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ORIGINAL ARTICLE

Assessment of Diced Cartilage versus Diced Cartilage with Platelet Rich Plasma in Nasal Tip Augmentation

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ABSTRACT

Background: For many years, diced-cartilage grafts have been utilized successfully to enhance the tip of the nose with exception of some cases which have skin irregularities deformities and graft resorption. This technique combining diced cartilage grafts, Platelet Rich Plasma (PRP) in a chrysalis manner allows correct nasal tip augmentation with no major complications and minimal graft resorption due to the regenerative properties of the PRP.
This study aimed to compare the outcome of using diced cartilage only or diced cartilage with PRP technique in nasal tip augmentation.
Methods: The study was conducted on 24 patients at Otolaryngology Department, Zagazig University Hospitals. Patients were divided into 2 groups: group 1: 12 patients underwent tip augmentation by diced cartilage only and group 2: 12 patients underwent tip augmentation by diced cartilage and PRP.
Results: There was significant difference between both groups regarding visual analogue scale (VAS) score. **Conclusions:** Diced cartilage with PRP technique for nasal tip augmentation may lead to improved postoperative outcomes with less pain and higher patient satisfaction without impacting graft integrity or resorption rates compared to diced cartilage only.
Keywords: Diced Cartilage; Platelet Rich Plasma; Nasal Tip Augmentation

INTRODUCTION

One of the trickiest plastic surgery treatments is rhinoplasty. In terms of technical difficulty, tip surgery is an art form. It calls for a thorough comprehension of the intricate three-dimensional anatomy of the nose, a thorough grasp of its physiology, familiarity with the procedures for nasal tip surgery as stated, and a refined sense of aesthetics. Revision rhinoplasty is frequently necessary due to anomalies in the nasal tip, which is widely acknowledged as the most complicated aspect of rhinoplasty [1].

The nasal tip's intricate three-dimensional structural architecture defines the final shape and function of the tip based on the interactions between these structures. Therefore, modifications to one nasal tip structure frequently result in modifications to other parts of the nasal tip [2].

Creating a stable, symmetric, aesthetically pleasing, projecting, and rotating nasal tip that is triangular at base view and harmonious with the remainder is the common aim of nasal tip surgery, and it should never hinder function [3].

A modified technique for autologous nasal tip augmentation using diced cartilage that also incorporates a PRP autologous carrier. This technique is a modification of Daniel and Calvert's technique that uses diced cartilage [4]. Diced cartilage in nasal tip augmentation was first popularized by **Erol** in a large series using the named Turkish delight technique [5].

Diced autologous cartilage wrapped in oxidized regenerated cellulose (Surgicel; Ethicon Inc.) was the method used by Erol. Some have criticized the procedure for not being easily replicable, citing higher rates of cartilage resorption using similar techniques, despite the extremely good results provided by Erol [1, 6].

Moreover, research on animals has revealed that cartilage grafts covered in surgicel do not proliferate, and surgicel has been linked to persistent inflammation [7].

Bullocks described an additional form of this approach that used diced cartilage in an autologous scaffold made from Platelet-Rich Plasma (PRP) and Platelet-Poor Plasma (PPP) [8].

Growth factors are present in PRP. According to the clinical experience, there are a number of possible drawbacks to this procedure, such as skin abnormalities that are palpable and apparent along the surface of the diced cartilage, a limited amount of overall dorsal augmentation, and the displacement of the cartilage graft. To overcome these limitations, which have been described by **Daniel** and **Calvert**, we used a procedure that combines PRP with diced cartilage, to reduce the likelihood of skin abnormalities and graft resorption while still obtaining effective nose augmentation [4].

METHODS

This prospective comparative study was conducted on 24 patients at Otolaryngology Department, Zagazig University Hospitals during the period from September 2023 to March 2024. An informed written consent was obtained from the patients. The study was approved by the Ethics Committee of Faculty of Medicine, Otolaryngology Department, Zagazig University Hospitals (IRB number: 10678).

Patients were divided into two groups: group 1 included 12 patients who underwent nasal tip augmentation with diced cartilage only and group 2 included 12 patients who underwent nasal tip augmentation with diced cartilage and PRP.

Inclusion criteria included both sexes, age from 18-60 years, patient of different nasal tip deformities, patients undergoing nasal tip augmentation and revision rhinoplasty.

Exclusion criteria included nasal malignancy, infection of the nose (sinusitis, rhinitis) non-traumatic deformity, youngsters, women who are pregnant or nursing, cardiac insults, autoimmune disorders, liver or kidney damage, and infections that have recently occurred locally or systemically within the past month.

All studied cases were subjected to a detailed history taking, general examination, laboratory investigations including CBC, LFT, KFT, HbA1C, HCV-Ab. HBS-Ag, PT, PTT, INR and radiological investigations including computed tomography and ECG if needed.

Patients were divided into 2 groups: group 1: 12 patients underwent tip augmentation by diced cartilage only and group 2: 12 patients underwent tip augmentation by diced cartilage and PRP.

Preoperative preparation:

Methylene blue was used to mark the nose's base, rear, and tip. A precise measurement of the nasal root's height was made. Preoperative photography was done, and the surgery consent was signed.

Surgical technique:

After informed consent (including photos publication for research issues), patients were photographed and marked. All patients underwent rhinoplasty procedures under general anesthesia with endotracheal intubation and in supine position with head had fixed on head ring. Infra-cartilaginous (rim) incision had been employed in closed rhinoplasty, with trans columellar incision in open rhinoplasty with diced cartilage insertion and fixation in pocket. Nasal dressing and nasal back had been fixed then nasal splint for 2 weeks. Donor sites of grafts included septal, conchal, and costal cartilage.

Diced cartilage:

In group 1, cartilage was diced into small pieces ranging in size from 0.5 to 1.0 mm cubes using a blade size of 11. This method allowed for the preparation of diced cartilage transplants. Cartilage was removed from the tragus, concha, ribs, and nasal septum without the presence of perichondrium. Subsequently, the cartilage was cut and divided into fragments with a diameter of less than 0.2 mm. Using tiny volumes (13 ml) of gentamicin solution or normal saline (NaCl) produced an adhesive effect through surface tension during the dicing process. Squeezing the cartilage throughout the cutting process was crucial to preserving the vitality of the chondrocytes. In the end, a fine-particle free diced cartilage (FDC) granulate with paste-like properties was created. After being dried and packed into a 1-ml syringe, the FDC paste was finally injected either directly into the targeted area or via raspatorium. We massaged and immediately fixed the nasal dorsum with a paper drape after applying FDC. We finished our surgery by applying an external nasal stent and steristrips at the conclusion. When the outer nasal cast was removed on the seventh post-operative day, during the initial post-operative visit, the stitches were taken out**.**

PRP procedures:

Patients who needed nose tip augmentation had chrysalis-shaped surgery employing diced cartilage in a PRP clot carrier. Following blood centrifugation, the PRP fraction was separated and utilized to transport the diced cartilage graft. Diced cartilage was administered to patients undergoing nasal tip augmentation using a PRP clot carrier. The cartilage was finely diced rather than mashed. Septum, concha, and chondro-costal union were the locations of cartilage donation. Slices of cartilage measuring 0.5–1 mm were made. Blood was centrifuged at 1800 rpm for 8 minutes to extract PRP. In the preoperative area,

4.5 cc sterile vacuum tubes containing 3.8% sodium citrate as an anticoagulant were used to extract 20 cc of peripheral blood. Sodium citrate's anticoagulant properties combined with low-intensity centrifugation preserved the integrity of the platelet membrane throughout the procedure. Three layers were seen in the tube following centrifugation: platelets were found in the upper yellow layer, which contained platelets, white cells were found in the middle thin layer, and red cells were found in the lower red layer. Furthermore, the platelet-containing top layer was separated into three layers: Platelet-Rich Plasma (PRP), which is the fraction of blood that interests us and makes up about 10% of the total volume drawn; Platelet-Poor Plasma (PPP), which is the layer that essentially only contains plasma and contains less platelet growth factors; and the middle layer, which is situated directly above the white series and shows a very similar platelet proportion of peripheral blood**.**

The PRP fraction was utilized to transport the diced cartilage graft; it was removed by hand pipetting. For every 0.5 cc of PRP, 0.05 cc of 10% calcium chloride was added to activate the PRP fraction. Platelets were able to release growth factors from the alpha granules by PRP activation. The activated PRP became a clot with a gelatinous nature after 7–8 minutes. The diced cartilage graft was inside this clot. Next, the graft was placed inside the nasal tip. The shape and location of the graft might be changed by hand. For seven days, the nasal dorsum was covered with steri-strip and a nasal splint. On the fourth day following surgery, a clinical revision was performed. The splint was removed to ensure that the graft had not shifted and to allow for manual modelling if required. It was then repositioned until the seventh day. Five days of antibiotic prophylaxis were administered. Linear superficial tissue ultrasonography was used to assess the thickness of the cartilage transplant in both groups during the first postoperative week and the third month. The thickness of the cartilage graft was measured there**.**

Open approach for nasal tip surgery:

In our study, we suggested this course of treatment for individuals with cleft tip nose, nasal valve constriction, tension nose, and gross nasal dorsum deformity associated with nasal tip abnormalities. The open technique offered more control over the procedure and bleeding, as well as precise, easy-to-use suturing and diced cartilage placement. The drawbacks were a lengthier recovery period, a higher chance of tip edema, trans-columellar scarring, and challenges forming pockets for graft stabilization**.**

Follow up and outcome measurement:

Postoperative morbidity, including edema pain via visual analogue scale (VAS) was recorded. Patients were followed up clinically for 6 months by assessment of tip irregularities and skin deformities.

Statistical Analysis:

All data were collected, tabulated, and statistically analyzed using SPSS 26.0 for windows (SPSS Inc., Chicago, IL, USA). The used tests were chi-square (X2) test and independent T-test.

RESULTS

There was no significant difference between both groups regarding age, gender, comorbidities, operative time, and technique type (Table 1-3). There was significant difference between both groups regarding VAS score (Table 4). There was no significant difference between both groups regarding follow up time and secondary outcome (Table 5,6).

Table (1): Demographic data among participants in each of the study group.

		Group 1(diced cartilage only) N=12		Group 2(Diced cartilage and PRP) N=12		t-test	P value
Age	**Mean(SD)**	33.50 ± 4.253		28.3 ± 8.3		1.9	0.08
Gender		N	%	N	%	0.68	0.48
	Male	4	33.3	6	50		
	Female	8	66.7	6	50		

Table (2): Comorbidities among participants in each of the study group.

		Group 1(diced cartilage only		Group 2(Diced cartilage and PRP)		X^2	p-value
		N	%	N	%		
Hypertension	**No**	8	66.7	9	75	0.2	0.65
	Yes	4	33.3	3	25		
Diabetes	**No**	5	41.7	9	75	2.7	0.09
	Yes	7	58.3	3	25		
Hyperlipidemia	**No**	9	75	6	50	1.6	0.21
	Yes	3	25	6	50		

Table (3): Operative data among participants in each of the study group.

		Group 1(diced cartilage only) N=12		Group 2(Diced cartilage and PRP) N=12		t-test	P value
Operative time(min.)	**Mean(SD)**	147.5± 14.4		137.7± 15.6		1.6	0.12
Technique type		**N**	**%**	**N**	**%**	-	-
	Open	12	100%	12	100%		

Table (4) Comparison between study groups regarding VAS.

Postoperative outcomes		Group 1(diced cartilage only) N=12	Group 2(Diced cartilage and PRP) N=12	t-test	P value
VAS (pain score)	**Median (Min-Max)**	3 (2-4)	2 (1-4)	MW=27	**0.007***

SD: Standard deviation **t-test:** Independent t-test *P<0.05 **P<0.001

Table (5): Follow up time among participants in each of the study group.

		Group 1(diced cartilage only		Group 2(Diced cartilage and PRP)		X^2	p-value
		N	%	N	%		
Follow-up time (Month)	**3m**	1	8.3	1	8.3	3.8	0.3
	4m	4	33.3	3	25.0		
	5m	6	50.0	3	25.0		
	6m	1	8.3	5	41.7		

Table (6): Comparison between the study groups regarding secondary outcomes.

		Group 1(diced cartilage only		Group 2(Diced cartilage and PRP)		X^2	p-value
		N	%	N	%		
Prolonged Supra-tip swelling	**No**	7	58.3	12	100	6.32	0.012
	Yes	5	41.7	0	0		
Nasal obstruction	**No**	12	100	12	100	-	-
	Yes	0	0	0	0		
Tip Irregularity	**No**	10	83.3	12	100	2.18	0.14
	Yes	2	16.7	0	0		
Tip Nodularity	**No**	12	100	12	100	-	-
	Yes	0	0	0	0		
Increased fibrosis formation	**No**	12	100	12	100	-	-
	Yes	0	0	0	0		
Edema in the face	**No**	12	100	12	100	-	-
	Yes	0	0	0	0		
Ecchymosis	**Yes**	12	100	12	100	-	-
	No	0	0	0	0		
Hypertrophied scar	**Yes**	12	100	12	100	-	-
	No	0	0	0	0		
Hematoma	**Yes**	12	100	12	100	-	-
	No	0	0	0	0		
Infection	**Yes**	12	100	12	100	-	-
	No	0	0	0	0		
Skin discoloration	**Yes**	12	100	12	100	-	-
	No	0	0	0	0		
Tip necrosis	**Yes**	12	100	12	100	-	-
	No	0	0	0	0		
Satisfaction	**Not satisfied**	5	41.7	1	8.3	4.27	0.102
	satisfied	4	33.3	4	33.3		
	Very satisfied	3	25.0	7	58.3		

DISCUSSION

In our study, there was no significant difference between both groups regarding age and gender, comorbidities, operative time, and technique type.

In our study, for group 1 with diced cartilage only, follow-up was 50% at 5 months, 33% at 4 months, 8% at both 3 and 6 months. For the PRP augmented Group 2, 41.7% had 6 months follow-up, 25% had 4-5 month, and 8% had 3-month follow-up. Statistical analysis showed no significant difference in follow-up times between the two groups (p=0.3).

Beut et al. reported that, a total of 31 patients, whose ages ranged from 42 to 50, had augmentation rhinoplasty using PRP and diced cartilage. A follow-up of 14 months was average. In twenty cases, an open rhinoplasty was used, and in eleven individuals, all cases are done by open approach rhinoplasty [9].

In agreement with our study, **Yan et al.** found that the nasal shape was stable, the contour was higher and more stereoscopic than before, and the average increase in nasal height was 3.0 mm in the combined group and 2.0 mm in the control group. They also sought to investigate ways to improve the fat retention rate in a total of 70 enrolled patients, randomly divided into two groups: the conventional fat-granule transplantation group (n = 35 in each group) and the platelet-rich fibrin (PRF) combined with high-density fat transplantation group (combined group) and the total number of patients randomly assigned to each group [10].

In addition, **Scafani,** found that platelet-rich fibrin matrix (PRFM) was found to work well when utilized as a nasolabial filler or graft material in facial aesthetic operations [11].

In a study by **Bullocks et al.,** split cartilage and platelet rich plasma (PRP) were used to treat 68 patients for dorsal augmentation. The authors

stated that during long-term follow-up, dorsal augmentation using cartilage graft and PRP was a safe and successful procedure [8]. PRP has certain drawbacks, including the fact that it is liquid or gel and cannot be wrapped around split cartilage grafts; additionally, it requires calcium and bovine thrombin to be added; it requires twice centrifugation; and it requires more blood to be drawn from the patient [12].

Studies have shown that when PRP is added to chondrocytes, cartilage production is significantly upregulated in comparison to controls [13]. These results are nevertheless relevant for cartilage grafts even if the majority of these papers deal with intra-articular cartilage regeneration [14]. Transforming growth factor-β (TGF-β), platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and epithelial growth factor (EGF) are a few of the growth factors that have been investigated the most. While VEGF is well recognized to be a strong angiogenesis stimulant, TGF-β has been connected to chondrogenesis [15].

Mishra et al. According to a study conducted in vitro, PRP improved chondrogenic differentiation [16].

Saito et al. showed, in a rabbit model, the injection of PRP-containing gelatin hydrogel microspheres prevents osteoarthritis degeneration [17].

Tasman et al. outlined a method of nose augmentation without fascia that uses a diced cartilage glue graft with Tisseel (Baxter International Inc.). Tisseel's maker warns that because the fibrin sealant is made from pooled human plasma, it may cause hypersensitivity or allergic reactions and may spread infectious pathogens [18].

An alternative procedure to ours, the combination of diced cartilage with an injectable fraction of PRF, demonstrated a decrease in cartilage resorption and an increase in viability and preservation of the nasal dorsum's form [19].

Without any additional material, diced cartilage may produce abnormalities on its own. Dorsal abnormalities could result from it congregating in a particular area. The use of an alternate technique for rhinoplasty was defined by **Öreroğlu et al.** [20]. Using autologous fibrin material was a practical and easy way to make diced cartilages more stable. The atmosphere was rather sticky, preserving the shape of the broken cartilage. Furthermore, it might improve cartilage viability through growth factors, which are an inherent component of I-PRF. Still, it was unclear if this combination would work.

Brenner et al. observed that autologous temporalis fascia did not adversely affect cartilage viability and regeneration in experimental research [21].

In their rhinoplasty, **Daniel and Calvert** used split cartilage wrapped in autologous temporalis muscle fascia to achieve long-term success [4].

The authors of the study by **Kim et al.** contrasted split cartilage wrapped in fascia with split cartilage wrapped in Alloderm. It has been shown that Alloderm exhibits a strong capacity for chondrocyte regeneration, matrix colloid production, and metaplastic bone formation [22].

In patients with dorsal nasal abnormalities, **Guerrerosantos et al.** employed fragmented and crushed ear conchal cartilage transplants wrapped in temporalis fascia, and demonstrated in a histological investigation that there is good graft contact. After six months of installation, it continues to remain in perfect macroscopical condition. Erythema and fascia resorption were the most frequent side effects [23].

In our study, there was no significant difference in cartilage transplant thickness between the two groups, however there was a significant difference in VAS score.

Moghazy et al. discovered that PRP may also lessen pain in wounds, which is consistent with our findings. They used either PRP gel or vacuum-assisted closure (VAC) to treat 40 patients with "complex wounds," which are characterized as acute or chronic wounds that present challenges for medical teams in terms of treatment and healing. Pressure sores, burn injuries, venous ulcers, diabetic ulcers, surgical wounds, and traumatic wounds were among the conditions that the patients in this study had experienced. The PRP group's hospital stays were shorter though not statistically significant and their VAS scores were considerably lower, according to the authors [24].

Malahias et al., and **Sabaah et al.** found that PRP shows promising results in terms of pain decrease [25,26]. **Hanci et al.** showed significantly better pain relief in treating TMJ disorders with intra-articular platelet-rich plasma injection [27].

Gentile et al. observed that pain levels were reduced significantly [28]. Also, pain reduction was reported by **Segreto et al.** following the application of modified nano-fat grafting and platelet-rich plasma to infected ulcers to enhance their regeneration and antibacterial properties [29].

In our study, there was no significant difference between both groups regarding secondary outcome. Graft resorption rates was

lower in the group with diced cartilage plus PRP compared to diced cartilage alone but it did not reach significant difference. Thus, we cannot conclude that PRP reduces graft resorption. Patient satisfaction was higher in group with diced cartilage plus PRP compared to diced cartilage alone but it did not reach significant difference.

According to **Yan et al.**, who also found greater rates of fat survival and patient satisfaction with their first operation, there was no significant difference in the healing process and time when compared to the control group. There were no problems, infectious induration, or fat embolism. This outcome suggests more precise fat volume regulation and improved soft tissue filling capacity [10].

On the other hand, **Beut et al.** conducted a study on nasal dorsal augmentation, noting that the majority of cases exhibited no cartilage resorption, maintaining nasal dorsum shape and integrity. The reported rate of partial graft resorption was 9.67%, significantly lower than rates seen with other techniques without PRP, which can reach up to 30%. Clinical examination, palpation, and photographic documentation were employed to assess results, and overall patient satisfaction was measured. No major complications requiring surgical revision were observed, including no extrusions, graft displacements, or skin irregularities. Among ex-cocaine users, three cases experienced partial graft resorption, but patients declined additional surgery. A single case of local infection resembling cellulitis was resolved with oral antibiotics, while two keloids at the ear donor site in African patients were treated successfully with triamcinolone injections. In the remaining cases, satisfactory nasal dorsal augmentation was achieved [9].

Güler et al. compared histologically in four rabbit comparison groups (bare diced cartilage, diced cartilage wrapped in AlloDerm, diced cartilage wrapped in Surgicel, and diced cartilage wrapped in platelet-rich fibrin matrix) the viability of chondrocytes, the amount of collagen fiber in the matrix, and the changes in peripheral tissue [30]. They came to the conclusion that the cartilage immersed in the platelet-rich fibrin matrix group had increased chondrocyte viability, a higher fiber content in the matrix, and alterations in peripheral tissue. **Manafi et al.** demonstrated that PRP was useful in boosting the ability of cartilage grafts to regenerate and survive in a rabbit model [31].

The benefits of platelet-derived growth factors extend beyond enhancing cartilage graft life. Adipose-derived stem cells (ADSC) have the potential to preserve the viability of diced cartilage, according to research by **Orbay et al.** Because ADSC are simple to extract and autologous, they might help enhance the long-term results of cartilage transplanting. On the other hand, getting PRP is easier than getting ADSC [32].

PPP functions as an organic fibrin adhesive. In a pig model, cyanoacrylate glue was tried instead of sutures to secure rib cartilage slices, however it was discovered that this solution caused a severe foreign body reaction that led to partial resorption of the graft [33].

In order to fill in and conceal the nasal dorsum in seven patients, **Tapia and Santamaria** utilized L-PRF combined with cartilage. They then subjectively evaluated the level of patient satisfaction and whether or not graft reabsorption took place over a range of 17 to 24 months. The authors deemed the usage of L-PRF to be both safe and effective in these few situations [34].

In their evaluation of the histologic effects of PRF use on the maturation of bone allografts in implant dentistry, **Choukroun et al.** noted that new formed bone and connective tissue were present despite PRF reabsorption, indicating a genuine biologic effect [35].

Gentile et al. found that patients receiving PRP gel application and maxillofacial surgery had a low rate of morbidity and good patient satisfaction. There was a noticeable decrease in pain [28].

According to **Brenner et al.,** temporalis fascia, like perichondrium, is thought to boost chondrocyte vitality, prevent graft resorption, and preserve the cartilage fragments' overall capacity for regeneration. The drawbacks of this fascia approach are scarring and the requirement for further incision [21].

CONCLUSIONS

Our study demonstrated that diced cartilage with PRP technique for nasal tip augmentation may lead to improved postoperative outcomes with less pain and higher patient satisfaction without impacting graft integrity or resorption rates compared to diced cartilage only.

Declaration of interest

The authors report no conflicts of interest.

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