ŚLIWIAK, Patryk, KONDRATOWICZ, Aneta, MIŁKOWSKI , Paweł, GŁĄBIEŃ, Marta, ALEKSANDROWICZ, Daria, KUŚNIERZ, Anna, JAKUBCZAK, Zofia, KUSIAK, Karolina, WIECZOREK, Olga and ZIMNIAK, Maria Weronika. The Effect of septoplasty on physical performance. Quality in Sport. 2024;24:54756. eISSN 2450-3118.
https://dx.doi.org/10.12775/QS.2024.24.54756
https://apcz.umk.pl/QS/article/view/54756

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.
Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.
Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 29.08.2024. Revised: 19.09.2024. Accepted: 04.10.2024. Published: 07.10.2024.

The effect of septoplasty on physical performance

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Abstract

The nasal septum is a key component of the nasal structure, affecting proper airflow and providing support for the nasal structures. A deviated septum (DSN) can lead to breathing disorders, impaired nasal patency, recurrent nosebleeds, olfactory disorders and frequent upper respiratory tract infections. In competitive sports, where ventilation performance is critical, septal deviation can adversely affect athletic performance. The purpose of this study is
to evaluate the effect of septoplasty on patients' physical performance.

Methodes

This article is based on the available literature found in the Google Scholar, PubMed database with the use of key words such as ,,septoplasty", ,,nasal septal deviation", ,,septoplasty quality of life", ,,nasal septal deviation athletes", ,,septoplasty sport", ,,nasal obstruction sport".

Results

Conducted studies show that surgical correction of a deviated nasal septum improves physical performance as well as respiratory and cardiovascular functions. Restoring proper airflow through the nose after surgery leads to a noticeable improvement in physical performance, highlighting the significance of septoplasty in enhancing patient comfort and improving athletic outcomes.

Key word: nasal septum, nasal septal deviation, septoplasty, physical fitness, respiratory functions, cardiovascular fitness, nasal obstruction in athletes

Introduction

The nasal septum is an essential component of the nasal structure that allows laminar airflow. It is the lamina separating the nose into 2 cavities. It is composed of cartilage in the anterior part and bone in the posterior part. It has an important supportive function for the nasal dorsum, the columella, the nasal tip and allows proper airflow through the nostrils.The most common defect in septal structure is curvature - a deviation of the cartilaginous and/or bony part

of the septum towards one or both nasal passages limiting the cross-sectional area.(1)

Curvature of the nasal septum can be congenital or acquired. It is most commonly a consequence of nasal trauma, including perinatal trauma. Other causes of DSN include congenital malformations. Patients with a crooked septum report: impaired nasal patency, recurrent nosebleeds, olfactory disturbances or recurrent sinusitis, snoring.

The compensatory mechanism for impaired nasal patency is breathing through the oral cavity. The air inhaled through the mouth is unheated and unhumidified. In competitive sport, the efficiency of the ventilation mechanism is crucial for good results. In this article, we look at how surgery to correct a crooked nasal septum affects the performance of sports training.

The importance of nasal structure on airflow

Physiological breathing should take place through the nose. It allows heating, filtration and humidification of the inhaled air. Properly functioning mechanisms are important for athletes during physical exercise. Physical exertion is associated with an increase in minute ventilation and a predominance of mouth breathing to minimise air resistance, which is observed with ventilation of 35-45 breaths/min. The point at which the change in breathing mode from nasal to oral varies from person to person, but is thought to occur when laminar airflow through the nose begins to become turbulent. At maximal exercise intensity, the nasal passages only account for 10% of minute ventilation, but the nose plays a key role in respiratory physiology due to being the entrance to the airways.(2)

The anterior part of the nose, defined as the area between the lateral part of the nose and the septum, bounded by the nasal apices and the upper edge of the vestibule, is an important part of the mobile part of the nose. The cartilaginous part of the septum called the quadrilateral cartilage, together with the facial muscles, forms the structure that enables the septum to close and open, which influences air resistance.(3)

The concept of the nasal valve was first introduced in 1903 by Mink. Its constraints are from the lateral side: the terminal segment of the lateral nasal cartilage, the lateral branch of the greater pterygoid cartilage and the anterior end of the inferior nasal auricle. On the medial side, the nasal valve is formed by the cartilaginous portion of the nasal septum. Thickening, twisting of the caudal edge of the lateral nasal cartilage or distortion of the septum: bending, twisting distortion of the colliculus may contribute to abnormalities of the valve.(4)

It is important to exclude pathologies of nasal valve function. If only for the correct qualification of patients for septoplasty and rhinoseptoplasty. There are convincing studies that the use of dilators (they open the nasal valve) improves physical performance. In a study by Ferreira, Dinardi Ibiapina,Andrade showed that END reduces nasal resistance, increases PNIF and improves VO2max. In addition, the effort score after a maximal cardiopulmonary test improved(5).

Nevertheless, there is no conclusive evidence that exercise reduces nasal airflow. At maximal exertion, the nasal passages participate in ventilation in a small proportion, but this does not limit athletic performance. Although nasal breathing may require more effort, some athletes can adapt to this without compromising performance. Nasal breathing by athletes has several benefits if only for a reduction in bronchospasm, as well as improved sleep quality and general well-being. (3)

Structural disorders of the nose

Permanent obstruction of the nose, resulting from anatomical abnormalities, is usually caused by narrowing of the nasal passages by bony lesions. This type of obstruction does not increase during exercise because the bony structures do not respond to changes in airflow. One such obstruction is: a crooked nasal septum, hypertrophied lower auricle or congenital nasal malformations. In athletes, the most common cause of septal deformity is previous trauma to the nose or face, especially in contact sports. A nasal bone fracture is the most common facial bone fracture and accounts for about 10 per cent of all sports injuries. Promptly attended and appropriately treated, the fracture allows a return to sporting activity in approximately 90 % of cases (6).

Epidemiological studies show that only 42% of newborns and 21% of adults have a straight nasalseptum.(7).Nasal symptoms are more common in athletes (70 %) than in non-athletes

(52 %).(3) However, there is a lack of literature on the prevalence of structural nasal obstruction in athletes. While there is no direct data on what percentage of athletes report worsening nasal patency due to nasal septal torsion, we are aware of data that show how the breathing obstruction affects athletes. In a study in Germany involving more than 600 athletes, more than 80 per cent of those with allergic rhinitis reported a deterioration in sports performance during the pollen season. In contrast, another study found that approximately 45% of recreational athletes with exercise-induced rhinitis found that their nasal symptoms negatively affected their sporting performance to a moderate or severe degree (8). We can surmise that the mere presence of an obstruction has these effects, the same curvature of the nasal septum that we will try to demonstrate later in this paper.

Septoplasty

Septoplasty is one of the basic procedures in ENT. The statistics of septoplasty procedures performed vary considerably between countries. In 2014, the number of septoplasties per 10,000 population was: 3.9 in England, 6.6 in the Netherlands and 12.2 in Germany. In the United States, the annual septoplasty rate was 8.7 per 10,000 population in 2006.(9)

Over the past few decades, it has undergone a significant evolution from complete removal of cartilage to classical septoplasty according to the Cottle method. The development of endoscopic techniques and their widespread availability make endoscopic septoplasty increasingly popular. Van Egmond conducted a randomised controlled trial showing that septoplasty is more effective than non-pharmacological treatment for nasal obstruction caused by septal curvature.(10) The most common causes of septal curvature are dislocated caudal, fracture septum, cases of vomeral spur, basal crest - these are indications for septoplasty.(11) However, it is challenging to guarantee that the symptoms will improve after surgery, particularly in patients who have an isolated contact point between the inferior turbinate and the septum without any nasal obstruction.(12)

Decrease in physical performance reported by patients

Patients with septal curvature report impaired nasal patency, which affects physical performance and fatigability during exercise. Korowacka A, Piątek T, Malkowski P. investigated whether a crooked nasal septum affects difficulties in physical activity. They found that more than 75 per cent of respondents had a problem with it, with 52.6 per cent experiencing moderate difficulty and 23.7 per cent experiencing definite difficulty in undertaking physical activity. There was a significant improvement after septoplasty, with over 85% of people noticing an improvement in their physical activity (74.3% a moderate improvement and 11.4% a significant improvement). Only 14.3% reported no improvement in terms of increased physical capacity. (13)

In a study by Naraghi M, Amirzargar B, Meysamie A, patients were monitored for 6 months after various nasal surgeries; 25% of patients underwent septoplasty. Before surgery, patients most commonly reported that a crooked nasal septum limited their physical activity (33.3% of patients). After septoplasty, patients noted improvement, especially in bothersome symptoms such as a blocked nose (14)

Alessandri-Bonetti's meta-analysis included 2577 patients, 65.1% of whom were male. The mean age of the patients was 33.3 years. The initial mean NOSE score (nasal function assessment scale) was 68.1. After 6 months of follow-up, the mean improvement in NOSE score after septoplasty compared to the initial value was -48.8.(15)

Septoplasty and improvement in performance

In addition to the subjective feelings of the patient, objective parameters of physical performance are important for the evaluation of septoplasty.In a study conducted by AKINOĞLU, Bihter, Murad Mutlu, and Tuğba Kocahan, out of a group of 37 patients, 20 patients did not attend the post-operative follow-up examination, so the study was terminated with 17 patients (four women and 13 men). The mean age of the patients was 27.52 ± 7.77 years and the mean body mass index (BMI) was 24.45 ± 3.92 kg/m². All patients were examined otorhinolaryngologically. Physical fitness tests were performed preoperatively and 6 months postoperatively. The study population was limited to individuals without the following exclusionary criteria: hypertension, coronary artery disease, diabetes, cerebral infarcts, other nasal pathologies, smoking status, or current use of illicit drugs. Patients with orthopaedic or systemic problems or after other surgeries were also excluded, as were those who could not cooperate during testing.

Functional outcomes were assessed by tests such as timed up and go (TUG), timed up and down stairs (TUDS), six-minute walk test (6mWT) and fitness tests: muscular strength endurance, flexibility, speed, agility and balance.

Table 1. Comparison of fitness test results before and after septoplasty (5)

			Preoperative	Postoperative	P*	Z
Functional outcome tests		TUG (sn)	3.29±0.66	2.96±0.35	0.017	-2.379
		TUDS (sn)	5.31±1.07	4.76±0.76	0.025	-2.249
Physical fitness tests	Cardiovascular endurance test	6-Min walk test distance (m)	666.47±100.74	799.41±90.58	0.001	-3.305
	Muscle strength	Trunk extensors	4.47±0.71	4.70±0,46	0.102	-1.633
		Abdominal flexors	4.23±0.83	4.70±0.46	0.031	-2.126
	Muscular endurance measurements	Back extension endurance (Pcs/min)	26.23±5.10	30±9.38	0.031	-2.161
		Abdominal shuttle (Pcs/min)	19.35±5.41	21.17±5.21	0.038	-2.077
		Squat (Pcs/min)	19.88±4.47	25.11±5.21	0.033	-2.077
	Flexibility tests	Sit-and-reach test (cm)	2.70±5.78	5.52±6.35	0.006	-2.767
		Back extension flexibility (cm)	16.94±3.41	20.11±4.01	0.008	-2.647
	Agility tests	10x5m shuttle test (sn)	24.79±7.62	19.64±2.84	0.001	-3.290
	Speed tests	Walking speed (sn)	8.06±1.54	6.90±1.11	0.001	-3.243
		Up and down stairs speed (sn)	4.87±1.03	4.42±0.68	0.002	-3.148
	Balance tests	Functional reach test (cm)	37±5.37	44.29±7.24	0.001	-3.313
	Values are presented as mean ± standard deviation. TUG,Time dup and go test, TUDS,timed up and down stairs test.* Wilcoxon signed-rank test.					

The results of the statistical analysis indicated that the patients exhibited enhanced functional performance following the surgical procedure. Additionally, the physical performance parameters, including distance covered during the 6-minute walk test, abdominal muscle strength, muscular endurance, flexibility, results of the 10 × 5 m shuttle running test, speed, and balance tests, demonstrated notable improvement post-surgery compared to the pre-surgical assessment. However, no statistically significant changes were observed in trunk extensor muscle strength. (16)

In another study by Tuzuner A, Bilgin G, Demirci S, Yuce GD, Acikgoz C, Samim EE on a group of 30 patients before septoplasty surgery and one month after, spirometry, 6mWT test and NOSE and SNOTT22 questionnaires were performed. Patients with other burdens were excluded, as in a previously reported study.

Table 2. Comparison of spirometry parameters before and after septoplasty.(17)

Parameter	Preoperative	Postoperative	P-value
FEV_1	3.45 (2.83-3.78)	3.49 (3.10-3.83)	0.428
FVC	4.09 (3.46-4.62)	4.13 (3.25-4.55)	0.191
FEV1/FVC	83.7±5.1	83.1±5.0	0.441
PEF	6.6±1.6	7.6±1.9	<0.001
$FEF_{25\%-75\%}$	3.7±1.2	3.7±1.1	0.786
$FEF_{50\%}$	4.2±1.2	4.1±1.2	0.741
$FIF_{50\%}$	3.0±1.1	4.6±1.2	<0.001

FEV1-forced expiratory volume in 1 second; FVC,-Forced vital capacity; PEF-peak expiratory flow; FEF25%-75%-forced expiratory flow 25%-75%; FEF50%-maximum expiratory flow at 50% of FVC; FIF50%-maximum inspiratory flow at 50% of FVC

The distance covered during the walking test increased from 702.3 m to 753.2 m, which is statistically significant (P<0.001). Spirometry results showed significant improvements in some parameters, such as maximum inspiratory flow (FIF50%) and maximum expiratory flow (PEF). Patients reported a reduced severity of dyspnoea assessed by the Borg scale from 2 to 1. The NOSE and SNOT22 scales indicated improvements in nasal patency after surgery.(17)

This is not the only study to show a positive effect of septoplasty on spirometric parameters. A longitudinal study from 1 October 2022 to 31 March 2024 examined patients aged 18-55 years with chronic nasal obstruction due to isolated septal curvature. Patients younger than 18 years and older than 55 years were excluded, as well as those undergoing combined nasal surgery and co-morbidities. The study included 30 men and 30 women, with a mean age of 35.6 ± 8.2 years.

Pre-operative assessment included detailed ENT examinations, blood tests, chest and sinus radiographs, spirometry, the Sino-Nasal Outcome Test-22 (SNOT22) questionnaire and the 6-minute walk test (6MWT). Post-operative assessment included repeat: spirometry, 6MWT after three weeks and SNOT22 questionnaire to assess subjective symptoms.

After septoplasty, significant improvements ($p < 0.05$) were observed in lung function parameters (FEV1, FVC, FEV1/FVC ratio, peak expiratory flow), exercise capacity (distance in 6MWT) and symptom severity (SNOT22 scores). Patients reported high satisfaction and noticeable improvements in quality of life (18).

Impaired nasal patency results in increased respiratory resistance, non-oxygenation and hypercapnia, which can cause cardiac systolic dysfunction.

Kaya H, Kurt E, Koparal M studied the effect of septoplasty on left ventricular systolic and diastolic function in patients with symptomatic nasal septal deflection (NSD). A study was conducted on 50 patients who underwent septoplasty. Before and three months after surgery, patients underwent transthoracic echocardiography to assess the myocardial performance index (MPI).

Table 3. Effect of septoplasty on overall and echocardiographic parameters(19)

	Before septoplasty	3 months after septoplasty	p-value
Age (years)	32.6 ± 10.5		
Gender, male (%)	32 (64)		
BMI (kg/m2)	23.5 ± 5.3	22.4 ± 4.9	0.068
Systolic BP (mmHg)	122.5 ± 7.4	120.3 ± 5.2	0.614
Diastolic BP (mmHg)	74.5 ± 4.8	73.7 ± 3.5	0.738
NOSE scale	68 ± 10.6	30.5 ± 10.1	<0.001
Heart rate (beats/min)	76.8 ± 13	73.2 ± 12	0.546
LVEF (%)	63.8 ± 2.8	64.6 ± 3.2	0.224
MPI	0.52 ± 0.06	0.41 ± 0.04	<0.001
IVRT (ms)	95.0 ± 12.5	78.0 ± 8.6	<0.001

IVCT (ms)	45.5 ± 7.8	39.5 ± 8.6	<0.001
E/A	1.42 ± 0.4	1.16 ± 0.2	0.006
ET (ms)	270.1 ± 18.3	286.5 ± 25.8	<0.001
DT (ms)	184.3 ± 32.5	163.6 ± 45.4	0.004

BMI - body mass index; BP - blood pressure; NOSE - nasal obstruction septoplasty efficacy; LVEF - left ventricular systolic ejection fraction; MPI - myocardial performance index; IVRT - isovolumic diastolic time; IVCT - isovolumic contraction time; E/A - early to late peak velocity ratio in the ear canal; ET - ejection time; DT - deceleration time.

The results showed that MPI and other echocardiographic parameters significantly improved after surgery, suggesting that plastic surgery of the curved nasal septum may lead to improved left ventricular function. The study highlights the importance of early surgical intervention to prevent potential cardiac complications. (19) The importance of left ventricular systolic function on the level of performance remains, which requires more research.

Treatment failure - discussion

Nasal surgery is considered for chronic nasal obstruction caused by structural abnormalities in the nasal bones or cartilages.Treatment failure may result from inadequate assessment of the nasal valve insufficiency, which is a conviction for septorhinoplasty.Therefore, it is important to carefully examine all nasal structures in patients with obstruction to establish an effective treatment plan and minimise the risk of surgical failure. For many patients, nasal septal deviation is only one of many structural problems, and a comprehensive assessment of the nasal obstruction is crucial for effective treatment.(20)

Summary

Clinical studies have shown that curvature of the nasal septum significantly affects physical performance. In a study by Korowacka and colleagues and Naraghi and colleagues, it was found that improved nasal patency after septoplasty led to a noticeable improvement in physical activity and a reduction in bothersome symptoms. The majority of patients noticed an improvement in physical activity after surgery.

Measurements of functional parameters showed improvements in fitness and functional tests after septoplasty, such as the 6-minute walk test, muscle strength, endurance and flexibility. Respiratory parameters in spirometry also improved. In addition, the study suggests that improved nasal patency may have a positive effect on left ventricular systolic function, which may be relevant to overall fitness.

All these findings highlight the significant health benefits associated with surgical correction of a crooked nasal septum, both in terms of improved physical performance and overall respiratory and cardiovascular health. Further research is needed, in particular randomised clinical trials that estimate the prevalence of the problem of septal curvature in athletes and the long-term health benefits following surgery.

Author's Contribution

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All authors have read and agreed with the published version of the manuscript.

FundingStatement

Study did not receive special funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Acknowledgments

Not applicable.

Conflict of Interest Statement

The authors of the paper report no conflicts of interest.

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