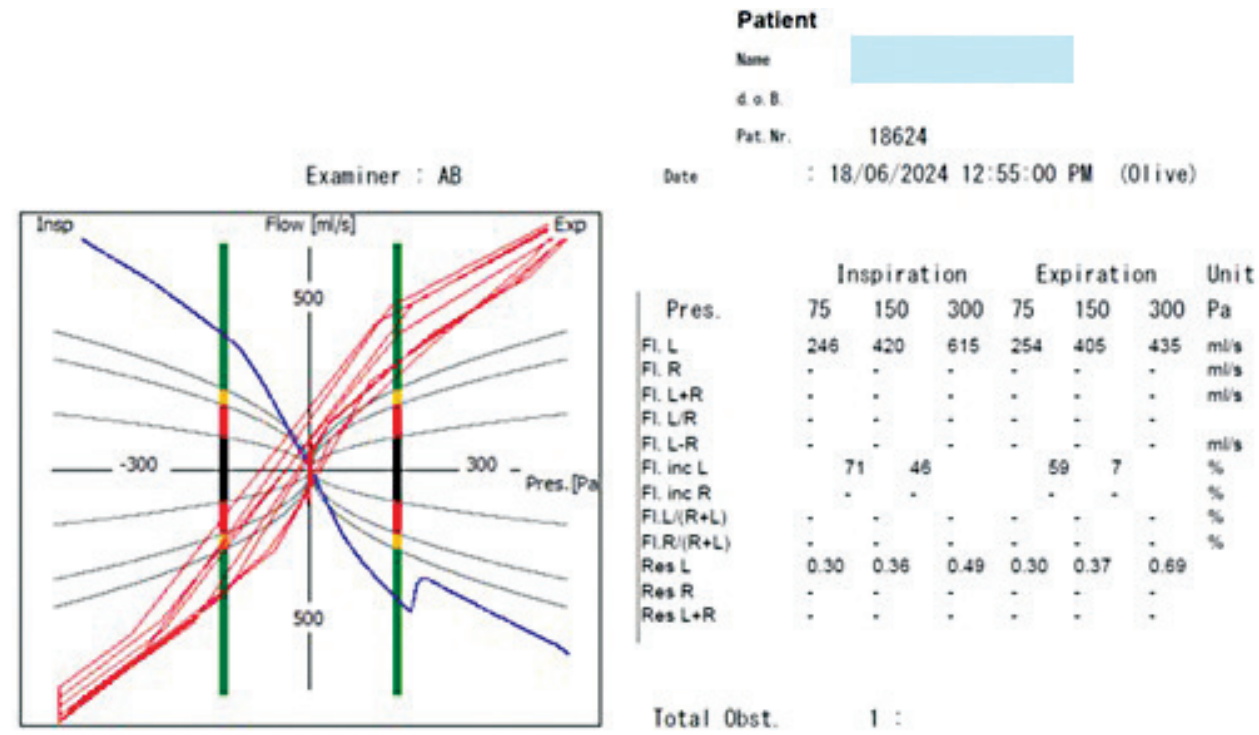


Fig. 9. *Abnormal rhinomanometry in a case of chronic allergic rhinitis*

The diagnosis of nasal breathing is performed correctly and accurately using the active anterior rhinometry method in a sitting position. (8) With the help of the rhinomanometry device, it is possible to accurately quantify and differentiate the nasal patency. With the development of technologies and the improvement of rhinomanometry devices, the applied parameters for analysis can be individualized. Modern means for applying the rhinomanometry method have auxiliary tools for reading the results and facilitate the assessment of the patients' condition and the correct and timely diagnosis. Rhinomanometry devices are hygienic, have removable filter pads located in the probe body, which prevent contamination inside the probe. (9) With the help of the rhinomanometer, pressure, volumetric flow and nasal resistance are measured (10, 11) and their alterations through the course of the treatment can be monitored and controlled (Fig. 10).

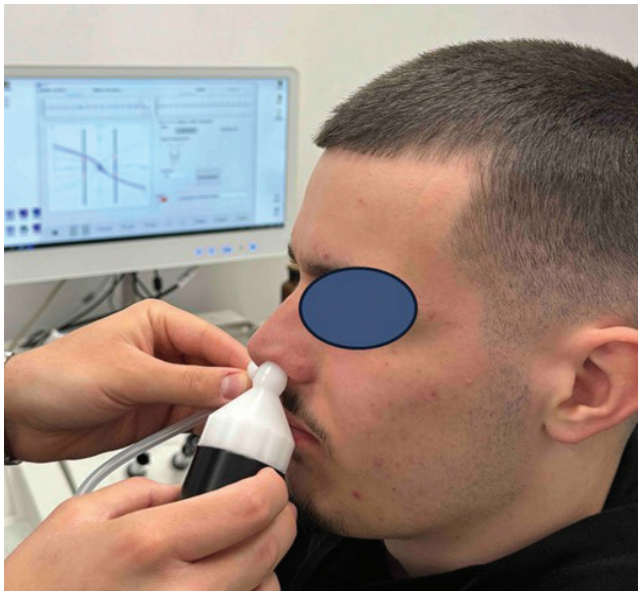


Fig. 10. *Moments of a patient clinical examination with the rhinomanometer.*

The distribution of the severity of the Obstructive sleep apnea cases (based on AHI) diagnosed can be seen on Table 1 (Table 1). SOSAS cases were diagnosed in 50 out of the 56 patients with an ENT-disorder. All patients with a SOSAS case were diagnosed with a nasal obstruction of a different degree.

Table 1. Obstructive sleep apnea cases diagnosed

Form of OSA	Male (n_1)	Female (n_2)
Mild (AHI=5-15)	15 (37.5%)	4 (40%)
Moderate (AHI=15-30)	20 (50%)	4 (40%)
Severe (AHI>30)	5 (12.5%)	2 (20%)
Total number of cases (N)	40 (71.4%)	10 (28.6%)

Authors re-tested the sleep quality and quantity of all SOSAS patients, after treating the nasal obstruction condition and found out that AHI tends to reduce. Symptoms of OSA were alleviated.

Conclusions

From the study authors conclude that early detection of altered pressure, volumetric airflow and nasal resistance using rhinomanometry can prevent or delay the development of the syndrome of obstructive sleep apnea and snoring. The results of the scientific study show that rhinomanometry is an effective clinical diagnostic method for measuring, assessing and diagnosing nasal breathing. Timely diagnosis of SOSAS is the key to successful and correct treatment of patients and improving their quality of life. Treating the nasal obstruction alleviates the symptoms of OSA.

Acknowledgments

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