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# Impact of Upper Lateral Cartilage Preservation in Open Preservation Rhinoplasty on Internal Nasal Valve Function

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## Abstract

**Background and Objectives:** Open preservation rhinoplasty is a surgical technique that aims to enhance both the aesthetic and functional aspects of the nose. Preservation of the upper lateral cartilages plays a crucial role in maintaining the structural integrity and function of the internal nasal valve. This study aimed to evaluate the impact of preserving the upper lateral cartilages on internal nasal valve function in open preservation rhinoplasty procedures, specifically focusing on the internal nasal valve .

**Methods:** A non-randomized clinical trial between April 2022 and January 2023 was conducted in the Sulaimani region of Kurdistan, Iraq, involving 36 adult patients undergoing OPR. Data collection included preoperative and postoperative assessments using the NOSE questionnaire, along with physical examinations at 9 days, 3 months, and 6 months post-surgery, and photographs 3 months post operative.

**Results:** The results showed significant improvements in functional outcomes, including nasal stuffiness or congestion, nasal obstruction, breathing problems through the nose, sleeping problems, and breathing problems during exercise. These improvements were statistically significant (p=0.001). Based on the Rhinoplasty Outcome Evaluation (ROE), significant differences were observed in nasal shape, nasal breathing, friends' and acquaintances' approval of the surgery, unrestricted social activities, the aesthetic and structural appearance of the nose, and the reasons for seeking nasal shape alteration or rhinoplasty.

**Conclusion:** Preservation of ULCs in OPR procedures positively impacts internal nasal valve function, as demonstrated by improved postoperative outcomes. This technique maintains nasal structure integrity and INV function, leading to favorable functional and aesthetic results.

**Keywords:** Internal nasal valve, Functional outcomes, Nasal wall function, Open preservation, Rhinoplasty, Upper lateral cartilage

## Introduction

Rhinoplasty, also known as nose reshaping surgery, is a cosmetic procedure that aims to improve the appearance and functionality of the nose. It involves the modification of the nose's shape, size, and symmetry, often to correct structural issues or to enhance the overall facial aesthetics (1). The procedure can be performed using various techniques, including open rhinoplasty, closed rhinoplasty, and dorsal preservation rhinoplasty (2, 3).

The concept of preservation rhinoplasty is rooted in the idea of safeguarding critical nasal structures like the upper lateral cartilage (ULC) to maintain the function of the internal nasal valve (INV) (4). The ULC is a key structure in the nasal anatomy, forming the lateral walls of the nasal passage and contributing to the support of the nasal valve area (5). Advocates of this technique suggest that by preserving the ULC, the surgeon can maintain the angle and function of the INV, thereby minimizing the risk of postoperative nasal obstruction (6). Additionally, the INV, as the narrowest part of the nasal airway, is critical for adequate nasal breathing and is a central consideration in rhinoplasty (7).

Open Preservation Rhinoplasty (OPR) represents a significant evolution in the surgical techniques used in nasal surgeries, particularly in balancing aesthetic improvement with the functional preservation of the nasal structures. This approach is gaining prominence due to its less disruptive nature, as it aims to maintain the integrity of the nasal framework while making the necessary adjustments to the shape and structure of the nose (8, 9). In this technique, instead of cutting the ULC, it is repositioned and reshaped, which helps to maintain the inner wall of the nose and ensures proper respiratory function (10). A study by Lujan et al (2023) revealed that implementing down dorsal preservation rhinoplasty can result in notable enhancements in nasal aesthetics, nasal breathing, and sleep (11).

To objectively evaluate the success of OPR in maintaining nasal function, the Nasal Obstruction Symptom Evaluation (NOSE) score is employed. This validated assessment tool provides a quantitative measure of nasal airway obstruction from the patient's perspective, both before and after surgery (12). It includes items related to nasal obstruction, such as nasal congestion, difficulty breathing through the nose, and facial pain. Scores range from 0 to 100, with higher scores indicating more severe symptoms (13). The score has been shown to have good internal consistency, reliability, and responsiveness to change (14, 15). The tool has been adapted and validated in various languages, including Hebrew (16), German (17), Turkish (18), and Arabic (19), demonstrating its cross-cultural applicability.

The necessity of conducting the present study stems from the growing importance of evidence-based approaches in aesthetic surgery. While the aesthetic outcomes of OPR have been well-documented, there is a paucity of comprehensive studies evaluating the functional outcomes using objective measures such as the NOSE score. The purpose of this study is to fill this gap by providing a detailed analysis of the functional outcomes in patients undergoing OPR with an emphasis on the preservation of the ULC.

## Methods and Materials

### Study design and setting

The study was designed as a non-randomized clinical trial to evaluate the functional outcomes of open preservation rhinoplasty, with a focus on the preservation of the upper lateral cartilages (ULC) and its impact on the internal nasal valve (INV) function. The study was conducted between April 2022 and January 2023. Conducted in the Sulaimani region of Kurdistan, Iraq, the research involved patients from both governmental and private hospital departments.

### Participants

Eligible participants were adult patients scheduled for OPR in the designated study locations. The sample size was determined using a power analysis to ensure adequate statistical power to detect differences in functional outcomes with the preservation of the upper lateral cartilage (ULC). Assuming an effect size of 0.5, an alpha level of 0.05, and a power of 0.8, a sample size of 36 patients was calculated to be sufficient.

Patients were included if they were over 18 years of age, had a primary indication for rhinoplasty, and consented to participate in the study. Exclusion criteria consisted of previous nasal surgery, systemic diseases affecting nasal structure or function, and inability to complete postoperative assessments.

### Preoperative Preparation

The patient underwent intubation and was placed in a supine position with mild head elevation to minimize bleeding. Marking of the columella and the dorsal hump, were identified and delineated for potential reduction. The administration of local anesthesia (2% lidocaine with 1:100,000 epinephrine) involved multiple injections at strategic locations to ensure adequate analgesia and hemostasis. Moreover, preparations included the cleaning of nostril hair and aseptic preparation with povidone-iodine. A waiting period of 7 to 10 minutes post-anesthesia allowed for optimal anesthetic effect.

### Operative technique

The surgical procedure began with a columellar incision and proceeded with dissection between the medial crura, taking care to avoid cartilage damage. The superficial muscular aponeurotic system (SMAS) layer was incised, and a perichondrial window was created to elevate the perichondrium, allowing for subperichondrial dissection along the nasal dorsum and lateral crura.

Dissection typically started at the lateral crus and advanced towards the center, revealing the Pitanguy ligament during the meticulous subperichondrial dissection of the tip cartilages. This technique aimed to preserve the nasal anatomy and function. The ULCs were gently dissected, followed by a subperiosteal dissection upon reaching the bone. Specialized elevators, such as Cottle or Freer, were used to gain access to and dissect the septal angle in a subperichondrial plane.

A key step in the OPR was preserving the ULCs during dorsal hump reduction. The perichondrium was carefully elevated from the ULCs, and a subdorsal septal excision was performed, focusing on maintaining the keystone area and the INV.

For the osseocartilaginous hump, a conservative approach was taken, removing less septal cartilage and leaving a 1 to 2 mm dorsal septal strip intact, preserving the dorsal aesthetic lines and structural integrity. boney-hump reduction is performed by rasping or osteotomies according to the desire hump reduction, the ULCs were repositioned and secured to the remaining septum with 4.0 PDO sutures, reconstructing the nasal vault while preserving the INV. Lateral osteotomies were executed with an external chisel to correct the open roof created by hump reduction, ensuring a symmetric nasal appearance.

In cases requiring septoplasty, only the necessary septal cartilage was removed, leaving at least 10 mm of L-shaped cartilage for structural support. Deviated cartilage and bone were removed with care to maintain structural and aesthetic integrity. The perichondrium of the septum was delicately approached, incised, and elevated for precise cartilage scoring and removal. Nasal airway patency was assessed with a 3-inch nasal speculum, and if needed anterior maxillary spine corrections were made with chisels and stabilized with sutures.

Nasal tip refinement included the use of various suturing techniques with 5.0 PDO sutures, ensuring a well-defined tip while avoiding over-resection of the lateral crura to preserve external nasal valve function by using; trans-domal, inter-domal,and collumelar-septal suture. If an alar base reduction was required, an elliptic tissue resection was performed with incisions placed along the alar crease, closed with 6/0 Prolene for minimal scarring. Internal nasal splints were placed post-operation, with external splints and casts removed after 7 to 9 days

Overall, the OPR technique focused on preserving nasal structure, maintaining INV function, and employing meticulous surgical methods to secure functional and aesthetic outcomes.

**Data Collection**

Preoperative and postoperative data were collected using the standardized NOSE questionnaire alongside the Rhinoplasty Outcome Evaluation (ROE) tool to assess functional and asthetic outcomes. physical examinations were conducted at 9 days, 3 months, and 6 months after surgery and photographs is taken after 3 months to document healing results.

**Ethical Endorsement**

This study was conducted in strict accordance with the principles outlined in the Declaration of Helsinki and complied with all relevant guidelines and regulations regarding ethical conduct in clinical research. Before their participation, informed consent was obtained from all participants, and the study protocol received approval from the Institutional Review Board of the hospital.

**Data Analysis**

Data were analyzed using SPSS version 27 software. Descriptive statistics were used to summarize patient demographics and surgical details. Differences in functional outcomes between preoperative and postoperative assessments were analyzed using paired t-tests. A p-value of less than 0.05 was considered statistically significant.

**Results**

The demographic variables are presented in Table 1. The mean age of the 36 patients was 28.472 ± 8.768 years. Age distribution indicated that 15 (41.7%) were male and 21 (58.3%) were female. Additionally, 24 (66.7%) patients were married and 12 (33.3%) were unmarried. Also, 18 (50%) patients smoked, and six (16.7%) had a history of alcohol use. Out of the 36 OPR patients, 28 (77.8%) resided in the city of Sulaymaniyah and 8 (22.2%) in the city of Kalar.

**Table (1 )Socio-demographic characteristics of the participants**

| Variable | | Open Preservasion Rhinoplasty (N=36) |
|---|---|---|
| **Age** | | **28.472±8.768** |
| **Sex** | **Male** | **15 (41.7%)** |
| | **Female** | **21 (58.3%)** |
| **Marital Status** | **Married** | **24 (66.7%)** |
| | **Unmarried** | **12 (33.3%)** |
| **Smoking** | **Yes** | **18 (50%)** |
| | **No** | **18 (50%)** |
| **Alcoholic** | **Yes** | **6 (16.7%)** |
| | **No** | **30 (83.3%)** |
| **Residency** | **Sulaimai** | **28 (77.8%)** |
| | **Kalar** | **8 (22.2%)** |
| | **Outside Iraq** | **0** |

Preoperative nasal measurements revealed that the mean Nasal Length (NL) was 48.722±4.293. The mean Nasal Width (NW) was 30.111±3.519. The mean Alar Base Distance (ABD) was 37.333±4.388, and the mean Nasolabial Angle (NLA) was 90.027±5.212. Postoperative nasal measurements indicated that the mean NL was 46.777±4.015. The mean NW was 32.305±3.984. The mean ABD was 38.583±3.706, and the mean NLA was 89.527±4.198. These measurements before and after the operation did not show a statistically significant difference except for the NW deviation (p=0.012).

**Table (2 )The nose size before and after surgery**

| Variable | Pre Operation | Post Operation | P-Value |
|---|---|---|---|
| NL | 48.722±4.293* | 46.777±4.015 | 0.066 |
| NW | 30.111±3.519 | 32.305±3.984 | 0.012 |
| ABD | 37.333±4.388 | 38.583±3.706 | 0.186 |
| NLA | 90.027±5.212 | 89.527±4.198 | 0.637 |

The results of the open preservation rhinoplasty operation show significant improvements in the post-operation phase compared to the pre-operation phase. In Nasal stuffiness or congestion, the number of participants with no problem decreased from 22 (61.1%) to 26 (72.2%), and the difference was statistically significant (p=0.001). In the nasal obstruction item, the number of participants with no problem decreased from 20 (55.6%) to 28 (77.8%), and the difference was statistically significant (p=0.001). In addition, significant improvements were observed in the items Breathing problems through the nose, Sleeping problems, and Breathing problems during exercise, which were statistically significant ($p \leq 0.001$), as shown in Table 3.

**Table (3) Comparison of NOSE score before and after surgery**

| Open Preservasi Rhinoplasty | Operation | | P-Value** |
|---|---|---|---|
| | Pre Operation | Post Operation | |
| **Nasal Stuffiness Or Congestion** | | | |
| No Problem | 22 (61.1%) * | 26 (72.2%) | 0.001 |
| Very Mild Problem | 4 (11.1%) | 9 (25%) | |
| Moderate Problem | 4 (11.1%) | 1 (2.8%) | |
| Bad Problem | 6 (16.7%) | 0 | |
| Severe Problem | 0 | 0 | |
| **Nasal Obstruction** | | | |
| No Problem | 20 (55.6%) | 28 (77.8%) | 0.001 |
| Very Mild Problem | 4 (11.1%) | 6 (16.7%) | |
| Moderate Problem | 7 (19.4%) | 2 (5.6%) | |
| Bad Problem | 5 (13.9%) | 0 | |
| Severe Problem | 0 | 0 | |
| **Breathing Problem Through The Nose** | | | |
| No Problem | 19 (52.8%) | 25 (69.4%) | 0.001 |
| Very Mild Problem | 6 (16.7%) | 11 (30.6%) | |
| Moderate Problem | 5 (13.9%) | 0 | |
| Bad Problem | 5 (13.9%) | 0 | |
| Severe Problem | 1 (2.8%) | 0 | |
| **Sleeping Problem** | | | |
| No Problem | 18 (50%) | 25 (69.4%) | 0.001 |
| Very Mild Problem | 8 (22.8%) | 9 (25%) | |
| Moderate Problem | 5 (13.9%) | 1 (2.8%) | |
| Bad Problem | 5 (13.9%) | 1 (2.8%) | |
| Severe Problem | 0 | 0 | |
| **Breathing Problem During Exercise** | | | |
| No Problem | 23 (63.9%) | 32 (88.9%) | 0.001 |
| Very Mild Problem | 4 (11.1%) | 3 (8.3%) | |
| Moderate Problem | 2 (5.6%) | 0 | |
| Bad Problem | 7 (19.4%) | 1 (2.8%) | |
| Severe Problem | 0 | 0 | |

*Frequency (%), ** P-value chi square (Fisher exact test)

Table 4 presents findings from the ROE before and after surgery in Open preservasion rhinoplasty group. "Do you like how your nose looks","Do you breathe well through your nose", "Do you believe your friends and people who are dear to you like your nose", "Do you think the current appearance of your nose hampers your social or professional activities", "Do you think your nose look as good as it could be" and "Would you undergo surgery to change the appearance of your nose or to improve your breathing" showed a significant difference between before and after surgery in Open preservasion rhinoplasty group (P≤0.05).

**Table (4 ) Intragroup comparison of ROE score before and after surgery in OPR**

| Variable | Operation | | P-Value ** |
|---|---|---|---|
| | Before Surgery | After Surgery | |
| **Do You Like How Your Nose Looks?** | | | |
| Absolutely No | 1 (2.8%) * | 0 | 0.014 |
| A Little | 3 (8.3%) | 0 | |
| More Or Less | 8 (22.2%) | 3 (8.35%) | |
| Very Much | 17 (47.2%) | 15 (41.7%) | |
| Absolutely Yes | 7 (19.4%) | 18 (50%) | |
| **Do You Breathe Well Thought Your Nose?** | | | |
| Absolutely No | 0 | 0 | 0.018 |
| A Little | 0 | 0 | |
| More Or Less | 0 | 6 (16.7%) | |
| Very Much | 11 (30.6%) | 13 (36.1%) | |
| Absolutely Yes | 25 (69.4%) | 17 (47.2%) | |
| **Do You Believe Your Friends And People Who Are Dear To You Like Your Nose?** | | | |
| Absolutely No | 0 | 0 | 0.03 |
| A Little | 0 | 0 | |
| More Or Less | 6 (16.7%) | 0 | |
| Very Much | 12 (33.3%) | 17 (47.2%) | |
| Absolutely Yes | 18 (50%) | 19 (52.8%) | |
| **Do You Think The Current Appearance Of Your Nose Hampers Your Social Or Professional Activities?** | | | |
| Always | 18 (50%) | | 0.001 |
| Frequency | 12 (33.3%) | | |
| Sometimes | 6 (16.7%) | 21 (58.3%) | |
| Rarely | 0 | 11 (60.6%) | |
| Never | 0 | 4 (11.1%) | |
| **Do You Think Your Nose Look As Good As It Could Be?** | | | |
| Absolutely No | 0 | | 0.001 |
| A Little | 1 (2.8%) | | |
| More Or Less | 4 (11.1%) | 1 (2.8%) | |

| | | | |
|---|---|---|---|
| **Very Much** | **12 (33.3%)** | **5 (13.9%)** | |
| **Absolutely Yes** | **19 (52.8%)** | **30 (83.3%)** | |
| **Would You Undergo Surgery To Change The Appearance Of Your Nose Or To Improve Your Breathing?** | | | |
| **Certainly Yes** | **0** | **3 (8.3%)** | **0.001** |
| **Very Likely Yes** | **0** | **15 (41.7%)** | |
| **Possibly Yes** | **3 (8.3%)** | **18 (50%)** | |
| **Probably No** | **15 (41.7%)** | | |
| **Certainly No** | **18 (50%)** | | |

*Frequency (%), ** P-value chi square (Fisher exact test)

The results of surgery in a number of patients are shown in Figure (1-5). All patients were fully satisfied without having any special complications or consequences in three months after the surgery.

**Figure (1):** 19 year old female patient with slight deviation to the left and complaining of a tip drop, the patient was treated with removal of the boney hump with rasping ,and subdorsal septal strip resection of the septum to decrease the dorsal hump,latral osteotome,and the dome suture for her tip with repositioning to the midline, (upper) preoperative frontal, oblique and lateral views.(lower) 3 months postoperative frontal, oblique and lateral views.

**Figure (2):** 25 year old lady complaining of dorasal hump and boxy tip,same procedure performed boney hump resected with osteotome and preserving ULC with subdorsal septal strip excision,domal suture with no resection of latral crura,also collumelar septal suture to maintain some tip rotation, (upper) preoperative frontal, oblique and lateral views.(lower) 3 months postoperative frontal, oblique and lateral views.

**Figure (3):** 26 year old male with large dorsal hump (no deviation) also he had breathing problem, underwent hump rection with ostotome with subdorsal septal excision and fixing the ULC to the septum with suture not to cause raise up again, also correction of the septum performed with excition of the deviated part, (upper) preoperative frontal, oblique and lateral views.(lower) 3 months postoperative frontal, oblique and lateral views.

**Figure (4):** 19 year old female with small dorsal hump and boxy tip, rasping of the hump and subdorsal septal excision with external latral osteotome and domal suture for her tip with slight trimming of latral crura**,** (upper) preoperative frontal, oblique and lateral views.(lower) 3 months postoperative frontal, oblique and lateral views.

**Figure (5):** 20 year old lady with some deviation to the left (c-shape)and she had also problem in breathing,correction of dorsal hump perfomed with rasping and osteotome to repositioning to the midline, subdorsal septal excision performed to cartilaginous dorsum, suturing of the tip for the tip definition**,** (upper) preoperative frontal, oblique and lateral views.(lower) 3 months postoperative frontal, oblique and lateral views.

## Discussion

In this study, the NOSE and ROE were employed to assess the impact of preserving the upper lateral cartilage during open rhinoplasty. The findings indicated that OPR was associated with reduced NOSE scores and improved nasal function. According to the Rhinoplasty Outcome Evaluation (ROE), significant differences in nasal form and function were observed pre-and post-surgery, suggesting that open rhinoplasty yields excellent outcomes in both functional and aesthetic aspects for patients.

The preservation of the upper lateral cartilage (septum) in open rhinoplasty plays a critical role in the functionality of the nasal sidewall. This cartilage provides a fundamental structure for the nose, aiding in the maintenance of its stability and function (20). A study by Stergiou et al. (2020) aimed to examine the impact of rhinoplasty on nasal surgery. The study demonstrated that nasal appearance and function are well-preserved following surgery, underscoring the significance of the open surgical technique (21).

In preserving the upper lateral cartilage, support for the nasal structure is effectively provided through the septum, which constitutes the primary framework of the nose. This preservation contributes to maintaining the shape and form of the nose post-surgery (22). It also prevents drooping of the nasal tip, as the septum holds the tip in place, averting any undesirable sagging or misshaping (23). Furthermore, preserving this cartilage aids in regulating airflow, as the septum serves to control the nasal air passage, facilitating proper and comfortable breathing after the surgery (24).

It should be noted that in nasal surgeries, the upper lateral cartilage should be preserved as much as possible, except in specific cases such as severe septal deviation or when cartilage grafting is necessary. Under these circumstances, partial removal of the upper lateral cartilage may be required. The study conducted by Ashrafi et al. (2014) elucidates the importance of preserving the upper lateral cartilage. This study examined the experiences of 2,500 rhinoplasty cases over a decade, focusing on the management of the upper lateral cartilages. The surgical strategy in this review was to preserve rather than remove or reduce these cartilages. The results confirmed the current study's findings, highlighting the crucial role of preserving the upper lateral cartilage in the shape and function of the nose and the growing importance of such preservation techniques in cosmetic nasal surgery treatments (25).

The significance of preserving the upper lateral cartilage in rhinoplasty has also been well-documented in other studies. A retrospective study by Paul et al. (2018) analyzed one hundred and seventy-eight patients over eight years. The outcomes of this study revealed that rhinoplasty while playing a vital role in preserving the upper lateral cartilage, can also be effective in addressing nasal tip droop issues (26).

In a retrospective study, Kandathil et al. (2021) did a study aimed to investigate the history of nasal obstruction and the timing of cosmetic rhinoplasty surgeries. This study assessed nasal obstruction

symptoms before and after surgery (NOSE) and used the Standardized Cosmetics and Health Nasal Outcomes Survey (SCHNOS) for 302 patients who had undergone surgery. A comparison of preoperative and postoperative NOSE and SCHNOS scores showed a significant reduction, indicating that rhinoplasty had a meaningful impact on alleviating patients' respiratory issues and was associated with improvements in both function and aesthetics (27).

Concordant with the current study's findings, research conducted in Brazil by de Souza et al. (2022) aimed to analyze various factors affecting the quality of life after nasal surgery and to determine the determinants of postoperative satisfaction. In this study, which involved 78 patients, a significant reduction in the NOSE score was observed after rhinoplasty. Moreover, there was a significant difference in the preoperative and postoperative ROE scores, reflecting favorable functional and aesthetic outcomes for the patients (28).

In another study conducted in Iran by Zojaji et al. (2024), the impact of rhinoplasty on surgical outcomes was examined. This prospective cohort study involved 100 nasal surgery patients aged 18 to 40 years. ROE questionnaires for assessing the outcome of rhinoplasty and NOSE evaluations for nasal obstruction symptoms before, and three and six months after surgery, were used. The findings indicated that post-rhinoplasty, there was a significant improvement in the ROE score compared to pre-surgery, and a significant reduction in the NOSE score, signifying positive functional and aesthetic results for the patients (29).

## Conclusions

Preservation of ULCs in OPR procedures positively impacts internal nasal wall function, as demonstrated by improved postoperative outcomes. This technique maintains nasal structure integrity and INV function, leading to favorable functional and aesthetic results.

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