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The Impact of Septoplasty on Physical Performance and Quality of Life in Active Individuals – A Literature Review

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ABSTRACT

Background. Appropriate upper airway patency is an essential component of exercise physiology. The nose is not only responsible for conditioning inhaled air but is also the primary source of nitric oxide (NO), which aids gas exchange in the lungs. Nasal septal deviation (NSD) disrupts flow aerodynamics, increases airway resistance, and forces a premature transition to the less efficient oral airway, depriving the physically active individual of metabolic benefits and limiting exercise potential.

Aim. The purpose of this study is to summarize the existing literature on the effect of nasal septal deviation on performance parameters and to determine how effective surgical correction (septoplasty) is in relation to performance, hemodynamic, and recovery parameters among physically active individuals.

Results. The literature review reveals that septoplasty offers several physiological advantages. During exercise, the process increases the economy of effort and delayed fatigue, as it decreases metabolic cost by increasing time to exhaustion without necessarily increasing absolute VO2max.

In the hemodynamic area, nasal patency significantly unburdens the heart by lowering pulmonary artery pressure (mPAP) and improving left ventricular function. In addition, the procedure normalizes sleep quality and heart rate variability (HRV) parameters, which is the basis of a successful recovery after exercise.

Conclusions. Septoplasty is an effective treatment that promotes exercise capacity in athletes. This process has a profound influence on minimizing the metabolic cost of breathing, improving cardiovascular function and the quality of biological recovery, eliminating the physiological and functional gap between patients with NSD and the healthy population.

Keywords: nasal septum deviation, septoplasty, physical performance, nitric oxide, sports medicine

1. Introduction

Physical ability depends on many factors, among which the functioning of the respiratory system is crucial. Generally, in sports medicine there has been a traditional interest in pulmonary and cardiovascular aspects, in recent years there has been growing interest in the role of the upper respiratory tract, and particularly the nasal cavity, as the “first line” of the respiratory system [1]. The nose is not only a passive conduit for air; it is responsible for conditioning it, which is essential for protecting the lower respiratory tract from bronchoconstriction caused by cold and dry air (EIB – Exercise-Induced Bronchoconstriction) [2-4]. Nasal obstruction can negatively affect an athlete's overall performance [5]. In terms of exercise physiology, the findings of the role of the paranasal sinuses as the main site of nitric oxide (NO) production are of fundamental importance. As demonstrated by Lundberg, inhaling air through the nose allows NO to be transferred to the alveoli and serves as a local vasodilator, increasing arterial oxygen saturation by up to 10–20% compared to breathing through the mouth [6,7]. Nasal septal deviation (NSD) is one of the most common anatomical anomalies of the craniofacial region. Advanced computational fluid dynamics (CFD) studies confirm that the internal geometry of the nasal cavity strictly determines the aerodynamic patterns and distribution of airflow [8]. The key mechanism is the phenomenon of a “switching point” – the moment when nasal resistance forces a switch to mouth breathing. In people with impaired nasal patency, this point occurs at significantly lower ventilation values, which deprives the athlete of the benefits of nasal breathing [9].

The purpose of this article is to review the literature on the impact of nasal patency on exercise physiology and to evaluate the effectiveness of surgical treatment (septoplasty). Although some studies suggest that removing nasal obstruction effectively delays the onset of fatigue, which translates into a significant increase in the time to exhaustion [10], others suggest that the benefits mainly result from improved sleep quality and recovery [11,12].

2. Functional anatomy and physiology of the nose in relation to exercise

The external nose and nasal cavities are the area with the highest flow resistance in the entire respiratory system, accounting for approximately 50% of the total airway resistance [1]. From an aerodynamic perspective, the nasal valve constitutes the essential structure. This area has a maximum acceleration of airflow, which can lead to the collapse of the nostrils during forceful inhalation [8]. At rest and during moderate physical exertion, breathing through the nose warms and humidifies the air, which prevents the mucous membrane of the lower respiratory tract from drying out [2]. However, the physical capacity of the nasal cavities is subject to strict

biomechanical limitations. Studies by Dallam et al. [13] show that as a result of long-term training adaptation, it is possible to maintain exclusive nasal breathing even at submaximal and maximal intensities. Maintaining full structural patency of the nose is considered a prerequisite for such effective nasal ventilation, as pathologies like septal deviation increase flow resistance significantly [10]. If there is an anatomical deficit, the physiological switching point to the oral pathway (oronasal switching point) undergoes a pathological shift towards lower exercise intensities [9]. This phenomenon leads to an interruption in the continuous transport of nitric oxide (NO) from the paranasal sinuses to the lower respiratory tract, depriving the body of the key hemodynamic benefits resulting from the vasodilatory effect of this gas [6].

3. Breathing mechanics with a deviated nasal septum

A deviated nasal septum is rarely an isolated pathology. It is often accompanied by compensatory hypertrophy of the turbinates on the opposite side. Even small deviations of the septum cause turbulence, which drastically increases flow resistance [1]. Studies by Li et al. based on CFD modeling have shown that subtle differences in the anatomy of the anterior nasal cavity - particularly the shape of the nasal vestibule- determine whether the air stream reaches the sensory zone. This demonstrates that the nose anatomy affects not only flow resistance but also sensory functions [8]. This aspect is perfectly illustrated by the classic studies by Morton et al. [14]. The authors showed that high aerodynamic resistance of the nose becomes a critical limiting factor during maximum exertion. When oxygen demand increases, the mechanical inability to increase flow through narrow nostrils leads to hypoventilation (insufficient gas exchange in relation to needs). For example, there is a drastic increase in the work of breathing (WOB) – the body consumes a disproportionate amount of energy just to overcome resistance in the upper airways, which in Morton's studies resulted in a lower aerobic capacity and accelerated fatigue. In addition, chronic nasal obstruction contributes to sleep disturbances. Avatef Fazeli et al. demonstrated a correlation between NSD and daytime sleepiness [15]. Untreated obstruction can lead to the development of obstructive sleep apnea (OSA), which significantly impairs post-exercise recovery [12].

4. The impact of septoplasty on performance parameters

Modern surgical treatment (septoplasty) is a procedure that goes beyond resecting the deviation. As reported by Fettman et al. in their review of surgical techniques [16], the essential purpose of the procedure is to reproduce physiologic airflow mechanics through precise reconstruction of the septum, while maintaining its structural support for the external nasal structures.

Conclusive evidence of the effectiveness of such procedures is provided by a systematic review and meta-analysis conducted by Alessandri-Bonetti et al. [17]. These authors, using statistical analysis of aggregate data from world literature, confirmed the high efficacy of septoplasty. They showed that the procedure leads to a significant and lasting improvement in nasal patency, specifically verified by a substantial reduction in the NOSE score (Nasal Obstruction Symptom Evaluation). This can be used as a baseline for more detailed consideration of the surgery effect on individual physiological variables.

We can summarise the available literature to extract three main benefits of such an intervention:

4.1. Maximal Oxygen Uptake (VO2max) and exercise tolerance:

The clinical importance of anatomy was demonstrated by Akinoğlu et al. The authors proved that nasal airflow correction (septoplasty) enhances physical performance as well. In functional tests (including the 6-minute walk test), patients performed better after surgery, which evidences that nasal patency is directly related to a greater capacity of effort and the delay in appearance of fatigue [10]. The potential of the nasal passage physiologically was demonstrated by Dallam et al. in a study of runners. They refuted the thesis that the nose limits performance during maximum exertion. It has been demonstrated that after a proper adaptation, athletes breathing through the nose achieve the same VO2max as when breathing through the mouth, while maintaining significantly better “physiological economy” (lower minute ventilation and lower respiratory rate). This phenomenon results from improved gas exchange efficiency: the nasal passage forces natural slowing of the breathing rhythm with a simultaneous increase in the volume of each breath. This type of breathing decreases the percentage of anatomical dead space (air that doesn't participate in gas exchange), so there is more oxygen to enter the alveoli. The total energy cost of respiratory muscle work (metabolic cost of breathing) decreases, which saves oxygen resources for working skeletal muscles [13]. These results suggest that surgical restoration of patency is a prerequisite for an athlete to exploit the full potential of respiratory economy without compromising their aerobic capacity.

4.2. Cardiopulmonary parameters:

Kaya et al. [18] report a comprehensive explanation of the pathomechanics that connect nasal anatomy with left ventricular function. The authors showed that septal surgery (septoplasty) leads to a statistically significant improvement in the Myocardial Performance Index (MPI). This mechanism is based on the elimination of chronic hypoxia and hypercapnia, which triggers Hypoxic Pulmonary Vasoconstriction (HPV) in patients with nasal obstruction. Increased

pulmonary resistance increases the afterload on the right ventricle, which, through ventricular interdependence, negatively affects the compliance and filling of the left ventricle. Surgical restoration of patency interrupts this cascade: normalization of gas exchange lowers vascular resistance, improving isovolumetric relaxation, and global myocardial contractility.

Celiker et al. [19] showed that chronic nasal obstruction disrupts the body's autonomic balance, leading to sympathetic dominance. The intervention of septoplasty had a positive effect on HRV parameters. From the perspective of sports physiology, this is a beneficial change, suggesting better adaptation of the circulatory system to stress and more efficient mechanisms for post-exercise recovery. Last but not least high HRV is generally considered in sports medicine as one of the most important markers of readiness to compete and absence of overtraining.

The effect of the nasal patency on pulmonary circulation is raised by Fidan and Aksakal [20] as a significant hemodynamic aspect. The authors studied patients with significant septal deviation, demonstrating elevated mean pulmonary artery pressure (mPAP). This phenomenon is explained by hypoxic pulmonary vasoconstriction (also known as the Euler-Liljestrand reflex): chronic alveolar hypoventilation leads to constriction of the arterioles in the lungs, which increases resistance to the right ventricle of the heart. The study showed that septoplasty leads to a statistically significant reduction in mPAP, suggesting that these changes are reversible and that the cardiovascular system is relieved after surgery. From the perspective of sports physiology, this is especially important for athletes as exercise physiology suggests decreased pulmonary vascular resistance facilitates better heart function and gas exchange under high metabolic demand.

4.3. Sleep quality and activity:

A complete overview of the impact of nasal patency on daily performance is offered in a review by da Silva de Oliveira et al. [11]. These authors emphasize that the effects of septoplasty go beyond improving ventilation parameters, significantly affecting the patient's psychological well-being. The analysis shows that the correction of breathing disorders (including obstructive sleep apnea) leads to a significant reduction in symptoms of anxiety and depression, which are often the result of chronic hypoxia and sleep fragmentation. The result of this study is that improved sleep quality after surgery directly translates into an increase in overall quality of life and mental well-being. For physically active individuals, this is a crucial finding, implying not only better physical recovery, but also a higher level of motivation and emotional stability, which is essential for regular training.

Bugten et al. [21] used a unique perspective in assessing the effectiveness of treatment by comparing patients qualified for septoplasty with a control group of healthy individuals. The study showed that prior to surgery, patients with NSD had a drastically lower quality of life and more severe symptoms than the general population. The key conclusion from this study is that surgical intervention allowed for the normalization of health-related quality of life parameters – 6 months after surgery, assessments approached the level represented by healthy individuals. For athletes, this means that septoplasty allows them to bridge the physiological gap between themselves and their fully fit rivals. Studies by Silva de Oliveira [11] and Bugten [21] indicate a radical improvement in sleep quality after surgery. Better sleep translates directly into a willingness to engage in physical activity.

An interesting supplement to the functional assessment is Subramaniam's [22] research on voice acoustics. The author showed that correction of the nasal septum, by changing the volume and shape of the nasal cavity (acting as a resonator), leads to significant changes in acoustic parameters such as formant frequencies, reducing the symptoms of hyponasality (closed nasalization). Aside from this, an association between voice function and sports performance can be less frequently observed; however, for team sport players good vocal quality is a pre-requisite when it comes to oral communication between team members on the field.

5. Discussion

An analysis of the cited literature allows us to formulate the thesis that nasal patency in physically active individuals should be considered not only as a matter of respiratory comfort, but also one of significant importance for assessment of cardiovascular fitness and regenerative potential.

A key issue raised in the literature is the relationship between anatomy and the so-called physiological economy of exercise. As Dallam et al. have demonstrated that nasal breathing theoretically has advantages over oral ventilation (reduction of dead space, improved gas exchange), but there is–crucially–no possibility of adapting to this pattern without the correct intranasal structure. The results of studies by Akinoğlu et al. suggest that septoplasty acts as an **"**unlocking factor" for this potential. By eliminating this mechanical break, the "switching point" to the oral pathway towards higher loads, allowing the athlete to benefit longer from nitric oxide transport and air humidification, thus delaying the onset of fatigue, according to Morton.

An often ignored and very relevant topic includes the influence of the nasal septum on cardiac hemodynamics. Kaya, Fidan, and Aksakal have contributed to our understanding of the systemic effects of NSD. It has been shown that nasal obstruction, through the Euler-Liljestrand

reflex mechanism and interventricular interaction, leads to functional overload of both ventricles. In this sense, septoplasty is no longer just an ENT procedure, but also a preventive procedure for the cardiovascular system, reducing pulmonary vascular resistance (mPAP), and improving myocardial contractility (MPI).

The third pillar of the discussion is recovery. The results of Celiker et al. relating to HRV parameters rise (activation of the parasympathetic nervous system) testify to the information presented by Silva de Oliveira's concerning better sleep quality. This suggests that in athletes with NSD, the nervous system is in a state of permanent physiological stress. Nasal septum surgery will rebuild autonomic balance and normalize quality of life to the level of the healthy population, as demonstrated by Bugten. This means that the benefit for the athlete is double: on the one hand, improved exercise parameters (VO2max exercise tolerance), and on the other, a fundamental improvement in the quality of biological recovery and mental stability.

6. Conclusions

The analysis of the literature leads to the conclusion that in physically active individuals, the role of septoplasty goes far beyond a subjective improvement in breathing comfort, constituting a multifaceted intervention that supports exercise capacity. The main advantage is enhanced exercise economy: restoration of proper intranasal anatomy reduces the work of the respiratory muscles and delays the transition to the less efficient oral airway, which directly translates into longer time to exhaustion, even if absolute VO2max values do not change dramatically. The implications for the cardiovascular system are equally important, albeit frequently overlooked. Elimination of pathomechanisms associated with chronic obstruction-such as the Euler-Liljestrand reflex or adverse interventricular interaction, allows for significant hemodynamic relief of the heart, manifested by a decrease in pulmonary artery pressure and improved left ventricular contractility. The clinical picture is accompanied by normalization of reparative processes. Increased sleep quality and restoration of the balance of the autonomic nervous system, visible in the increase in HRV parameters, are the foundation of effective post-workout recovery and psychophysical stability of the athlete, eliminating the physiological distance between patients with NSD and the healthy population.

Disclosure

Authors do not report any disclosures.

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