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Use of Solid Monoblock Rib Cartilage Graft for Augmentation Rhinoplasty in Tertiary Care Centre: A Prospective Study

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ABSTRACT

Introduction

Autologous rib cartilage is commonly used graft material for major dorsal augmentation, especially in asian rhinoplasty, however, concern persists regarding warping and donor-site morbidity. This study aims to evaluate the aesthetic satisfaction and complications associated with autologous rib cartilage grafts in augmentation rhinoplasty.

Methods

This prospective observational study was conducted at the Department of Ear, Nose, and Throat of Kathmandu Medical College from April 2023 to March 2025. Fifty-six patients aged between 18 to 50 years with severe saddle nose deformity either due to congenital or traumatic nasal malformations were included. Patients with nasal polyposis or granulomatous diseases were excluded. Primary outcome was evaluated by using Rhinoplasty Outcome Evaluation (ROE) score (0-24 scale) pre, 6 months and 1 year postoperatively. Secondary outcome included complication rates.

Results

A total of 56 patients (mean age 31.63 ± 5.68 years; 53.6% female) were included, with congenital abnormalities constituting of 80.4%. Mean ROE scores improved from 8.13 ± 1.74 preoperatively to 18.02 ± 1.22 at 6 months and 18.40 ± 2.15 at 1 year postoperatively ($p<0.001$). Graft-related complications were warping occurring in 2 cases (3.57%) and graft displacement in 1 case (1.79%). Donor-site morbidity included hypertrophic scar in 2 cases (3.57%) and persistent donor-site pain in 1 case (1.79%). No infections, graft extrusions, or pneumothorax were observed.

Conclusion

By using solid autologous costal cartilage graft, good patient satisfaction, and minimal donor-site complications can be achieved.

Keywords

Costal cartilage; graft survival; patient-reported outcomes; rhinoplasty

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INTRODUCTION

Rhinoplasty has emerged significantly since its earliest descriptions in ancient Indian texts circa 600 BC.[1] Augmentation rhinoplasty in Asian patients presents a distinct surgical challenge due to characteristic anatomical features: weak osteocartilaginous framework, low nasal dorsum, and thick soft tissue envelope.[2] These characteristics frequently compel dorsal grafting to achieve both functional improvement and aesthetic enhancement.[3]

In reconstructive rhinoplasty, the ideal graft material remains controversial. Although septal cartilage serves as the gold standard for minor augmentations, but due to insufficiency in severe saddle nose deformity demands alternative solutions.[4] Autologous rib cartilage offers several benefits due to abundant material for significant dorsal reconstruction, superior biocompatibility, and ability to create natural dorsal contours.[5] However, contemporary literature emphasizes persistent challenges including graft warping (5-20%) and donor-site morbidity.[6]

Rhinoplasty Outcome Evaluation (ROE) questionnaire developed by Alsarraf[7] in 2000, is a screening tool for finding patient's satisfaction to assess the results of facial aesthetic surgeries that enabled the conversion of subjective patient information into quantitative data. Normality values for the ROE questionnaire were studied by Izu, et al[8] to get better post-operative results. Our study aims to quantify patient satisfaction using validated ROE scores, evaluate complication profiles and provide comparative data against alternative grafts.

METHODS

This is a prospective observational study conducted at the Department of ENT-HNS of Kathmandu Medical College Teaching Hospital. The study was conducted after receiving ethical clearance from the Institutional Review Committee (IRC) of same hospital (Ref:12082024/15).

This study included all cases of patients registered at a tertiary care center from April 2023 to March 2025. Participants were selected based on specific inclusion and exclusion criteria. The study included patients suffering from congenital nasal malformations such as cleft lip and palate, Asian ethnic group of patients with severe saddle and broad nose deformities, those with serious nasal trauma necessitating accurate reconstruction, and patients undergoing secondary (revision) septorhinoplasty. Patients with nasal polyposis or granulomatous diseases such as tuberculosis, syphilis, or Wegener's granulomatosis, as well as those diagnosed with Body Dysmorphic Disorder (BDD), were excluded from the study.

Surgical technique

1. Harvesting of Rib Cartilage Graft:

Cartilage was typically harvested from the sixth or seventh costal cartilage. The incision length was 3 to 3.5cm lateral from the vertical line of the nipple–areola–complex. After exposure of selected rib, a longitudinal incision was made through the perichondrium along the length of the central axis of the rib using electrocautery. Careful perichondrial dissection was continued circumferentially along the length with the help of perichondrial elevators to release the posterior adherence between the rib cartilage and perichondrium. Split costal grafts of appropriate size from superior aspects were harvested, leaving the deep perichondrium and the remaining inferior costal cartilage intact so as to avoid injury to neurovascular bundle which causes severe postoperative donor site pain. The wound was evaluated for any obvious air leak due to plural puncture. The harvested rib cartilage was placed in ciprofloxacin antibiotic solution for half an hour to see any warping.

2. Carving of Cartilage and its Placement

The dorsal graft was carved into a "fusiform" shape; which is tapered off at both ends with a wider mid portion. After the dorsal graft was carved, some balanced cuts were made in several directions in the cartilage to prevent it from warping. In patients with thin skin or a high dorsal graft, rib perichondrium or muscle fascia was attached on the dorsal aspect of graft using tissue glue, so as to camouflage graft visibility and irregularities. The graft was placed in the dorsal nasal pocket and was sutured caudally on to the cephalic portion of lower lateral cartilage using 5-0 PDS suture. Any remaining tip work is then completed as well as indicated osteotomies, if not previously performed.

The preoperative and postoperative views following augmentation rhinoplasty with costal cartilage is shown in Figure 1.

The preoperative and postoperative assessment was done with the help of the ROE questionnaire. The questionnaire was composed of 6 questions and each question has five options between 0 and 4. For all six questions, the total score was calculated and the result was divided by 24 and multiplied by 100 (Zero represents minimum satisfaction and 100 the maximum one). A higher score indicates greater satisfaction. The mean ROE score < 50 are considered failures, 50 to < 75 is considered good, and ≥ 75 is considered excellent.[9] The success of the surgery is determined primarily by the patient's satisfaction with the aesthetic and functional outcomes.[10] The primary outcome measure was the Rhinoplasty Outcome Evaluation (ROE) questionnaire, while secondary outcomes included complications and donor-site morbidity,

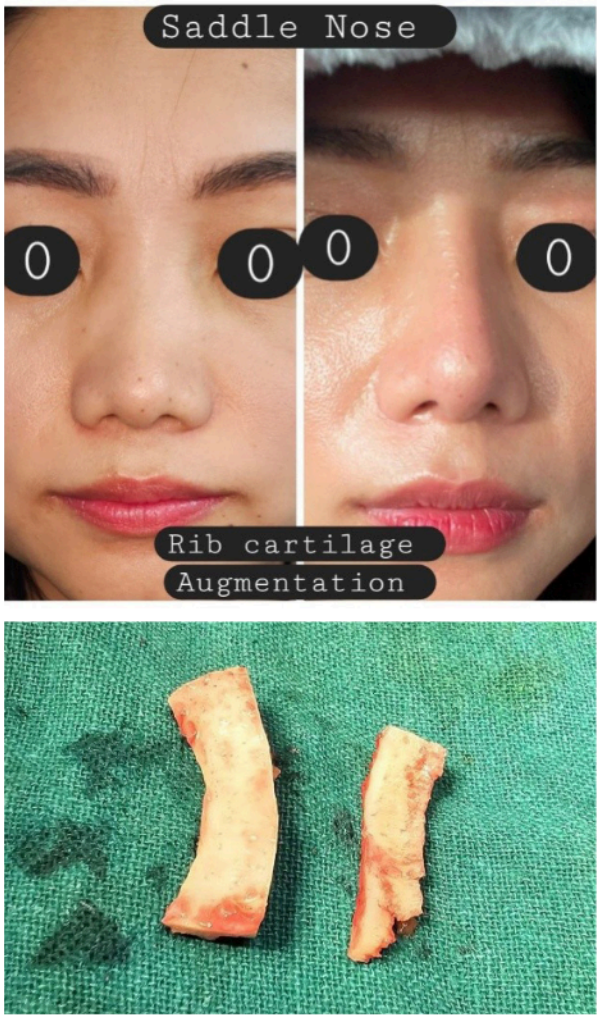

Figure 1. Preoperative saddle nose deformity and postoperative correction at 6 months with use of costal cartilage

assessed using the Vancouver Scar Scale.[11,12]

Data were entered in Microsoft Excel and analyzed using SPSS vs 20. Descriptive statistics were described by mean, median, standard deviation (SD) and interquartile range (IQR). Categorical variables were summarized using frequencies and percentages. Inferential statistics were performed using paired t-tests. A significance level of $\alpha = 0.05$ was considered for all statistical analyses.

RESULTS

Among 56 patients, 26 (46.43%) were male and 30 (53.57%) were female. The male to female ratio was approximately 0.87:1. The mean was 31.63±5.68 years, and the etiology was congenital in 45 (80.36%) of cases and traumatic in 11 (19.64%). Rhinoplasty Outcome Evaluation (ROE) questionnaire was used to compare the pre and postoperative satisfaction results in patients undergoing augmentation rhinoplasty using autologous solid monoblock rib cartilage graft. The mean ROE score preoperatively was (8.13±1.74) and postoperatively at 6 months was (18.02±1.22) with an increment of (+9.89) score and in 1 year (18.40±2.15) with an increment of (+10.27) score. We found statistically significant difference of ROE score (p <0.001) in both the postoperative period (Table 1).

In the preoperative period, we noticed that 48 (85.71%) patients had a satisfaction score of <50 and 8(14.28%) patients had score (>50 to <75). In one-year follow-up, 3(5.35%) patients had score <50 was considered as failure, 13(23.21%) patients had a score of 50 to <75 was considered to have good outcome and 40(71.42%) patients had a score >75 was considered to have an excellent outcome.

Among the 56 patients, complications included warping of graft in 2 cases (3.57%), hypertrophic scar at the donor site in 2 cases (3.57%), displacement of graft in 1 case (1.79%), and donor-site pain in 1 case (1.79%). No cases of infection, extrusion, or pneumothorax were observed.

DISCUSSION

In our study, the mean preoperative ROE score was 8.13±1.74 and mean post operative score was18.02±1.22 at 6 months and 18.40±2.15 at 1 year follow up period which is similar to the study done by Bashir et al in which mean ROE score of all patients preoperatively was 9.21±0.8 which increased to 19.56±1.1 after three months of surgery.[13]The difference was statistically significant. These results are consistent with multiple other studies in which comparable pre and post operative scores was found.[14,15] This significant increase in mean post operative scores depicts significant improvement in aesthetic outcome. The observed

Table 1. Patient-Reported Outcomes from ROE Questionnaire

Pair	Time-point	ROE Score (Mean±SD)	Improvement (Δ)	p-value
Pair 1	ROE score before Surgery ROE score 6 months after surgery	8.13±1.74 18.02±1.22	+9.89	<0.001
Pair 2	ROE score before Surgery ROE score 1 year after Surgery	8.13±1.74 18.40±2.15	+10.27	<0.001

ΔROE of +10.27 points at one year exceeds reported outcomes for alternative materials in Asian populations, including silicone implants (ΔROE +7.2, Moon 2018), diced cartilage (ΔROE +8.5, Erol 2000), and irradiated homografts costal cartilage (ΔROE +6.9, Kridel 2009).[16,17] This superiority of autologous costal cartilage is due to monoblock's structural integrity, providing consistent dorsal support that resists the soft tissue compression common in thick-skinned patients.[2]

In our study, we found 48(85.71%) patients had a satisfaction score of <50 in the preoperative period, however only three patients (5.35%) had score <50 in 1-year postoperative period. Likewise, 13(23.21%) patients had a score of (>50 to <75) was considered to have good outcome and 40(71.42%) patients had a score >75 was considered to have an excellent outcome in 1 year follow up. In total 53(94.64%) patients had satisfaction score of >50. This satisfaction score of 94.64% in our study is similar to a meta-analysis studies reviewed by wang et al, in which the patient satisfaction rate consistently remained high; 94.9% of patients reported satisfaction with improvements in contour and symmetry.[18]

In our study, complications included warping of graft was seen in 2 cases (3.57%) which is similar to the study done by Rohrich et al. had graft warping of 2.7%.[19] In order to minimize warping rate, we used the central segment of the rib, balanced cuts were made in multiple directions, and the graft was placed in an antibiotic solution prior to carving to see the direction of warping. We found only 1 patient (1.79%) had displacement of graft, unlike the study done by Tiong et al in which 12.5% had displacement of graft.[20] In our study, we minimized the displacement of graft by making an adequate dorsal pocket, so that the graft snugly fits inside the pocket. Hypertrophic scar at the donor site was seen in 2 cases (3.57%) in our study. Only one patient (1.79%) complained of donor-site pain in our study. During harvesting of costal cartilage, we left the inferior border of the rib intact in order to minimize post-operative pain and donor-site morbidity because it helps to preserve the integrity of the intercostal nerve and vessels, which run along the inferior margin of the rib. This technique reduces nerve damage, a primary cause of severe and long-lasting pain. A study done by Rohrich et al had infection rate of 2.2%, however, no cases of infection, extrusion of graft and pneumothorax were observed in our study.[19] Revision rate is (5.35%) in our study, for which 3 patients underwent revision rhinoplasty for correction of warping and displacement of graft after 6 months of surgery, which is similar to the study done by Rohrich et al in which revision rate is 2.2% and unlike a study done by Yilmaz et al in which revision rate is 23.7%.[19, 21]

The ideal graft material should be biocompatible, structurally stable to strengthen the nasal framework to improve dorsal contour and symmetry and free from long-term complications.[22] Autologous cartilage is regarded as most ideal graft material because of its excellent biocompatibility, low infection and extrusion rates, favorable elasticity, ease of shaping, sustained viability despite limited vascularity, and minimal tendency for resorption.[23] Despite these promising results there are certain limitations still present in our study. One year follow-up period does not allow complete assessment of late resorption, and single-surgeon consistency may limit the application of the findings to broader surgical settings.[24] Future studies should assess cost-effectiveness in under-resourced environments and use 3D simulation for objective analysis.[25]

CONCLUSION

Good aesthetic satisfaction can be obtained by the use of autologous solid monoblock rib cartilage in severe saddle nose deformities for dorsal augmentation. This graft when precisely carved and meticulously handled, the risk of graft warping, graft extrusion and graft resorption is minimal, while donor-site morbidity remains low, making it an effective solution for complex nasal reconstruction.

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CONFLICT OF INTEREST

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AUTHOR CONTRIBUTIONS

Nain Bahadur Mahato: Conceptualization, methodology, analysis, investigations, original draft, review and editing; Sujan Pradhan: Literature review, analysis, original draft, review and editing; Prajwol Neupane: Literature review, analysis, original draft, review and editing; Shristi Neupane: original draft, review and Editing; Rosi Pradhan: methodology, investigations

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