

# The use of diced cartilage grafts in nasal aesthetic and reconstructive surgeries: Clinical and radiological evaluation

## Original Article

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## ABSTRACT

**Background:** Rhinoplasty is considered to be one of the most fascinating and challenging operation for any plastic surgeon (1).

The aim of using grafts for the nasal dorsum is either to augment or to camouflage minor irregularities (4, 5).

Grafts on the nasal dorsum are easy to be visible. For this purpose, it is better to use diced cartilage (DC) grafts either free to smoothen the nasal dorsum or wrapped in the fascia (DC-F) to augment it (6, 7).

The main goal of this study is to assess the impact of the use of DC grafts on the aesthetic outcome as well as its role in the reconstruction of the nasal dorsum. Evaluation is done clinically using the nasal obstruction symptom evaluation score and rhinoplasty outcome evaluation score, (8, 9) as well as radiologically using ultrasound measurement of the thickness of the DC-F graft during a follow-up period of 4 weeks, 3 months, and 6 months' intervals.

**Patients and Methods:** This prospective study was conducted between January 2022 and March 2024. Twenty patients were included and planned for using DC whether free or wrapped in fascia.

**Results:** All patients (14 females and six males) underwent open rhinoplasty. DC-F was used in 12 (60%) cases, while free DC in 8 (40%) cases. A statistically significant difference between preoperative and postoperative nasal obstruction symptom evaluation scores was found ( $P < 0.001$ ). The mean postoperative rhinoplasty outcome evaluation score was 88.73.

**Conclusion:** It was found that the DC-F was an effective technique in nasal dorsum augmentation with guaranteed long-term results and with no risk of graft visibility. Meanwhile, a free DC graft is a versatile tool in camouflaging minor irregularities on the nasal dorsum as well as the nasal tip.

**Key Words:** Augmentation rhinoplasty, diced cartilage, nasal dorsum reconstruction, saddle nose.

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## INTRODUCTION

Rhinoplasty is considered to be one of the most fascinating and challenging operations for any plastic surgeon, not only for aesthetic outcomes but also for the functional purpose<sup>[1]</sup>.

Understanding the nasal anatomy and its impact on nasal aesthetics besides the surgeon skills is considered the gold standard for reaching good results<sup>[2]</sup>. Grafts always play an important role in rhinoplasty operations that can fix several aesthetic and functional problems<sup>[2,3]</sup>. Of course, autografts remain the safest type of grafts used<sup>[4]</sup>. The choice between different graft sources (septal, conchal, or costal cartilage) has many influences. Septal cartilage is the first choice for any surgeon as it is usually harvested during septoplasty, it is strong, straight, and abundant. Usually, it is used for spreader grafts and columellar strut grafts. Conchal cartilage is curved and weaker than

septal or costal cartilage. It is better not to be used when structural grafting is required. Conchal cartilage is good for tip grafting. Costal cartilage is usually needed when a large number of grafts are needed usually in saddle nose deformity, cleft lip nasal deformity, and secondary rhinoplasty cases with excessive cartilage resection or when the nasal septum was previously harvested as a graft source in a previously operated nose<sup>[4,5]</sup>.

The nasal dorsum aesthetics attracts the attention of not only the surgeons but also the patient. Nasal dorsum reduction is usually done more than dorsum augmentation as many patients came complaining of a dorsal hump. However, saddle deformity is more frequently a cause of excessive hump reduction (iatrogenic). Other causes of dorsal saddling include posttraumatic injuries, some cleft lip nasal deformities, and ethnic variations as observed in some African noses<sup>[6,7]</sup>.

Although hump reduction is a common step in rhinoplasty operation, it can lead to severe deformities of the nasal dorsum. The most common are, open roof deformity, residual dorsal irregularities, or dorsal saddling from excessive lowering of the nasal dorsum<sup>[8]</sup>.

Many surgeons tried many grafts on the nasal dorsum, either to camouflage some dorsal irregularities or to augment it. One of the commonly used camouflage grafts is the morselized onlay graft. The main drawback of this graft is its high resorption rate (as crushing the chondrocytes always affects graft viability).

Meanwhile, using en block onlay grafts to augment the nasal dorsum is not without its disadvantages, the main ones are graft visibility and warping in the case of using a costal cartilage graft<sup>[9]</sup>.

The use of diced cartilage (DC) grafts has a great impact on nasal dorsum aesthetics. DC can be used either free (Free DC) or wrapped in fascia (DC-F). The main advantage of using free DC grafts is to camouflage minor irregularities without the risk of resorption, as cutting the cartilage into small pieces rather than crushing it does not affect the chondrocytes' viability. However, advantages of using DC-F when used for nasal dorsal augmentation are no risk of graft visibility or warping and excellent graft viability that ensures long-term results<sup>[9-11]</sup>.

This study aims to assess the use of DC grafts in nasal aesthetic and reconstructive surgeries. using both nasal obstruction symptom evaluation (NOSE) and rhinoplasty outcome evaluation (ROE) questionnaires<sup>[12,13]</sup> to assess the aesthetic and the functional outcome of the operation, and ultrasound imaging to assess the viability of the DC-F graft by measuring its thickness at 4-week, 3-month, and 6-month intervals.

#### **PATIENTS AND METHODS:**

This prospective study was conducted between January 2022 and March 2024. Twenty patients were included and planned for using DC whether free or wrapped in fascia.

#### ***Inclusion criteria of patients***

Patients aged from 18 to 50 years of both sexes with any saddle nose deformity whether posttraumatic or iatrogenic, cleft lip nasal deformities, secondary rhinoplasty cases with excessive cartilage excision, and patients with huge dorsal hump expected to have residual open roof deformity even after adequate lateral osteotomies.

#### ***Exclusion criteria of patients***

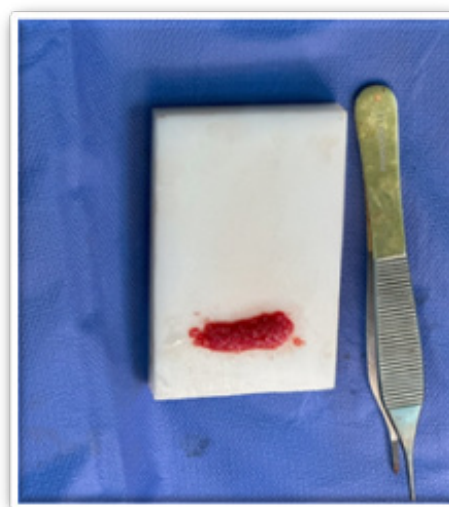
Patients with nasal trauma of less than 6 months, active nasal infection, severe internal mucosal defects or scarring, short scarred columella, or unrealistic expectations.

#### ***Surgical technique***

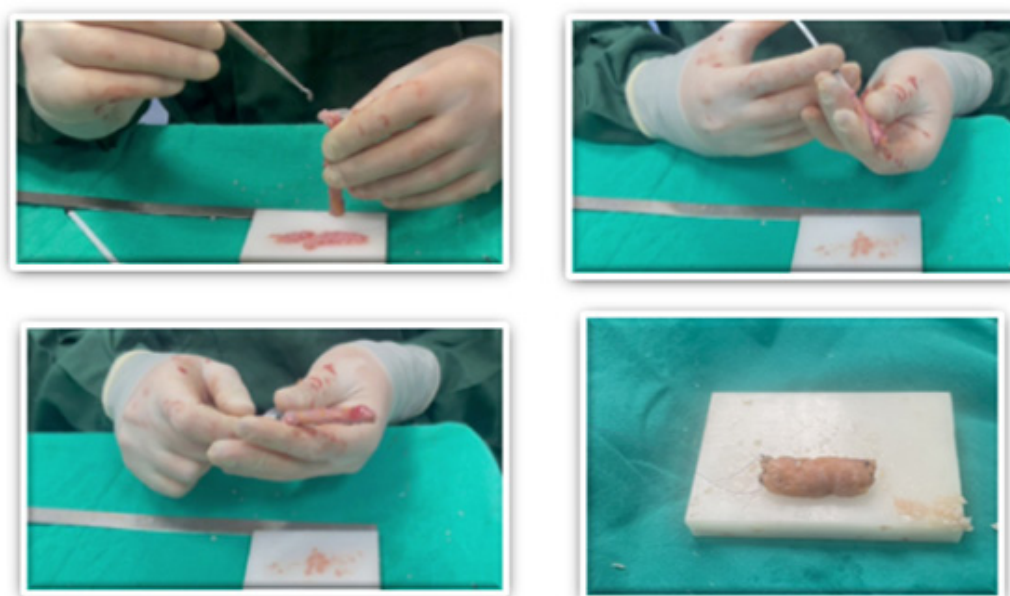
DC could be prepared from any remaining pieces of harvested cartilage. The remaining cartilage parts were cut using a no. 11 blade into small cubes of less than 0.2 mm in diameter.

The scrub nurse or one of the assistants was asked to dice any remaining cartilage to save the operative time. When free DC was planned for use, the anesthesiologist was asked to add 1 or 2 cc of fresh blood on the previously prepared DC on the cutting board and then left for 2 min to coagulate to hold DC together (Fig. 1). Then by using a Freer elevator, Free DC can be precisely put on the nasal dorsum or the tip as needed.

However, when DC-F was needed for dorsal augmentation, part of the rectus fascia was harvested (as commonly costal cartilage was used in cases where nasal dorsum augmentation was the goal) from the same incision for costal cartilage graft harvesting in order not to add another incision elsewhere. The harvested fascia usually (4 cm x 4 cm) was sutured with 5/0 Vicryl sutures as a tube on a tuberculin syringe. DC grafts were then inserted through this syringe to fill the fascial bag and then the hub was used to push DC grafts inwards. The distal end of the DC-F was intentionally left open to squeeze any DC out if needed (Fig. 2). Two pull-out 5/0 Vicryl sutures were placed on the cranial end of the DC-F. The exact place to put the DC-F was marked, the nasal skin was elevated, the pull-out sutures were passed and finally, the DC-F graft was gently pulled onto the nasal dorsum on the preplanned site. Excessive DC were squeezed (if needed) by gentle massaging on the nasal dorsum; otherwise, the distal end was closed with 5/0 Vicryl sutures. It was important to fixate the DC-F to any soft tissue laterally to prevent migration. The two pull-out sutures were fixed to the forehead skin with a piece of 0.5-inch Steri-strips<sup>®</sup>. After closure of the columellar incision, 0.5-inch Steri-strips were applied horizontally on the nasal dorsum before putting the external nasal splint.



**Fig. 1:** Free diced cartilage graft with blood.



**Fig. 2:** Steps of preparation of DC-F.

## **RESULTS:**

This prospective study was conducted between January 2022 and March 2024, 20 patients were included and planned for nasal dorsal augmentation or reconstruction.

Of these, 12 (60%) cases were seeking primary rhinoplasty, 4 (20%) cases were suffering posttraumatic saddle nose deformity, 3 (15%) cases cleft lip rhinoplasty, and the rest 5 (25%) cases had primary aesthetic problems. However, 8 (40%) cases were seeking secondary rhinoplasty.

Not only aesthetic complaints were encountered, but functional problems were common and was seen in 17 (85%) cases. Thirteen cases had septal deviation (65%). Internal valve collapse was seen in 7 (35%) cases, while external valve problems in 5 (25%) cases. Inferior turbinate hypertrophy affected 7 (35%) cases and lastly mucosal synchia in 1 (5%) case.

Open approach was used in all cases as well as cartilage grafting. The source of cartilage grafting was either the nasal septum in 7 (35%) cases or costal cartilage in 13 (65%) cases.

Dorsum augmentation was done in 12 (60%) cases, while dorsum reduction was done in 7 (35%) cases. For nasal dorsum augmentation costal cartilage grafts were used in the form of on-lay graft on the most depressed part of the nasal dorsum (if needed) and DC-F on top. On-lay graft was put in 9 of these cases together with DC-F graft, while DC-F alone was used in 3 cases for dorsum augmentation. However, Free DC was used as well to camouflage contour irregularities on the dorsum in 7 (35%) cases after major hump reduction and on the tip in 1 (5%) case.

Other grafts used were columellar strut in seven (35%) patients and spreader grafts in seven (35%) patients. Extended spreader grafts were used in 11 (55%) cases, caudal extension graft was used in 11 (55%) patients, and lateral crural strut grafts were used in eight (40%) patients.

## **Case presentation**

### **Case 1**

A 50-year-old female patient presented with severe dorsal saddling post submucous resection of the whole nasal septum since 2002. The seventh costal cartilage was harvested. Two extended spreader grafts and caudal extension grafts were used for L-strut reconstruction. Reconstruction of the dorsum was done using on-lay graft and DC-F (Fig. 3).

### **Case 2**

A 28-year-old female patient with posttraumatic saddling. The seventh costal cartilage was harvested. Reconstruction was done using two extended spreader grafts and caudal extension graft, a unilateral lateral crural graft on the left side, and an on-lay dorsal graft covered with DC-F (Fig. 4).

### **Case 3**

A 30-year-old female patient with over-resected dorsum after a previous open rhinoplasty since 2018. The seventh costal cartilage was harvested and used for reconstruction. Two spreader grafts and a columellar strut were used, and the DC-F graft was used for some dorsal augmentation (Fig. 5).

**Case 4**

A 28-year-old female patient with cleft lip nose deformity. The sixth rib was harvested. Two extended spreader grafts and a caudal extension graft were used as well as a bilateral crural strut graft. Nasal dorsal augmentation was done with the DC-F graft (Fig. 6).

**Case 5**

A 18-year-old male patient seeking primary rhinoplasty. The patient was complaining of a dorsal hump and a droopy tip. The open approach was done and after dorsal hump (bony and cartilaginous) reduction, lateral osteotomies, free DC was used for a smoother contour of the nasal dorsum and to prevent any residual open roof deformities.

**Case 6**

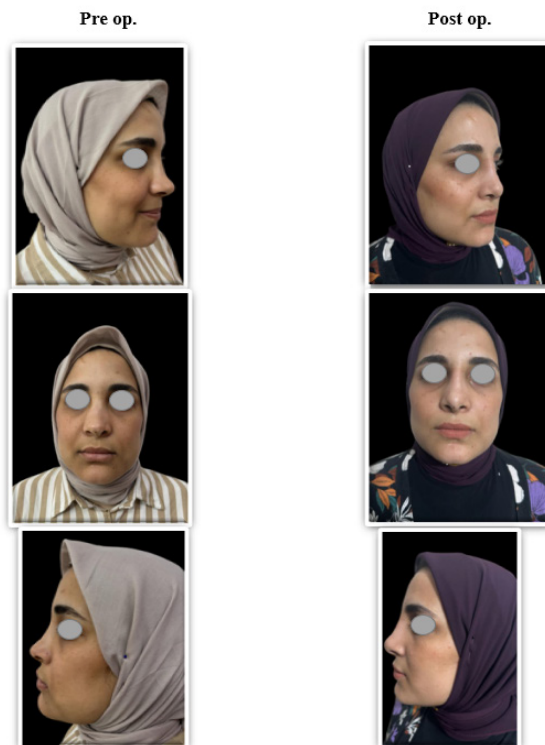
A 41-year-old male patient seeking primary rhinoplasty. Complaining of a long nose and seeking a better looking tip. An open rhinoplasty approach was done, the lower lateral cartilages were deformed with two breaks at the middle crus part. Cutting through these two breaks were done. Medial and lateral crural overlap was done. Free DC was used on the tip to camouflage any irregularities and to give a better definition (Fig. 8).



**Fig. 3:** Case (1) Dorsal augmentation rhinoplasty with preoperative views (left), 6 months' postoperative views (right).



**Fig. 4:** Case (2) Posttraumatic dorsal augmentation rhinoplasty with preoperative views (left) and 3 months' postoperative views (right).



**Fig. 5:** Secondary rhinoplasty case with correction of bony deviation and dorsal saddling with preoperative views (left), 6 months' postoperative views (right).





**Fig. 6:** Cleft lip rhinoplasty with preoperative views (left) and 4 months' postoperative views (right).



**Fig. 7:** Preoperative views (left) and 9 months' postoperative views (right).



**Fig. 8:** Preoperative views (left), 6 months' postoperative views (right).

**Postoperative complications**

Rhinoplasty complications are not uncommon especially when dealing with secondary or posttraumatic cases.

Prolonged tip edema was a common complication in open rhinoplasty. It was noticed to be persistent in six cases after 1 month and in three cases after 2 months. For these patients, local corticosteroid (Betamethasone) was injected with much improvement after 2–3 weeks.

Radix edema and erythema were a bothering complication early postoperative in half of cases with DC-F grafts. Prolonged radix edema was seen in three of these cases. They were managed conservatively using plaster tapes (Steri-strips<sup>®</sup> 0.5 inch) on the radix area as well as anti-edematous drugs (Fig. 7).

The following table and bar chart summarize the most common complications encountered in the studied patients (Fig. 9, Fig. 10, Table 1).

**Table 1:** Complications

Case No. (%)	Residual nasal deviation	Residual nasal obstruction	Overcorrection	Prolonged radix edema	Prolonged tip edema of more than 6 weeks	Nostrils' asymmetry	Supra-tip depression
	1 (5)	2 (10)	1 (5)	3 (15)	3 (15)	3 (15)	1 (5)

Case 1



Fig. 9: Postoperative radix erythema and edema 6 weeks' postoperative on the left and six months' postoperative on the right.

Case 2



Fig. 10: Some degree of overcorrection.

Postoperative radiological assessment

Using ultrasound, the thickness of the DC-F graft was measured after 1 month, 3 months, and 6 months postoperatively. (Fig. 11) The difference in graft thickness denoted the degree of resorption. (Fig. 12).

The following bar graph summarizes DC-F thickness measurement using ultrasound at 1, 3, and 6 months' intervals (Fig. 12).

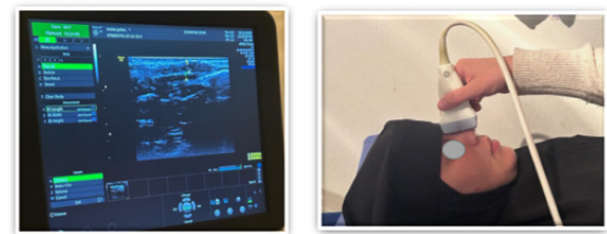


Fig. 11: Ultrasound measurement of the DC-F height during the follow-up period.

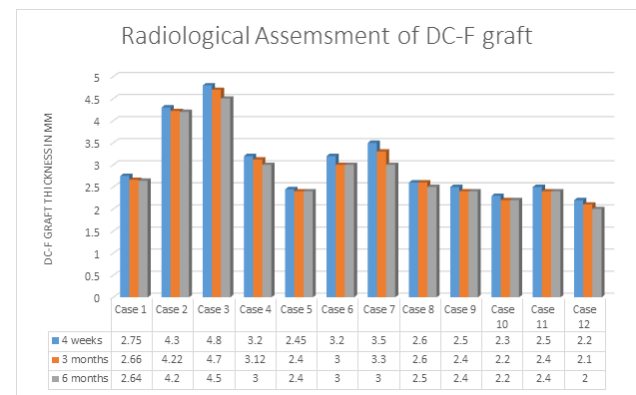


Fig. 12: Bar graph showing different DC-F thicknesses measured by ultrasound at 1, 3, and 6 months' intervals

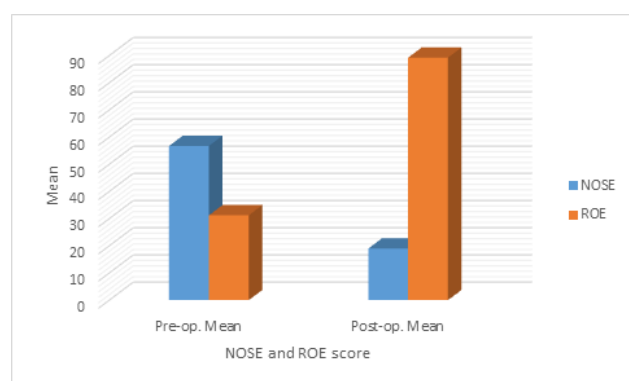
Patient satisfaction

According to the NOSE and ROE questionnaire, analysis of the NOSE scale with paired t-test showed significant improvement in the postoperative functional state compared with the preoperative state ( $P < 0.01$ ). The mean NOSE score preoperatively was 56.75; the mean NOSE score postoperatively was 19 (Table 2) and (Fig. 13).

Analysis of the ROE scale with paired t-test showed significant improvement in the postoperative cosmetic state compared with the preoperative state ( $P < 0.01$ ). The mean ROE score preoperatively was 31.21; the mean postoperative score was 88.73 (Table 2) and (Fig. 13).

Table 2: Nasal obstruction symptom evaluation and rhinoplasty outcome evaluation scores

Score scale	Preoperative (mean)	Median difference	Postoperative (mean)	Median difference	P value
NOSE	56.75	55	19	17.5	0.006
ROE	31.21	33.3	88.73	89.25	0.001



**Fig. 13:** Patient satisfaction (nasal obstruction symptom evaluation and rhinoplasty outcome evaluation scores).

## DISCUSSION

Operating on rhinoplasty patients, especially those with secondary or posttraumatic cases with severe deformities presents the ultimate challenge for any plastic surgeon. Preoperatively, the surgeon should clearly understand the patient's complaints with each of his deformities. This helps the surgeon to focus his surgical plan to meet the patient's priorities; because in some cases, it is impossible to solve all the difficult functional and cosmetic problems faced by the patient.<sup>[2]</sup>

This study was carried out on 20 patients (70% females and 30% males) with a mean age of 31.6 years. On reviewing 20 rhinoplasty cases, the patients were classified, according to the cause, into 4 cases who were suffering posttraumatic saddle nose deformity (20%), three cases of cleft lip rhinoplasty (15%), five cases had primary aesthetic problems (25%), and eight cases (40%) were seeking secondary rhinoplasty.

Dorsum saddling was seen in more than half of the patients in this study (55%). The most common causes were either posttraumatic in four cases or iatrogenic due to an over-resected dorsum in six cases. The remaining case was due to cleft lip nasal deformity. Dorsum saddling was managed first by reconstruction of a strong L Strut using two extended spreader grafts and a caudal extension graft, and then an on-lay dorsum graft on the most depressed part of the nasal dorsum (in some cases), and finally DCF graft on top.

A study carried out by Cerkes N concluded that DC wrapped in rectus fascia is an effective technique for nasal dorsum augmentation with no risk of resorption. In addition, using rectus fascia instead of temporal fascia does not add donor site morbidity<sup>[10]</sup>.

There was another study by Chen Y on different degrees of dorsum saddling. It was concluded that costal cartilage grafting is essential in severe degrees of dorsal saddling, where much more cartilage grafts

were needed. Reconstruction of a strong L strut involves using two extended spreaders and a caudal extension graft. The two spreaders can be fixed 1-2 mm above the existing nasal dorsum to add some dorsal augmentation. Finally, DC-F was much more preferred over the block-on-lay graft for further dorsal augmentation<sup>[6]</sup>.

Forms of dorsum hump, open roof, or inverted V deformity were managed by hump excision, proper osteotomies, repairing the key-stone area, and finally using Free DC to fill minor irregularities and to smooth the nasal dorsum, especially in thin nasal skin patients.

In a systematic review by Ledo *et al.* on six studies including a total number of 4,044 patients on the outcome of free diced cartilage grafts is rhinoplasty, it was concluded that free diced cartilage grafting is a versatile tool allowing the correction of small imperfections on the dorsum, thus contributing to the improvement of the nasal contour and irregularities. The graft resorption was reported in four articles, which described 22 out of 3,288 (0.67%) cases of partial resorption. Therefore, the available evidence suggests that resorption of the graft and unfavorable outcomes are rare. Moreover, the main reasons for the reoperation cases were overcorrection and nasal contour irregularities; therefore, for the author Ma *et al.*, an over-correction should not be performed<sup>[14]</sup>.

In a popular study carried out by Daniel and Calvert<sup>[11]</sup> to assess the long-term results of the 'Turkish delight' (DC wrapped in Surgical) described by Erol, Ö<sup>[15]</sup>, Daniel and Calvert concluded that Surgical had a negative impact on DC viability due to significant foreign body reaction that did not happen when they used temporal fascia instead. This was proved clinically by graft resorption and resaddling as well as histologically by excessive collagen deposition, which denotes fibrosis in cases where Surgical was used for DC wrapping<sup>[11]</sup>.

In our study, assessment of DC-F viability was done by measuring graft thickness by means of ultrasound imaging and comparing its thickness during the follow-up intervals at 4 weeks, 3, and 6 months. It was found that the overall graft thickness remains stable throughout the follow-up period. So DC-F is a stable graft and its resorption is rare. This conclusion is also documented by other studies such as the Keyhan *et al.* systematic review and meta-analysis<sup>[16]</sup>.

In the current study, the main complications were radix edema and tip edema seen in three (15%) cases each. Radix edema was managed conservatively in all cases, while prolonged tip edema resolved dramatically upon local corticosteroid injection (Betamethasone), residual nasal deviation in one case, nasal obstruction

in two cases, overcorrection of a saddle deformity is seen in one case in one case (5%), and a supra-tip depression in one case (5%). There were no infections, resorption, warping, or skin necrosis.

In a meta-analysis carried out by Keyhan *et al.*, it was found that 13 groups reported graft resorption for 380 patients in total. The weighted mean percentage of resorption was 2.52%. Twelve studies reported deviation rates with an aggregate of 254 patients. The pooled estimate of deviation was 1.77%. Twelve groups reported the infection for 345 patients in total; the weighted mean percentage was 2.30%. Seven studies with 256 cases reported supra-tip depression. The weighted mean percentage of supra-tip depression was 1.13%. Four studies with a total of 165 patients reported overcorrection; the pooled estimate was 3.06%. Seven groups (125 cases) reported visible bulging of the graft in the rhinion area with a pooled estimate of 2.64%<sup>[16]</sup>.

## CONCLUSION

Rhinoplasty, whatever the cause, remains one of the most challenging operations performed by plastic surgeons. Correction of secondary cases is a complex and technically demanding task and it demands expert hands for aesthetic as well as functional improvement<sup>[5]</sup>.

Paying attention to the nasal dorsum aesthetics is as important as the tip aesthetics<sup>[7]</sup>. The main challenges about grafting the nasal dorsum are graft visibility and durability<sup>[17]</sup>. That is why the use of diced cartilage grafts either free for camouflaging minor irregularities or wrapped in the fascia for augmentation has solved this dilemma<sup>[10,18]</sup>. In cases of saddle nose deformity, it is important to look for structural support first (strong L strut) before thinking about dorsum augmentation<sup>[19]</sup>.

## CONFLICT OF INTEREST

There are no conflicts of interest.

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