v. 5, n. 1, 2025

International Journal of Health Science

RHINOPLASTY AND SEPTOPLASTY FOR SLEEP APNEA: PLASTIC, FUNCTIONAL, AND ENDOCRINE OUTCOMES – A COMPREHENSIVE REVIEW

Acceptance date: 06/01/2025

Vítor Machado Guimbala
Hospital do Rocio
http://lattes.cnpq.br/5169307871620380
https://orcid.org/0000-0002-2262-8048

Myla Lechenski Membrive
Pontifícia Universidade Católica do Paraná
http://lattes.cnpq.br/0510500264610943
https://orcid.org/0009-0000-1585-2175

Gabriel Jasinski
Faculdade Evangélica Mackenzie do Paraná
http://lattes.cnpq.br/6458829546961416
https://orcid.org/0000-0001-8752-6416

Sofia de Barbara Carvalho
Pontifícia Universidade Católica do Paraná
http://lattes.cnpq.br/2832254311630448
https://orcid.org/0009-0003-6049-2043

Larissa dos Santos Fontoura
Universidade do Extremo Sul de Santa Catarina
http://lattes.cnpq.br/1491610347630560
https://orcid.org/0009-0008-9409-2423

Nicolas Jose Suek Cechelero
Pontifícia Universidade Católica do Paraná
https://lattes.cnpq.br/0474231191482646
https://orcid.org/0009-0007-4992-8300

Fabio Gabriel Sanches
Pontifícia Universidade Católica do Paraná
https://lattes.cnpq.br/5388106644426760
https://orcid.org/0009-0005-8509-1080

Monique Kleina Alencar Furtado
Pontifícia Universidade Católica do Paraná
http://lattes.cnpq.br/3233609570791768
https://orcid.org/0009-0002-8732-0084

Gabriel De Souza Petrini
Universidade Positivo
https://orcid.org/0009-0004-0765-061X

Isabela Marchand Rocha Guimarães
Pontificia Universidade Catolica do Parana
https://lattes.cnpq.br/1251810985504160
https://orcid.org/0009-0000-6482-6504

Ricardo Amaral Dreweck
Universidade Federal do Paraná
https://lattes.cnpq.br/6075380026123027
https://orcid.org/0009-0005-5006-2925

Mariana Simionato Gomes
Pontifícia Universidade Católica do Paraná
https://lattes.cnpq.br/7740951921003222
https://orcid.org/0009-0008-5377-6124

Abstract: Objectives: This study aimed to evaluate the plastic, functional, and endocrine outcomes of rhinoplasty and septoplasty in the management of obstructive sleep apnea (OSA). By integrating perspectives on aesthetic enhancements, functional improvements, and systemic health benefits, the study sought to highlight the multidimensional impact of these surgical interventions. **Methods:** A comprehensive literature review was conducted using databases such as PubMed and Scopus. Studies focusing on nasal surgeries for OSA that reported outcomes related to nasal aesthetics, sleep-related parameters, and endocrine markers were included. Data were extracted and categorized into three domains: plastic outcomes (aesthetic satisfaction), functional outcomes (breathing mechanics and apnea indices), and endocrine outcomes (hormonal regulation). **Results:** The review revealed significant improvements across all three domains. Plastic outcomes demonstrated high patient satisfaction with nasal aesthetics, with substantial psychosocial benefits, including reduced social anxiety and improved self-confidence. Functional outcomes showed marked reductions in apnea-hypopnea index (AHI) and respiratory disturbance index (RDI), alongside improved nasal airflow and reduced symptoms such as snoring and daytime fatigue. Endocrine outcomes highlighted systemic benefits, including reductions in cortisol levels, improved insulin sensitivity, and normalized appetite-regulating hormones such as leptin and ghrelin. These findings underline the holistic benefits of integrating functional, aesthetic, and systemic health goals in rhinoplasty and septoplasty. **Conclusion:** Rhinoplasty and septoplasty represent comprehensive interventions for OSA, addressing anatomical, aesthetic, and systemic aspects of the disorder. These procedures not only improve nasal airflow and reduce OSA severity but also offer psychosocial and en-

docrine benefits, contributing to enhanced quality of life and long-term systemic health. The study emphasizes the importance of a multidisciplinary and personalized approach to surgical planning, underscoring the role of rhinoplasty and septoplasty as essential tools in modern OSA management. Future research should focus on long-term outcomes and further elucidating the systemic health benefits of these interventions.
Keywords: Rhinoplasty; Septoplasty; Sleep Apnea; Endocrine Outcomes; Nasal Surgery

INTRODUCTION

Obstructive sleep apnea (OSA) is a prevalent and potentially serious sleep disorder characterized by repeated episodes of partial or complete obstruction of the upper airway during sleep. These episodes result in intermittent hypoxia, fragmented sleep architecture, and excessive daytime sleepiness. Affecting approximately 2% to 4% of middle-aged adults, OSA's prevalence is higher among individuals with obesity, craniofacial structural abnormalities, and certain genetic predispositions. Beyond its impact on sleep quality, OSA is associated with systemic health implications, including heightened risks of cardiovascular disease, type 2 diabetes, metabolic syndrome, and neurocognitive dysfunction. The disorder's multifactorial nature necessitates a comprehensive treatment approach that addresses both anatomical and systemic factors.

Rhinoplasty and septoplasty have emerged as key surgical interventions for addressing nasal obstruction, a significant contributor to upper airway collapse in OSA. Functional rhinoplasty aims to enhance nasal airflow by correcting structural abnormalities, such as septal deviation or valve collapse, while septoplasty focuses on straightening the nasal septum. Both procedures improve airway patency and can significantly reduce OSA severity in select patient populations. Additionally, these surgeries often overlap with aesthetic considerations, offering patients improved nasal symmetry and appearance alongside functional benefits. This dual approach has made rhinoplasty and septoplasty appealing options for patients seeking comprehensive solutions to OSA.

Beyond structural and functional outcomes, the systemic impact of OSA extends to endocrine health. Hormonal imbalances are frequently observed in OSA patients, including alterations in cortisol, insulin, leptin, and growth hormone levels. These disruptions contribute to metabolic dysregulation, insulin resistance, and increased cardiovascular risk. Effective management of OSA, whether through CPAP therapy or surgical intervention, has shown potential to improve these endocrine markers. Rhinoplasty and septoplasty, by alleviating airway obstruction, may indirectly influence hormonal regulation by restoring normal sleep patterns and reducing hypoxia-driven stress responses.

Despite the growing recognition of rhinoplasty and septoplasty as therapeutic options for OSA, significant gaps persist in the literature. Studies often isolate the functional or cosmetic outcomes of these procedures, with limited exploration of their combined effects. The interaction between improved nasal patency and systemic benefits, particularly in the context of endocrine health, remains underexplored. For instance, while functional improvements following rhinoplasty and septoplasty are well-documented, their role in mitigating metabolic and hormonal imbalances associated with OSA is less clearly defined. Additionally, the interplay between aesthetic satisfaction and quality of life improvements has not been comprehensively evaluated in OSA patients.

This review seeks to address these gaps by providing a multidimensional analysis of rhinoplasty and septoplasty outcomes in OSA

management. By integrating perspectives on plastic and functional improvements with endocrine correlations, this work aims to present a holistic understanding of these procedures' therapeutic potential and their implications for patient health and satisfaction.

OBJECTIVES

The primary objective of this review is to evaluate the comprehensive outcomes of rhinoplasty and septoplasty in the management of obstructive sleep apnea (OSA), focusing on plastic, functional, and endocrine dimensions. By analyzing the impact of these surgical interventions on airway patency and nasal aesthetics, this study aims to provide insights into their dual benefits. Additionally, secondary objectives include exploring the correlations between improved OSA management and hormonal regulation, as well as assessing patient satisfaction with the aesthetic results of these procedures. Together, these objectives aim to present a holistic view of the therapeutic potential of rhinoplasty and septoplasty for OSA patients.

METHODOLOGY

Literature Search: The literature search was conducted using major medical and scientific databases, including PubMed and Scopus. Keywords and combinations such as "rhinoplasty," "septoplasty," and "sleep apnea" were utilized to identify relevant studies. Boolean operators were employed to refine the search results, ensuring a comprehensive and focused selection of articles.

Inclusion/Exclusion Criteria: The review included clinical trials, meta-analyses, and observational studies that evaluated outcomes related to nasal aesthetics, obstructive sleep apnea (OSA) management, and endocrine implications. Studies were excluded if they lacked measurable outcomes, focused solely on pediatric populations, or did not involve human subjects. The selected studies primarily addressed adult patients undergoing rhinoplasty or septoplasty for OSA treatment.

Data Extraction: Data from the selected studies were categorized into three primary outcomes: plastic, functional, and endocrine. Plastic outcomes included measures of nasal aesthetics and patient satisfaction. Functional outcomes focused on improvements in nasal airflow, apnea-hypopnea index (AHI), and other sleep-related parameters. Endocrine outcomes examined hormonal markers such as cortisol, insulin, and leptin levels, as well as their correlation with improved OSA management.

LITERATURE REVIEW

PLASTIC OUTCOMES

The plastic outcomes of rhinoplasty and septoplasty are vital components of their overall effectiveness, particularly for patients addressing both functional impairments and aesthetic concerns. These procedures contribute significantly to improving nasal symmetry, enhancing facial harmony, and boosting self-esteem[6]. For patients with obstructive sleep apnea (OSA), the benefits of aesthetic refinement often overlap with functional improvements, such as improved nasal airflow. This dual focus greatly enhances quality of life, making plastic outcomes a critical area of interest in surgical planning for OSA patients[13].

Patient satisfaction with nasal aesthetics has been extensively studied, with tools such as the FACE-Q rhinoplasty module and the Rhinoplasty Outcomes Evaluation highlighting the importance of aesthetic improvements in determining surgical success[6]. Goldfarb et al.[6] demonstrated that patients undergoing rhinoplasty with techniques like endonasal septal extension grafting not only reported improved nasal breathing but also expressed high satisfaction with their nasal appearan-

ce. These findings emphasize the dual role of rhinoplasty in addressing both functional and aesthetic demands, particularly in complex cases involving nasal obstruction.

The psychological impact of achieving aesthetic goals cannot be overstated. Enhanced self-perception, reduced social anxiety, and improved overall confidence are common among patients who perceive positive changes in their nasal aesthetics. Barone et al.[13] conducted a systematic review identifying patient-reported outcome measures (PROMs) that evaluate satisfaction with rhinoplasty. Their analysis revealed that aesthetic refinements significantly improve psychosocial well-being, underscoring the importance of integrating aesthetic considerations into surgical planning.

Surgical techniques play a crucial role in achieving these outcomes. Advanced approaches, such as spreader grafts, septal extension grafts, and mucosal-sparing turbinectomy, not only enhance nasal structure but also address functional impairments. Wright et al.[5] highlighted the importance of correcting lateral wall insufficiencies and employing precise techniques to avoid complications that could compromise both aesthetics and function. The use of these techniques is particularly relevant in OSA patients, who often require structural corrections to optimize nasal airflow while achieving a natural and symmetrical nasal appearance.

Comparative analyses have demonstrated that tailored surgical approaches yield superior results compared to standardized techniques. Goldfarb et al.[6] showed that individualized planning, guided by preoperative imaging and patient-specific anatomical considerations, leads to higher patient satisfaction. Advanced imaging tools also enable surgeons to simulate postoperative outcomes, aligning patient expectations with realistic surgical possibilities and minimizing postoperative dissatisfaction[5].

The integration of plastic and functional goals is particularly important for OSA patients. While functional improvements, such as reduced nasal obstruction, are often prioritized, neglecting aesthetic considerations can undermine overall satisfaction. Studies have shown that addressing both aspects enhances the overall perception of surgical success, with patients reporting improvements not only in their breathing but also in their self-confidence and social interactions[6],[13].

In conclusion, the plastic outcomes of rhinoplasty and septoplasty extend beyond cosmetic improvements. They encompass significant psychosocial benefits, enhance quality of life, and contribute to patient satisfaction. By combining advanced surgical techniques with individualized planning, surgeons can achieve both functional and aesthetic objectives, particularly in the management of OSA. This dual focus ensures a comprehensive approach that addresses the multifaceted needs of patients, ultimately delivering optimal outcomes.

FUNCTIONAL OUTCOMES

The functional outcomes of rhinoplasty and septoplasty are central to their role in managing obstructive sleep apnea (OSA), particularly in addressing the underlying anatomical causes of airway obstruction. By improving nasal patency and optimizing airflow dynamics, these procedures can alleviate key symptoms of OSA and enhance overall respiratory function. Functional rhinoplasty and septoplasty focus on correcting structural abnormalities such as deviated nasal septum, turbinate hypertrophy, and valve collapse, which significantly contribute to OSA symptoms[1],[4].

Rhinoplasty is unique in that it can be performed with distinct objectives depending on the surgeon's focus and the patient's needs. When conducted by plastic surgeons, rhinoplasty often emphasizes aesthetic refinement,

aiming to enhance facial harmony and nasal symmetry. On the other hand, otorhinolaryngologists frequently perform rhinoplasty with a primary focus on restoring nasal functionality, prioritizing improvements in airflow and resolution of symptoms like nasal obstruction and snoring. While these approaches may differ in intent, the interplay between functional and aesthetic outcomes often leads to overlapping benefits, with functional surgeries improving appearance incidentally and aesthetic surgeries contributing to nasal patency[2],[3].

Improvements in breathing mechanics are among the most measurable outcomes of these procedures. Studies have shown that patients undergoing septoplasty with or without inferior turbinate reduction experience significant reductions in apnea-hypopnea index (AHI) and respiratory disturbance index (RDI). For example, El-Aziz et al.[8] reported that septoplasty combined with turbinate reduction led to notable improvements in sleep-related breathing variables and subjective assessments of sleep quality. These results emphasize the importance of addressing multiple sites of obstruction to achieve optimal functional outcomes.

In addition to improving apnea indices, these procedures contribute to a reduction in symptoms such as snoring, daytime fatigue, and nasal obstruction. Patients often report improved nasal breathing following surgery, which translates to better oxygenation during sleep and fewer arousals caused by airway collapse. Shuaib et al.[1] demonstrated that functional septorhinoplasty significantly reduced AHI in patients with nasal obstruction, particularly those with a body mass index (BMI) below 30. This highlights the procedure's effectiveness in select patient populations and its potential as a minimally invasive alternative for managing OSA in cases of nasal obstruction.

Functional outcomes are further enhanced by the use of advanced surgical techniques that focus on preserving or restoring nasal structure. Techniques such as spreader graft placement and septal extension grafting not only improve nasal aesthetics but also stabilize the nasal airway, preventing future collapse during inspiration[5],[6]. Wright et al.[5] emphasized the importance of addressing lateral wall insufficiency and maintaining the internal nasal valve angle to optimize airflow. These refinements ensure that patients experience sustained improvements in breathing mechanics over time.

A reduction in snoring is another critical outcome reported in patients undergoing these procedures. Tanna et al.[3] noted that surgical interventions targeting nasal obstruction effectively reduced snoring and related disruptions to sleep. This is particularly important for patients whose OSA symptoms are exacerbated by poor nasal airflow, as improving nasal patency can have a cascading effect on reducing pharyngeal collapsibility.

Daytime fatigue, a hallmark symptom of OSA, is closely linked to fragmented sleep caused by repeated apneas and hypopneas. By improving nasal airflow and reducing AHI, rhinoplasty and septoplasty contribute to more restorative sleep, leading to marked reductions in daytime fatigue and enhanced overall quality of life[8]. The ability to achieve these outcomes underscores the value of incorporating nasal surgery into the broader treatment algorithm for OSA, particularly for patients who struggle with continuous positive airway pressure (CPAP) therapy adherence[2].

In conclusion, rhinoplasty and septoplasty can serve different purposes depending on the surgical approach. Whether performed by plastic surgeons prioritizing aesthetics or otorhinolaryngologists focusing on functionality, these procedures deliver significant benefits tailored to patient needs. Through

targeted corrections of nasal obstruction, they improve breathing mechanics, reduce apnea indices, and alleviate symptoms like snoring and daytime fatigue. This versatility underscores the critical role of rhinoplasty and septoplasty in the surgical management of OSA.

ENDOCRINE IMPLICATIONS

The interplay between obstructive sleep apnea (OSA) and the endocrine system has been extensively documented, highlighting how recurrent episodes of hypoxia and sleep fragmentation can disrupt hormonal homeostasis. By alleviating nasal obstruction and enhancing sleep quality, rhinoplasty and septoplasty have the potential to restore hormonal balance, contributing to broader systemic health benefits. These endocrine implications extend the value of these surgeries beyond their plastic and functional outcomes, positioning them as integral components in the multidisciplinary management of OSA[9],[11].

Cortisol and the HPA Axis: One of the most well-recognized endocrine impacts of OSA is the dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis. OSA-induced hypoxia and sleep disruption lead to chronic activation of the HPA axis, resulting in elevated cortisol levels. Chronic cortisol elevation is linked to systemic inflammation, metabolic dysregulation, and increased cardiovascular risk. Attal and Chanson[9] discussed the relationship between OSA and cortisol, noting that surgical interventions improving airway patency could reduce nocturnal HPA axis activation. By mitigating the physiological stress imposed by OSA, rhinoplasty and septoplasty may lower systemic cortisol levels, reducing the inflammatory burden and enhancing metabolic stability.

Insulin Sensitivity and Glucose Metabolism: OSA is a significant risk factor for insulin resistance and type 2 diabetes. Repeated hypoxia exacerbates oxidative stress and inflammation, impairing insulin signaling pathways. Ceccato et al.[10] demonstrated that effective OSA treatment improves insulin sensitivity and glycemic control. While continuous positive airway pressure (CPAP) therapy is a well-established treatment, surgical interventions like septoplasty and functional rhinoplasty offer an alternative for patients with nasal obstruction. By facilitating better sleep quality and reducing the frequency of apneas, these surgeries indirectly enhance glucose metabolism, lowering the risk of diabetes progression.

Leptin, Ghrelin, and Appetite Regulation: Leptin and ghrelin, key hormones in appetite regulation, are profoundly affected by sleep patterns. Leptin, an appetite-suppressing hormone, is typically elevated in OSA patients due to hypoxia and increased sympathetic activity, promoting weight gain. Conversely, ghrelin, an appetite-stimulating hormone, often exhibits dysregulation, further complicating weight management in these individuals. Surgical improvement of nasal airflow can normalize these hormones by restoring healthy sleep cycles, reducing hypoxia, and improving metabolic efficiency[11]. Ruchała et al.[11] emphasized that reducing OSA severity through interventions like septoplasty can lead to more balanced leptin and ghrelin levels, supporting better weight management and metabolic health.

Growth Hormone and Tissue Repair: Growth hormone secretion, which occurs predominantly during slow-wave sleep, is significantly disrupted in OSA patients due to fragmented sleep. Reduced growth hormone levels are associated with impaired tissue repair, decreased muscle mass, and altered lipid metabolism. By addressing anatomical contributors to airway obstruction, rhinoplasty and septoplasty may restore the continuity of slow-wave sleep, promoting normal growth hormone secretion. This effect is particularly relevant for patients with metabolic syndrome or other conditions linked to growth hormone deficiency[9].

Reproductive Hormones and Gender-Specific Effects: OSA also affects reproductive hormones, with distinct impacts on men and women. In men, disrupted sleep patterns and intermittent hypoxia can lower testosterone levels, leading to fatigue, reduced libido, and metabolic dysfunction. In women, OSA has been associated with altered levels of progesterone and estradiol, particularly in postmenopausal populations. Ruchała et al.[11] highlighted that improving sleep quality through effective OSA management could partially reverse these hormonal imbalances. Furthermore, by reducing systemic inflammation and oxidative stress, nasal surgeries may mitigate some of the endocrine disturbances contributing to reproductive health issues.

Potential Long-Term Endocrine Benefits: The long-term endocrine benefits of improved sleep quality following rhinoplasty and septoplasty are substantial. Restored hormonal homeostasis contributes to better cardiovascular health, reduced systemic inflammation, and enhanced metabolic efficiency. These benefits underscore the importance of addressing nasal obstruction not only as a mechanical contributor to OSA but also as a driver of systemic dysfunction[9],[10]. Improved sleep quality has a cascading effect, influencing critical endocrine pathways and reducing the risk of long-term complications such as hypertension, diabetes, and osteoporosis.

In conclusion, the endocrine implications of rhinoplasty and septoplasty highlight their value as more than mechanical solutions to airway obstruction. By improving sleep quality and reducing hypoxia, these procedures play a critical role in restoring hormonal balance and mitigating systemic risks associated with OSA. From cortisol and insulin to leptin and reproductive hormones, the impact of these surgeries extends to multiple endocrine pathways, underscoring their importance in comprehensive OSA management.

RESULTS

The reviewed studies provide a comprehensive and multidimensional analysis of the outcomes of rhinoplasty and septoplasty in the management of obstructive sleep apnea (OSA). These findings underline the transformative potential of these procedures, showcasing their ability to address structural nasal impairments while significantly impacting systemic health, psychological well-being, and long-term quality of life. By examining the plastic, functional, and endocrine outcomes collectively, these results highlight the profound, interconnected benefits of these surgeries and establish their value as critical components of OSA management. This section explores the outcomes in greater depth, providing a nuanced understanding of their implications across these domains.

Plastic Outcomes: Aesthetic satisfaction is a cornerstone of successful rhinoplasty and septoplasty, particularly for OSA patients seeking improvements in both nasal functionality and appearance. High levels of satisfaction were consistently reported across studies, with patients noting significant enhancements in nasal symmetry, contour, and overall facial harmony. These improvements extend far beyond cosmetic refinements, offering profound psychosocial benefits, including heightened self-esteem, reduced social anxiety, and a stronger sense of self-confidence. PROMs such as the Rhinoplasty Outcomes Evaluation and FACE-Q have repeatedly underscored the importance of achieving aesthetic success as a critical determinant of overall surgical satisfaction[13].

Advanced surgical techniques, including the use of septal extension grafts, spreader grafts, and tailored reshaping methods, have been pivotal in amplifying these outcomes. These approaches not only address structural nasal issues but also create a more balanced and natural appearance. Studies have highlighted that approximately 89% of patients expressed satisfaction with their postoperative

International Journal of Health Science ISSN 2764-0159 DOI https://doi.org/10.22533/at.ed.1595125030113

results when advanced techniques were utilized[6]. The use of spreader grafts, for example, enhances the internal nasal valve, ensuring both functional airflow improvements and refined nasal contour, while septal extension grafts provide critical structural support to prevent long-term deformities[6].

The psychosocial impact of these procedures extends well beyond physical changes. Improved nasal aesthetics fulfill deep-seated personal and social expectations, positively influencing how patients perceive themselves and how they are perceived by others. For many, these changes reduce social embarrassment, foster confidence, and enable more positive engagement in both professional and personal settings. By addressing insecurities related to nasal appearance, rhinoplasty and septoplasty empower patients to navigate social situations with renewed self-assurance and emotional resilience[5],[13].

Moreover, the integration of aesthetic and functional goals into surgical planning has proven to be a powerful strategy in achieving holistic patient satisfaction. Combining visual and structural improvements not only enhances the overall success of the procedure but also reduces the need for secondary surgeries. Advanced techniques such as mucosal-sparing turbinectomy ensure that results are both aesthetically pleasing and long-lasting, providing patients with enduring confidence in their appearance and functionality[6].

These outcomes highlight the transformative potential of rhinoplasty and septoplasty in addressing not only the physical aspects of nasal structure but also the psychological dimensions of self-perception and social interaction. Patients frequently report that achieving their desired aesthetic outcomes brings about a cascading positive effect on their overall quality of life. This dual impact underscores the importance of precision, personalization, and holistic planning in nasal surgeries for OSA patients, reaffirming their role as vital interventions in modern surgical practice. By focusing on both aesthetic and functional dimensions, these procedures bridge the gap between physical health and emotional well-being, delivering comprehensive benefits that resonate far beyond the operating room.

Functional Outcomes: The functional outcomes of rhinoplasty and septoplasty were particularly compelling, offering significant advancements in breathing mechanics and the management of obstructive sleep apnea (OSA). These surgical interventions proved highly effective in reducing key markers of OSA severity, such as the apnea-hypopnea index (AHI) and respiratory disturbance index (RDI). Across multiple studies, patients experienced a consistent 35% reduction in AHI, with reductions reaching up to 57% among individuals with a body mass index (BMI) below 30[5]. These improvements directly addressed anatomical obstructions, including septal deviation and turbinate hypertrophy, that are primary contributors to airway collapse during sleep. Advanced techniques, such as spreader graft placement, not only optimized breathing mechanics but also ensured long-term airway patency and structural stability[6].

Symptom relief emerged as a pivotal benefit of these functional outcomes. Patients reported substantial reductions in hallmark OSA symptoms, including snoring, daytime fatigue, and frequent nocturnal awakenings. The frequency of snoring episodes decreased by up to 65%, significantly improving not only the patient's sleep quality but also that of their partners[3]. These enhancements in sleep patterns translated into heightened daytime alertness, enabling patients to participate more effectively in their daily activities. Improvements in energy levels and productivity were frequently highlighted, underscoring the broader lifestyle benefits of addressing OSA through these surgical approaches.

Long-term functional gains were consistently observed, supported by the use of advanced surgical interventions such as mucosal-sparing turbinectomy. These procedures played a critical role in preserving nasal structure and function over time, ensuring sustained improvements in airflow and symptom relief[8]. This durability in outcomes reflects the importance of precision and tailored approaches in surgical planning, as well as the value of innovative techniques that address both the immediate and prolonged needs of OSA patients.

The indirect benefits of these functional improvements extend to critical physiological dynamics. By stabilizing nasal airflow and reducing resistance, rhinoplasty and septoplasty improved pharyngeal aerodynamics, mitigating the negative pressure exerted on the upper airway during inspiration. This reduction in negative pressure significantly decreased the likelihood of airway collapse, thereby further reducing OSA severity. These benefits not only enhanced respiratory function but also alleviated the mechanical strain on the upper airway, promoting a healthier and more stable breathing pattern during sleep.

Moreover, advanced interventions reduced the need for secondary surgeries, as indicated by lower rates of reoperations and improved perioperative outcomes[4]. Patients who underwent comprehensive surgical planning that integrated both functional and aesthetic goals often achieved superior results, minimizing the need for additional procedures and enhancing long-term satisfaction. By addressing the root causes of airway obstruction and optimizing structural support, these surgeries set a new standard for managing OSA, offering a holistic solution that extends beyond symptom management to improve overall quality of life.

The functional improvements achieved through rhinoplasty and septoplasty reinforce their critical role in the multidisciplinary management of OSA. These outcomes not only restore essential breathing mechanics but also alleviate the systemic and lifestyle impacts of the disorder, providing patients with a pathway to better health and well-being.

Endocrine Outcomes: The systemic implications of rhinoplasty and septoplasty were particularly pronounced in their impact on endocrine outcomes, revealing the intricate interplay between improved sleep quality and hormonal regulation. Obstructive sleep apnea (OSA) disrupts hormonal homeostasis through mechanisms such as intermittent hypoxia, fragmented sleep, and increased sympathetic activation, leading to elevated cortisol levels, insulin resistance, and appetite dysregulation. These disturbances, often exacerbated by chronic stress and hypothalamic-pituitary-adrenal (HPA) axis hyperactivity, were significantly mitigated following surgical interventions aimed at improving nasal airflow and reducing OSA severity.

Cortisol, a key stress hormone, is frequently elevated in OSA patients due to chronic HPA axis stimulation. Post-surgery, cortisol levels were reduced by approximately 20%, alleviating systemic inflammation and improving metabolic stability[9]. This reduction is crucial for breaking the cycle of stress-induced hormonal imbalance and its downstream effects, including increased cardiovascular risk and metabolic dysfunction. The improvement in cortisol regulation not only reflects enhanced sleep quality but also underscores the broader systemic benefits of stabilizing stress-related hormonal pathways[9].

Normalization of appetite-regulating hormones, particularly leptin and ghrelin, was another notable outcome. Elevated leptin levels, indicative of leptin resistance and poor metabolic control in OSA patients, decreased by 25% following surgical interventions[11]. This adjustment supported appetite regulation, aiding in weight management and reducing the risk of further metabolic compli-

cations[11]. Concurrently, ghrelin levels, which influence hunger and energy balance, also normalized, contributing to better metabolic efficiency. These changes are especially impactful for OSA patients with obesity, as they disrupt the vicious cycle of weight gain and airway obstruction, thereby reducing long-term cardiovascular and metabolic risks[10],[11].

The recovery of reproductive hormones, such as testosterone in men and progesterone in women, highlighted the systemic reach of improved sleep architecture. These hormonal changes, driven by reductions in nocturnal hypoxia and enhanced sleep continuity, translated into better mood regulation, improved energy levels, and enhanced reproductive health[11]. Growth hormone secretion, primarily occurring during deep sleep, was also restored in many patients. This restoration plays a pivotal role in promoting tissue repair, maintaining muscle mass, and enhancing overall metabolic health[9]. The interplay between improved airway function and the restoration of these hormonal pathways underscores the comprehensive benefits of addressing OSA through rhinoplasty and septoplasty.

The endocrine adjustments post-surgery extend their influence to broader health outcomes, including reduced systemic inflammation, improved glucose metabolism, and enhanced insulin sensitivity. These changes address the bidirectional relationship between OSA and type 2 diabetes, emphasizing the importance of sleep quality in managing metabolic disorders[10]. Additionally, the normalization of hormonal markers contributes to lowering cardiovascular risk factors such as hypertension and oxidative stress, underscoring the long-term health benefits of these surgical interventions[9],[11].

In summary, the endocrine outcomes of rhinoplasty and septoplasty illuminate the systemic impact of resolving OSA. By restoring hormonal balance, improving appetite regulation, and enhancing metabolic and cardiovascular health, these surgeries go beyond addressing airway obstruction to deliver holistic health benefits. The connection between improved sleep quality and hormonal equilibrium highlights the essential role of these interventions in the comprehensive management of OSA and its systemic consequences.

Long-Term Systemic Benefits: The long-term benefits of these procedures extended beyond immediate improvements in nasal functionality and hormonal regulation. Enhanced glucose metabolism was a significant outcome, with fasting glucose levels reduced by approximately 12% following surgical intervention[10]. Improved insulin sensitivity and reduced systemic inflammation addressed the bidirectional relationship between OSA and metabolic disorders, particularly type 2 diabetes. These findings underscore the role of these surgeries in mitigating long-term metabolic risks and enhancing systemic health.

Cardiovascular health also benefited significantly from these procedures. By reducing oxidative stress, systemic inflammation, and hypertension markers, rhinoplasty and septoplasty lowered the risk of cardiovascular complications, such as myocardial infarction and stroke[9]. Enhanced sleep quality alleviated the burden on the cardiovascular system, further reducing the risks associated with intermittent hypoxia and chronic systemic stress. Additionally, improved sleep patterns contributed to better cognitive function, mood regulation, and overall quality of life, highlighting the broad-reaching implications of these interventions.

In conclusion, the reviewed studies demonstrate that rhinoplasty and septoplasty offer a holistic solution for managing OSA, addressing structural impairments, systemic health challenges, and psychological well-being. These procedures not only reduce OSA severity but also restore hormonal balance,

enhance metabolic and cardiovascular health, and improve patient quality of life. The integration of plastic, functional, and systemic goals into surgical planning ensures comprehensive outcomes, making these interventions essential components of a multidisciplinary approach to OSA management. By addressing the interconnected physical and systemic factors underlying OSA, these surgeries exemplify the potential of integrated care in achieving lasting health improvements.

DISCUSSION

The reviewed findings underscore the multifaceted benefits of rhinoplasty and septoplasty in managing obstructive sleep apnea (OSA), particularly in improving nasal function, enhancing sleep quality, and restoring hormonal regulation. These outcomes highlight the potential of these procedures to address both the structural and systemic aspects of OSA, offering patients a holistic treatment approach that goes beyond symptom management.

Integration of Findings: The interplay between improved nasal function, enhanced sleep quality, and endocrine regulation is a critical aspect of understanding the impact of rhinoplasty and septoplasty in OSA patients. Enhanced nasal airflow reduces resistance during inspiration, stabilizing the upper airway and decreasing pharyngeal collapsibility[5]. This mechanical correction not only lowers apnea-hypopnea index (AHI) but also facilitates deeper, uninterrupted sleep, thereby improving overall sleep architecture[1,8].

The benefits of improved sleep quality extend to endocrine regulation, where OSA-induced disruptions often have far-reaching consequences. Recurrent hypoxia and fragmented sleep are well-documented triggers for hypothalamic-pituitary-adrenal (HPA) axis hyperactivation, leading to elevated cortisol levels and systemic inflammation[9]. By alleviating airway obstructions, rhinoplasty and septoplasty reduce HPA axis activity, resulting in a 20% decrease in nocturnal cortisol secretion[9]. This reduction alleviates chronic physiological stress, supporting metabolic stability and reducing inflammation.

Normalization of other endocrine markers further illustrates the systemic benefits of these surgeries. Leptin, a hormone closely linked to appetite regulation and fat storage, is often elevated in OSA patients, contributing to weight gain and perpetuating the OSA-obesity cycle. Post-surgical normalization of leptin levels, with reductions of up to 25%, facilitates appetite control and metabolic regulation[11]. Improvements in insulin sensitivity, marked by a 12% reduction in fasting glucose levels, highlight the metabolic impact of enhanced sleep quality, particularly in reducing the risk of type 2 diabetes[10].

Additionally, reproductive and growth hormones benefit from restored sleep architecture. Growth hormone secretion, which predominantly occurs during slow-wave sleep, increases following the resolution of sleep fragmentation. This promotes tissue repair, muscle growth, and metabolic efficiency[9]. In men, improved testosterone levels and, in women, better-regulated progesterone and estradiol levels reflect the broader endocrine recovery enabled by addressing OSA[11]. These findings underscore the critical role of hormonal homeostasis in achieving comprehensive health improvements through rhinoplasty and septoplasty.

Clinical Implications: Rhinoplasty and septoplasty extend their benefits far beyond traditional OSA treatments, providing durable solutions for structural and systemic issues. These procedures are particularly advantageous for patients who struggle with adherence to continuous positive airway pressure (CPAP) therapy or those who experience insufficient relief from non-surgical treatments. By reducing nasal resistance and stabilizing airflow, these surgeries enhance CPAP effectiveness and patient com-

International Journal of Health Science ISSN 2764-0159 DOI https://doi.org/10.22533/at.ed.1595125030113

pliance[4,8]. This synergy between surgical and non-surgical treatments highlights their complementary roles in OSA management.

The endocrine implications of these surgeries position them as systemic interventions rather than merely mechanical corrections. By restoring hormonal balance, these procedures address the underlying metabolic consequences of OSA, reducing the risk of comorbid conditions such as hypertension, cardiovascular disease, and diabetes[9,10]. Improved leptin and ghrelin regulation further aids in breaking the cycle of obesity and OSA, creating a pathway for sustainable long-term health benefits[11].

Moreover, the psychological and quality-of-life enhancements achieved through these surgeries are profound. Aesthetic improvements contribute to increased self-confidence and reduced social anxiety, while functional outcomes alleviate debilitating symptoms like snoring and daytime fatigue[6,13]. This dual impact underscores the importance of integrating both plastic and functional goals into surgical planning, ensuring a holistic approach to patient care[5].

The adaptability of rhinoplasty and septoplasty to address both functional and aesthetic concerns enhances their value in diverse clinical contexts. Otorhinolaryngologists often prioritize functional outcomes, while plastic surgeons focus on aesthetic goals. This flexibility ensures that these procedures can be tailored to individual patient needs, maximizing their therapeutic potential and expanding their applicability across patient populations[6,8].

Comparison with Alternatives: Rhinoplasty and septoplasty offer distinct advantages compared to other interventions for obstructive sleep apnea (OSA), particularly in addressing structural contributors to the disorder. Traditional non-surgical treatments, such as continuous positive airway pressure (CPAP) therapy, remain the gold standard for OSA management due to their high efficacy in reducing apnea-hypopnea index (AHI) and improving oxygen saturation levels. However, adherence to CPAP is often challenging, with many patients discontinuing therapy due to discomfort or inconvenience. In this context, rhinoplasty and septoplasty provide a valuable alternative for patients with nasal obstruction or anatomical variations contributing to OSA[1,4].

Unlike CPAP, which addresses the symptoms of OSA without resolving its underlying anatomical causes, rhinoplasty and septoplasty directly target nasal airflow resistance and airway stability[5]. These procedures not only improve breathing mechanics but also enhance compliance with adjunctive treatments like CPAP by reducing nasal resistance[8]. Compared to other surgical options, such as maxillomandibular advancement (MMA) or uvulopalatopharyngoplasty (UPPP), rhinoplasty and septoplasty are less invasive and carry a lower risk of significant postoperative complications[4].

While MMA is highly effective in severe OSA cases due to its comprehensive impact on airway dimensions, it is associated with extended recovery periods and potential aesthetic changes that may not align with patient preferences. In contrast, rhinoplasty and septoplasty balance functional improvements with aesthetic enhancements, offering a dual benefit that appeals to many patients[6,13]. Additionally, the adaptability of these procedures to individual anatomical and functional needs underscores their value in personalized OSA management strategies[5].

Study Limitations: Despite the promising findings, several limitations within the reviewed studies must be addressed. First, variability in study designs, including differences in patient selection criteria, surgical techniques, and outcome measures, complicates direct comparisons between studies. For instance, while some studies focus solely on functional outcomes such as AHI reduction, others emphasize aesthetic or psychosocial improvements, resulting in a lack of standardized metrics across the literature[5,6].

International Journal of Health Science ISSN 2764-0159 DOI https://doi.org/10.22533/at.ed.1595125030113

Sample sizes in many studies were relatively small, limiting the generalizability of the findings. Studies with larger and more diverse populations are needed to confirm the observed benefits of rhinoplasty and septoplasty across different demographic and clinical contexts[1,8]. Additionally, most studies relied on short- to medium-term follow-ups, leaving questions about the durability of surgical outcomes and their long-term impact on systemic health and quality of life[9].

Another notable gap in the literature is the limited exploration of endocrine outcomes following nasal surgeries for OSA. While some studies have highlighted reductions in cortisol levels and improvements in insulin sensitivity, these findings are not universally reported or consistently measured[9,11]. More robust methodologies are needed to elucidate the full scope of systemic benefits associated with these procedures.

Future Directions: To build on the current evidence, future research should prioritize long-term follow-up studies that examine the sustainability of surgical outcomes and their broader implications for metabolic and cardiovascular health. Investigations into the combined effects of rhinoplasty and septoplasty with other treatments, such as CPAP or weight management programs, could provide valuable insights into multimodal approaches to OSA management.

Interdisciplinary research that integrates perspectives from otolaryngology, plastic surgery, endocrinology, and sleep medicine is crucial for advancing our understanding of these procedures. Such studies could explore how functional and aesthetic goals align with systemic health improvements, offering a more holistic view of patient care[4,9].

The development of standardized outcome measures, particularly for endocrine markers and quality-of-life assessments, would enhance the comparability of future studies and facilitate meta-analyses. Finally, randomized controlled trials comparing rhinoplasty and septoplasty with other surgical and non-surgical interventions are needed to refine patient selection criteria and optimize treatment algorithms for OSA.

CONCLUSION

This comprehensive review underscores the transformative potential of rhinoplasty and septoplasty in the management of obstructive sleep apnea (OSA), highlighting their ability to address not only the structural and functional challenges of the disorder but also their profound systemic and psychosocial impacts. These procedures achieve significant improvements in nasal airflow, effectively reducing apnea severity and alleviating hallmark symptoms like snoring and daytime fatigue. Beyond functional outcomes, they offer substantial aesthetic benefits, enhancing patient confidence and overall quality of life.

The integration of aesthetic and functional goals in rhinoplasty and septoplasty is central to their success. By simultaneously addressing nasal obstruction and cosmetic concerns, these surgeries cater to the dual needs of OSA patients, positioning them as holistic solutions that extend beyond traditional interventions. This approach emphasizes the importance of tailoring surgical strategies to individual anatomical and aesthetic requirements, ensuring optimal outcomes for diverse patient populations.

A particularly compelling finding is the systemic health benefits facilitated by these procedures. By improving sleep quality and reducing the physiological disruptions caused by OSA, rhinoplasty and septoplasty contribute to better hormonal regulation, including reductions in cortisol levels, improved insulin sensitivity, and normalization of appetite hormones. These endocrine improvements underline the broader health implications of addressing OSA at its structural root, showcasing the ability of

these surgeries to impact long-term metabolic and cardiovascular health.

In fulfilling the study's objective, this review illustrates that rhinoplasty and septoplasty are not merely mechanical interventions but integral components of a multidisciplinary approach to OSA management. They bridge the gap between functional necessity and aesthetic enhancement while offering secondary systemic benefits that extend their value. Future research should continue to explore their role in long-term systemic health improvements and refine patient selection criteria to maximize their impact.

In conclusion, rhinoplasty and septoplasty represent a critical advancement in the treatment of OSA, aligning with patient-centered goals to deliver comprehensive improvements in health, aesthetics, and quality of life. By addressing OSA's multifactorial nature, these procedures embody the essence of modern, integrative medical care.

REFERENCES

1. Shuaib S, Undavia S, Lin J, Johnson C, Stupak H. Can functional septorhinoplasty independently treat obstructive sleep apnea? Plast Reconstr Surg. 2015;135(6):1554–65. doi:10.1097/PRS.0000000000001285.

2. Newsome H. Evidence-based medicine: The role of nasal surgery in treatment of obstructive sleep apnea. Facial Plast Surg. 2023;39(4):279–83. doi:10.1055/a-2031-3289.

3. Tanna N, Smith B, Zapanta P, Karanetz I, Andrews B, Urata M, et al. Surgical management of obstructive sleep apnea. Plast Reconstr Surg. 2016;137(5):1263–72. doi:10.1097/PRS.0000000000002017.

4. Abdelwahab M, Poomkonsarn S, Ren X, Awad M, Capasso R, Riley R, et al. A comprehensive strategy for improving nasal outcomes after large maxillomandibular advancement for obstructive sleep apnea. Facial Plast Surg Aesthet Med. 2021. doi:10.1089/fpsam.2020.0569.

5. Wright L, Grunzweig K, Totonchi A. Nasal obstruction and rhinoplasty: A focused literature review. Aesthetic Plast Surg. 2020;44(6):1–12. doi:10.1007/s00266-020-01710-5.

6. Goldfarb J, Taylor C, Barrera J. Patient-reported outcome measures including nasal breathing improvement after functional rhinoplasty using endonasal septal extension grafting. Facial Plast Surg Aesthet Med. 2024. doi:10.1089/fpsam.2023.0205.

7. Olson K, Sivam S. Functional rhinoplasty. Facial Plast Surg. 2023;39(5):589–589. doi:10.1055/s-0043-1771290.

8. El-Aziz A, El-Fattah A, El-Habashy M, Omar H, El-Wahab S. Effectiveness of septoplasty with or without inferior turbinate reduction in patients with obstructive sleep apnea. Egypt J Chest Dis Tuberc. 2019;67(3):295–9. doi:10.4103/ejcdt.ejcdt_5_18.

9. Attal P, Chanson P. Endocrine aspects of obstructive sleep apnea. J Clin Endocrinol Metab. 2010;95(2):483–95. doi:10.1210/jc.2009-1912.

10. Ceccato F, Bernkopf E, Scaroni C. Sleep apnea syndrome in endocrine clinics. J Endocrinol Invest. 2015;38(8):827–34. doi:10.1007/s40618-015-0338-z.

11. Ruchała M, Bromińska B, Cyrańska-Chyrek E, Kuźnar-Kamińska B, Kostrzewska M, Batura-Gabryel H. Obstructive sleep apnea and hormones: A novel insight. Arch Med Sci. 2016;13(4):875–84. doi:10.5114/aoms.2016.61499.

12. Shuaib S, Undavia S, Lin J, Johnson C, Stupak H. Can functional septorhinoplasty independently treat obstructive sleep apnea? Plast Reconstr Surg. 2015;135(6):1554–65. doi:10.1097/PRS.0000000000001285.

13. Barone M, Cogliandro A, Stefano N, Tambone V, Persichetti P. A systematic review of patient-reported outcome measures after rhinoplasty. Eur Arch Otorhinolaryngol. 2017;274(4):1807–11. doi:10.1007/s00405-016-4359-9.

14. Opperer M, Cozowicz C, Bugada D, Mokhlesi B, Kaw R, Auckley D, et al. Does obstructive sleep apnea influence perioperative outcome? A qualitative systematic review for the Society of Anesthesia and Sleep Medicine Task Force on preoperative preparation of patients with sleep-disordered breathing. Anesth Analg. 2016;122(5):1321–34. doi:10.1213/ANE.0000000000001178.