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REVIEW ARTICLE

Efficacy and safety of platelet-rich fibrin combined with diced cartilage in rhinoplasty: a systematic review and meta-analysis

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Abstract

Purpose The purpose of this study was to evaluate the efficacy and safety of combining platelet-rich fibrin (PRF) with diced cartilage (DC) in patients undergoing rhinoplasty.

Methods A systematic search of MEDLINE/PubMed, Cochrane Library, Web of Science, and Scopus was conducted, including studies published through August 9, 2024. We included observational studies and clinical trials of rhinoplasty using the DC technique with PRF. Primary outcomes were cartilage resorption, nasal dorsum/tip irregularity, and patient satisfaction. Secondary outcomes included postoperative complications such as edema, hematoma, infection, erythema, displacement, and extrusion. Risk of bias (ROB) was assessed using the ROB2 tool for randomized trials and the MINORS checklist for observational studies.

Results Seven studies with 286 participants were included. Results showed minimal cartilage resorption in five studies. The pooled incidences of nasal dorsum/tip irregularity, erythema, and displacement were 0.43% [95% CI: 0.00-1.95%], 1.63% [95% CI: 0.00-4.99%], and 0.63% [95% CI: 0.00-2.22%], respectively. Patient satisfaction was high, with a pooled rate of 94.33% [95% CI: 89.28-99.38%].

Conclusion The addition of PRF to DC in rhinoplasty was associated with favorable postoperative outcomes and high patient satisfaction, with a low incidence of complications. However, the lack of comparative studies makes it difficult to determine whether PRF provides significant benefits over DC alone. Larger randomized controlled trials with longer follow-up are needed to further validate these findings.

Keywords Cartilage scales · Diced cartilage · Nasal dorsum augmentation · Nasal dorsum camouflage · Platelet-rich fibrin · Rhinoplasty

Introduction

Rhinoplasty is one of the most commonly performed procedures in facial plastic surgery. In addition, rhinoplasty is a challenging procedure due to the complex anatomy and tissue relationships in the different regions of the nose [1, 2].

One of the most common complications following rhinoplasty is the development of nasal dorsal irregularities. When these irregularities are visible or palpable, they reduce patient satisfaction and require revision rhinoplasty [3, 4]. To avoid this complication, dorsal camouflage can be used to support the skin-soft tissue envelope. In addition, dorsal camouflage can also correct minor bony and cartilaginous irregularities of the nasal dorsum [3, 4].

Several techniques have been described for nasal camouflage using a variety of materials, including autologous and non-autologous grafts [3, 4]. One of the most commonly performed camouflage techniques is diced cartilage (DC), which has the advantages of reliability and flexibility. In addition, the DC technique has shown better biocompatibility compared to other alloplastic materials [5, 6]. However, cartilage resorption may occur after the DC technique in some patients, resulting in postoperative nasal dorsal irregularities [5], especially in thin-skinned patients [3, 4].

To overcome the problem of bone resorption after DC, the combination or wrapping of cartilage with other materials

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to form a stabilizing scaffold has been investigated [7, 8]. The materials used included Surgicel, temporalis fascia, and Allo-Derm [9, 10]. This technique has been successfully advocated to reduce the resorption rate at the expense of viability. However, there are some disadvantages associated with the use of these materials. The technique is time consuming as additional time is required to prepare the wrapped graft [4]. In addition, the use of temporalis fascia requires the performance of an additional surgical procedure to harvest the fascia. Furthermore, the use of Surgicel has been associated with increased inflammatory reactions, while AlloDerm is expensive [4].

Platelet-rich fibrin (PRF) is a second-generation platelet concentrate that has been used in orthopedic and dental procedures [11, 12]. PRF has several advantages. As an autologous biomaterial rich in leukocytes and platelets, PRF promotes wound healing and induces less severe inflammatory response and rejection compared to other biomaterials [2, 13]. In addition, PRF reduces edema and ecchymosis, which has increased its use in facial plastic and reconstructive surgery [14, 15].

Öreroğlu et al. [16] used autologous fibrin glue similar to PRF as a sticky environment to maintain the shape of DC in rhinoplasty with encouraging results. Other studies have also evaluated the effect of adding PRF to DC on postoperative outcomes after rhinoplasty [2, 3, 17]. However, there is a need to evaluate the results reported from these studies, especially since most of the studies have a small sample size. Therefore, the present meta-analysis aimed to synthesize the evidence regarding the efficacy and safety of PRF combined with DC in patients undergoing rhinoplasty.

Methods

Methodology

This systematic review and meta-analysis was registered at the International Prospective Register of Systematic Reviews (PROSPERO) (ID: CRD42024584976, Date: 10-9-2024). This study was conducted following the principles of the Cochrane Handbook for Systematic Reviews of Interventions, version 6 and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [18].

Eligibility criteria

Types of studies

This review includes observational studies and clinical trials published in English from their inception to August 9, 2024.

Participants

The study population comprises patients undergoing rhinoplasty utilizing the DC technique.

Intervention

The intervention of interest is the use of PRF in conjunction with the DC technique.

Comparison

Both single-arm studies and comparative studies evaluating PRF with the DC technique against the DC technique alone were considered eligible.

Exclusion criteria

We excluded conference abstracts, duplicate records, case reports, review articles, commentaries, editorials, and clinical guidelines.

Search strategy

Online search of databases

An online search encompassed the databases of MEDLINE/PubMed, Cochrane Library, Web of Science, and Scopus, without using search filters. The search terms for Medline/PubMed were ("Platelet-Rich Fibrin"[Mesh] OR "Platelet Rich Fibrin"[All Fields]) AND ("rhinoplasty"[MeSH Terms] OR "rhinoplasty"[All Fields] OR "rhinoplasties"[All Fields]) AND (("diced"[All Fields] OR "dicing"[All Fields]) AND ("cartilage"[MeSH Terms] OR "cartilage"[All Fields] OR "cartilages"[All Fields] OR "cartilages"[All Fields])). The search terms for the other databases were formulated using the Polyglot Search Translator [19] from Systematic Review Accelerator (SRA), Bond University.

Other sources

The reference lists of all retrieved full-text articles identified through the database search were screened to uncover additional potentially relevant records.

Selection of studies

An online search was conducted, followed by screening of titles and abstracts, and full-text assessment of the retrieved records to determine their eligibility for inclusion.

Data extraction

The extracted data encompassed (a) Study details: design, country, sample size, and length of follow-up; (b) Patient characteristics: age, sex, and history of prior rhinoplasty; and (c) Outcomes: resorption of the DC graft, irregularities of the nasal dorsum and tip, postoperative complications (edema, hematoma, infection, erythema, displacement, and extrusion), and patient satisfaction. Only published data were included in the analysis.

Outcomes

Primary outcome

The primary outcome was the resorption of the DC graft and the occurrence of irregularities on the nasal dorsum or tip.

Secondary outcomes

The secondary outcomes included postoperative complications (edema, hematoma, infection, erythema, displacement, and extrusion) and patient satisfaction.

Assessment of the risk of bias in included studies

The risk of bias (ROB) was assessed using the ROB2 tool for randomized clinical trials [20] and the MINORS checklist for non-randomized clinical trials (NRCT) and observational studies [21]. The ROB2 tool is composed of five domains to evaluate the ROB arising from the randomization process, deviations from the assigned treatment, missing data, measurement of the outcome, and reporting of the outcomes and results. The overall ROB for each study is determined by the highest ROB obtained from five domains. The MINORS checklist is composed of twelve questions. Each question receives points ranging from 0 to 2 based on the reporting of this item in the study. Questions from 9 to 12 are for studies with a control group. The overall ROB is assessed by summing the points for each question and dividing the total points into tertiles. The first, second, and third tertiles correspond to high, uncertain, and low ROB, respectively [22].

Data synthesis

Analyses were conducted using the R Statistical language (version 4.4.1) [23], using the package meta (version 7.0.0) [24]. The incidence of each outcome was calculated using the inverse variance method on the untransformed proportions, along with the 95% Clopper-Pearson confidence interval for individual studies. A continuity correction of 0.5 was applied to studies with zero cell frequencies. In the case of significant heterogeneity (a p-value from the Cochran Chi-square test <0.1 and/or the I^2 index $\geq 50\%$), a random-effects model was used for pooling the studies' results. Otherwise, a fixed-effect model was used [25]. Forest plots were created for the study results and pooled incidence. Formal testing for publication bias was not performed as the number of included studies was less than 10 trials.

Results

Results of literature search and study selection

The search strategy yielded 103 records, of which 28 were duplicates. The remaining 75 records were screened for titles and abstracts, and 68 records were excluded. The full texts of the remaining seven records were retrieved, but we were unable to obtain two records [26, 27]. The full texts of the remaining five studies were retrieved. One study was excluded because PRF was not combined with DC [8], while the remaining four were included in this systematic review and meta-analysis [2, 3, 28, 29]. Searches of citations and reference lists yielded six potentially relevant records, of which three were excluded because one did not use PRF [30], one was a case report [31], and the third was a duplicate [32]. The remaining three studies were eligible and included [17, 33, 34]. In total, seven studies were included after removal of duplicates (Fig. 1).

The basic characteristics of the included studies

A total of 286 participants were included in the seven studies. Four studies were NRCT [2, 17, 28, 33], while two studies were randomized controlled clinical trials [3, 29], and one study was a retrospective case series [34]. Only three studies included a control group [3, 17, 29], while the other four studies were single-arm. The duration of follow-up varied widely, from 2 months to 48 months, with a median follow-up of 9 months (Table 1).

The seven studies showed some variation in the characteristics of the participants included. The patients were mostly young adults, but two studies included adolescents [2, 28] and three studies included patients in their fifties [2, 28, 34]. Female gender was predominant in most studies. However, the percentage of female patients in the DC + PRF arm was 50% or less in two trials [3, 17]. Two studies included only patients undergoing primary rhinoplasty [3, 29]. Three studies included varying proportions of patients with previous rhinoplasty [2, 28, 34]. Two studies included only patients who underwent primary rhinoplasty [3, 29],

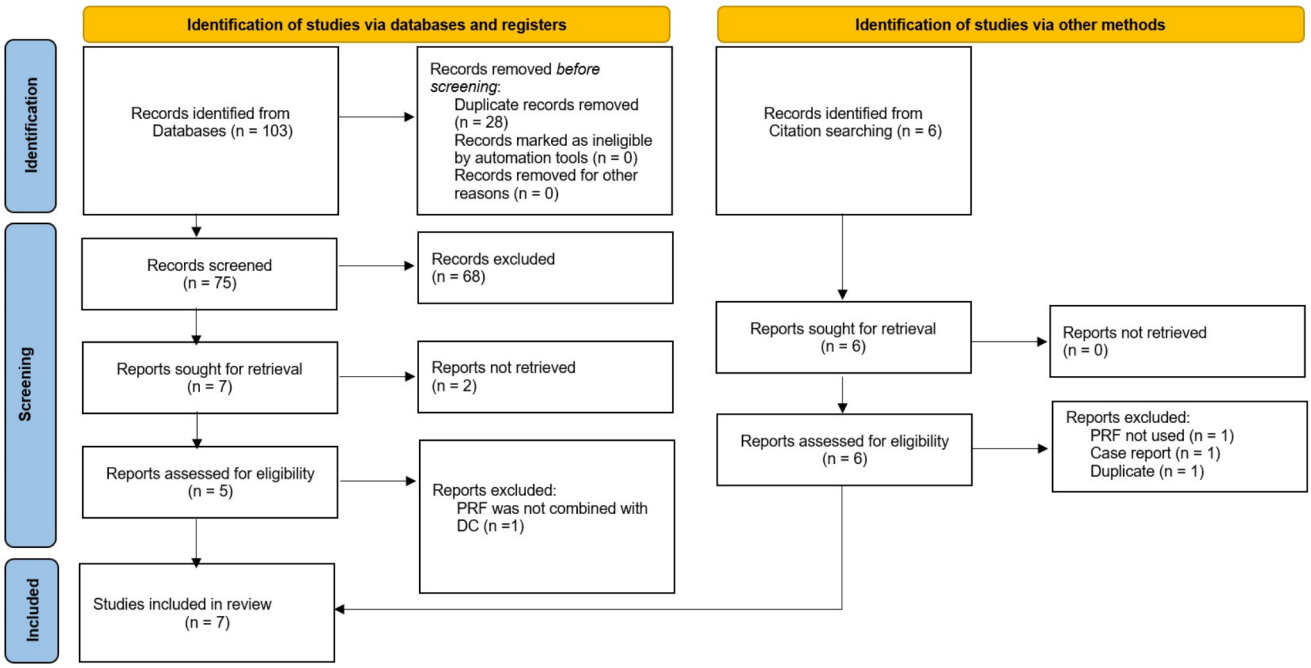

Fig. 1 PRISMA flow chart diagram for the results of literature search and study selection. DC: diced cartilage; PRF: platelet-rich fibrin

Table 1 Characteristics of the included studies ($n=7$)

Study	Location	Time span	Sample size	Design	Follow-up (months)
Bullocks et al. 2011 [33]	USA	From Mar 2005 through Jun 2008	68	NRCT (single-arm)	Mean 15 (range: 2–36)
Castro-Govea et al. 2015 [28]	México	NR	45	NRCT (single-arm)	Mean 24 (range: 6–48)
Kovacevic et al. 2017 [34]	Germany	Between Dec 2015 and Oct 2016	48	Retrospective case series	NR
Gode et al. 2019 [3]	Turkey	Between Feb 2018 and Aug 2018	38	RCT	3
Da S. Neto et al. 2020 [2]	Brazil	From Jan 2017 to Jan 2018	23	NRCT (single-arm)	12
Attia et al. 2024 [17]	Egypt	From Sep 2023 to Mar 2024	24	NRCT (two-arm)	Mean 5 (range: 3–6)
Mohebbi et al. 2024 [29]	Iran	In 2018 and 2019	40	RCT	6

NR: not recorded; NRCT: non-randomized clinical trial; RCT: randomized clinical trial

while the remaining two studies did not clarify this point [17, 33] (Table 2).

The assessment of the risk of bias in the included studies

The ROB for NRCT and observational studies showed potentially high risk regarding the inclusion of consecutive patients [17, 28, 33], prospective collection of data [28, 34], unbiased assessment of outcomes [2, 17, 33, 34], appropriate length of follow-up [17, 34], as well as the reporting of loss to follow-up and prospective calculation of the study size [2, 17, 28, 33, 34]. The overall ROB was uncertain in three studies [2, 17, 28] and high in two studies [33, 34] (Table 3).

The ROB of the two randomized clinical trials showed uncertain risk regarding the process of randomization due to a lack of details about the generation of the random sequence [3] and allocation concealment [3, 29]. The risk of deviations from intended interventions showed high risk due to non-blinding of carers and the lack of information about the use of an appropriate analysis used to estimate the effect of assignment to intervention [3, 29]. One study showed a high ROB in the domain of measurement of outcome due to the non-blinding of outcome assessors [29]. As regards the domain of selective reporting, one study presented some concerns [3] due to the non-availability of a pre-specified protocol or analysis plan to compare with the study methods (Fig. 2).

Table 2 Summary of baseline criteria in the included studies ($n=7$)

Study	Arm	*N*	Age (years)	Female %	Thin Skin %	Secondary rhinoplasty %
Bullocks et al. 2011 [33]	DC+PRF	68	NR	NR	NR	NR
Castro-Govea et al. 2015 [28]	DC+PRF	45	Range: 17–53	75.6%	NR	22.2%
Kovacevic et al. 2017 [34]	DC+PRF	48	Range: 22–56	91.7%	NR	25%
Gode et al. [3]	DC+PRF	19	Mean: 27.3 (Range 20–38)	42.1%	NR	0%
	DC	19	Mean 27.5 (Range 18–37)	52.6%	NR	0%
Da S. Neto et al. 2020 [2]	DC+PRF	23	Mean: 32 (Range: 14–50)	78.3%	39.1%	39%
Attia et al. 2024 [17]	DC+PRF	12	Mean ± SD: 28.3 ± 8.3	50%	NR	NR
	DC	12	Mean ± SD: 33.50 ± 4.253	66.7%	NR	NR
Mohebbi et al. 2024 [29]	DC+PRF	20	Mean ± SD: 26.65 ± 8.16	100%	NR	0%
	DC	20	Mean ± SD: 29.05 ± 7.02	100%	NR	0%

DC: diced cartilage; N: Number; NR: not recorded; PRF: platelet-rich fibrin; SD: standard deviation

Results of systematic review and meta-analysis

Resorption of cartilage

Five studies reported the assessment of volume change/resorption [3, 17, 28, 29, 34]. Castro-Govea et al. [28] reported that cartilage volume retention ranged from very good to good, indicating little resorption. Kovacevic et al. [34] reported no resorption. In the two-arm studies, two studies reported significantly less volume loss in the DC+PRF group compared to the DC alone group (Fig. 3) [3, 29], while one study reported that the difference did not reach statistical significance [17] (Table 4).

Irregularities on nasal dorsum/tip

Six studies reported on the outcome of the development of nasal irregularities after rhinoplasty [2, 17, 28, 29, 33, 34]. Overall, only five cases out of 216 patients were reported. A fixed effect model was used to pool the incidence as the heterogeneity was not significant (Q = 4.58, $p=0.469$, I2 = 0%). The pooled incidence was 0.43% [95% CI: 0.00%, 1.95%], indicating that approximately four cases of irregularity occur per 1000 patients undergoing rhinoplasty with DC+PRF (Fig. 2). Two-arm studies reported an insignificantly lower incidence in the DC+PRF arm compared to the DC-alone arm [17, 29] (Table 4).

Patients' satisfaction

Three studies reported patient satisfaction after rhinoplasty [2, 17, 28]. Overall, 75 out of 80 patients were satisfied/very satisfied. A fixed effect model was used to pool the incidence because heterogeneity was not significant (Q = 0.54, $p=0.765$, $I^2=0\%$). The pooled incidence was 94.33% [95% CI: 89.28%, 99.38%], indicating that approximately 94 out of 100 patients undergoing rhinoplasty with DC+PRF were satisfied/very satisfied (Fig. 2). Only one comparative study assessed patient satisfaction [17] and reported no significant difference between the two groups (Table 4).

The need for further intervention

Three studies reported the outcome of the need for further intervention after rhinoplasty [3, 28, 34]. Overall, 4 out of 112 patients required further treatment (3.57%) (Table 4).

Postoperative edema

Three studies reported the outcome of postoperative edema [2, 3, 17]. Two comparative studies reported that edema was significantly less in the DC+PRF group compared to the DC alone group [3, 17]. The study by Da S. Neto et al. [2] reported that 17.4% of their patients developed edema (Table 5).

Erythema

Six studies reported the development of erythema after rhinoplasty [2, 3, 17, 28, 33, 34]. In total, 11 of 215 patients developed erythema. A random effects model was used to pool the incidence as the heterogeneity was significant (Q = 12.57, $p=0.028$, $I^2=60\%$). The pooled incidence was 1.63% [95% CI: 0.00%, 4.99%], indicating that approximately 16 patients per 1000 undergoing rhinoplasty with DC+PRF develop erythema (Fig. 4). In the two comparative studies, none of the patients in the DC+PRF or DC alone groups developed erythema [3, 17] (Table 5).

Displacement of graft

Four studies reported the occurrence of displacement after rhinoplasty [2, 28, 33, 34]. Overall, two of 184 patients experienced graft displacement (Table 5). A fixed effect model was used to pool the incidence as the heterogeneity was not significant (Q = 1.45, $p=0.694$, $I^2=0\%$). The pooled incidence was 0.63% [95% CI: 0.00%, 2.22%], indicating

Table 3 The risk of bias assessment for the included non-randomized and observational studies based on the MINORS checklist ($n = 5$)

Studies	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Total	Overall ROB
Bullocks et al. 2011 [33]	0	0	1	1	0	2	0	0	NA	NA	NA	NA	4	High
Castro-Govea et al. 2015 [28]	2	0	0	1	2	2	0	0	NA	NA	NA	NA	7	Uncertain
Kovacevic et al. 2017 [34]	2	1	0	1	0	0	0	0	NA	NA	NA	NA	4	High
Da S. Neto et al. 2020 [2]	2	2	2	1	0	2	0	0	NA	NA	NA	NA	9	Uncertain
Attia et al. 2024 [17]	2	0	2	1	0	0	0	0	2	2	2	1	12	Uncertain

Q1. A clearly stated aim; Q2. Inclusion of consecutive patients (no exclusion or details about the reasons for exclusion); Q3. Prospective collection of data; Q4. Endpoints appropriate to the aim of the study, intention-to-treat basis; Q5. Unbiased assessment of the study endpoint; Q6. Follow-up period appropriate to the aim of the study; Q7. Loss to follow up less than 5%; Q8. Prospective calculation of the study size; Q9. An adequate control group; Q10. Contemporary groups; Q11. Baseline equivalence of groups; Q12. Adequate statistical analyses; the items are scored 0 (not reported), 1 (reported but inadequate) or 2 (reported and adequate); NA: non-applicable

that displacement occurs in approximately six out of 1000 patients undergoing rhinoplasty with DC + PRF (Fig. 4).

Other complications

None of the patients in the included studies developed ecchymosis/hematoma [2, 3, 17], infection [2, 3, 17, 28, 33, 34], graft extrusion [2, 28, 33, 34], or excessive scarring [3, 17]. In two comparative studies, patients undergoing DC alone did not also develop any of these complications [3, 17] (Table 5).

Discussion

Summary of the main findings

The present systematic review and meta-analysis was conducted to synthesize the evidence regarding the efficacy and safety of PRF combined with DC in patients undergoing rhinoplasty.

We found that the addition of PRF to DC was associated with satisfactory postoperative outcomes in terms of cartilage resorption, postoperative adverse events, and patient satisfaction. The incidence of postoperative adverse events was very low. However, the significant heterogeneity among the included studies requires further investigation to contextualize these findings.

Both Bullocks et al. [33] and Castro-Govea et al. [28], although single arm NRCT, demonstrated the feasibility of combining PRF with DC. Bullocks et al. [33] reported no infection or graft displacement, suggesting a stabilizing effect of PRF. Castro-Govea et al. [28] highlighted an impressive durability of cartilage volume, with most cases rated as "very excellent". However, the lack of control groups and variable follow-up periods limit the generalizability of these results.

The randomized controlled trials by Gode et al. [3] and Mohebbi et al. [29] provided critical comparative evidence. Gode et al. [3] demonstrated significantly less cartilage resorption in the PRF group compared to DC alone. This study highlights the ability of PRF to mitigate the primary disadvantage of DC resorption. Mohebbi et al. [29] further quantified this effect and reported significantly less volume loss in cases with PRF compared to those without PRF. The inclusion of PRF appears to optimize cartilage preservation, especially in the long term.

The retrospective case series conducted by Kovacevic et al. [34] provided valuable insight into the safety profile of PRF, reporting no resorption or significant complications. Although retrospective designs are prone to bias, this study reinforces the consistency of the benefits of PRF.

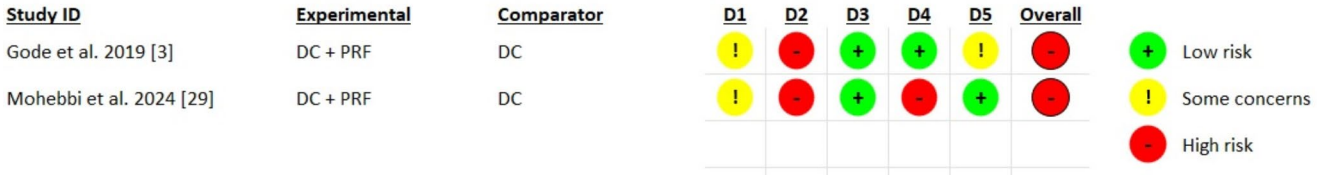

Fig. 2 Risk of bias assessment for randomized clinical trials using ROB2 tool. D1: Randomization process; D2: Deviations from intended interventions; D3: Missing outcome data; D4: Measurement of the outcome; D5: Selection of the reported result; Overall: Overall risk of bias

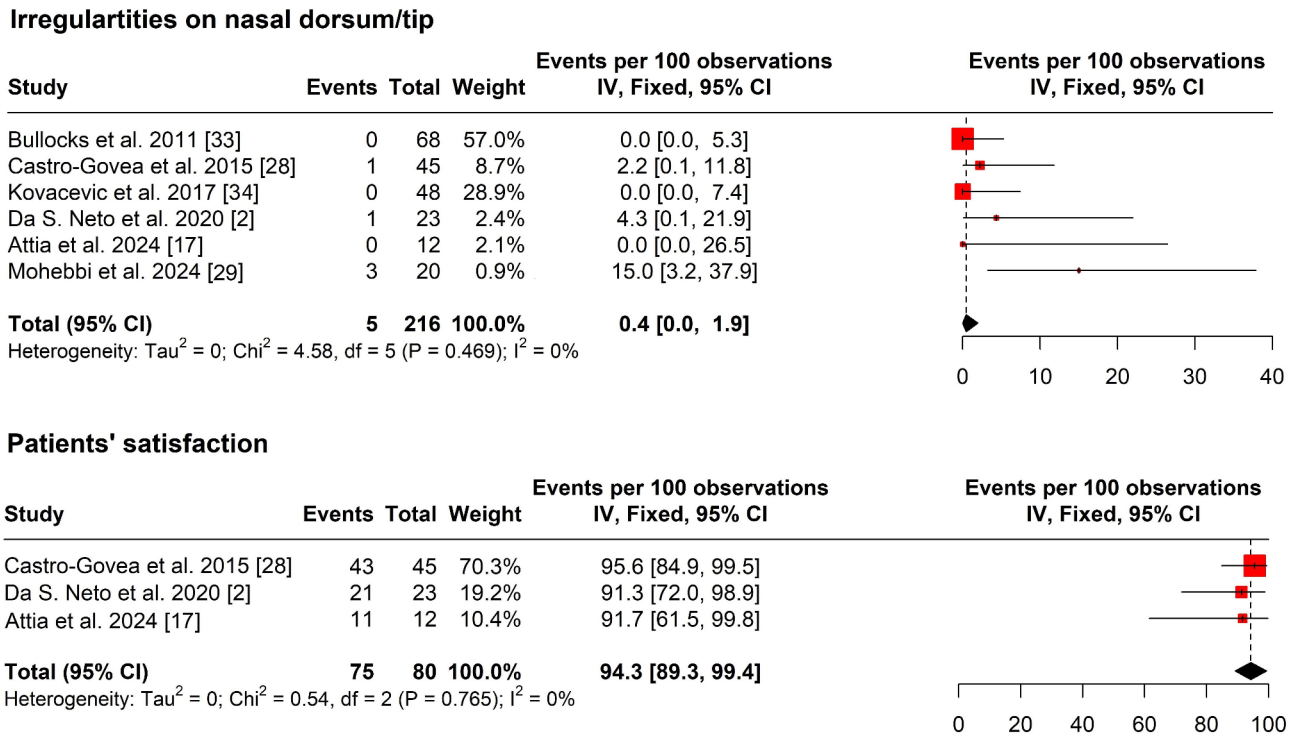

Fig. 3 Forest plot showing pooling of the studies' findings regarding the occurrence of irregularities and patient satisfaction (presented as percentages). CI: Confidence interval

The study by Da S. Neto et al. [2] is notable for not reporting any complications other than an emphasis on postoperative edema, a critical determinant of patient satisfaction in rhinoplasty. The incidence of edema was relatively low, while satisfaction rates were high; however, the lack of a comparison arm limits definitive conclusions.

The comparative NRCT study by Attia and colleagues [17] showed significant differences in patient satisfaction and nasal irregularities between the PRF and non-PRF groups, with no complications in the PRF group and a relatively high incidence of edema and irregularities in the control group. This study highlights the utility of PRF in achieving more predictable aesthetic outcomes, especially in complex cases.

The beneficial effect of PRF may be partially attributed to the stabilization of DC with the fibrin matrix, which prevents the accumulation of cartilage in some regions, thus reducing the likelihood of dorsal irregularities [35]. In addition, PRF contains many growth factors and cytokines, so the use of PRF reduces the inflammatory response during the postoperative period and enhances the healing process. Research has shown that topical application of platelet concentrates is associated with tissue regeneration through stimulation of angiogenesis as well as cell recruitment, proliferation, remodeling and differentiation [7]. The improvement in wound healing leads to a reduction in postoperative edema and decreases the formation of excessive scar tissue [2, 36].

In rhinoplasty, minimizing postoperative edema, ecchymosis, and development of dorsal irregularities is of paramount importance due to the large contribution of the nose to the aesthetic aspects of the face [1, 2]. The low incidence of these events contributed to the high satisfaction of patients undergoing rhinoplasty using PRF with DC.

Postoperative edema after rhinoplasty may persist for several months before resolving completely, especially in patients with thick skin. Edema develops mainly as a result

Table 4 Resorption, irregularities, patient satisfaction and further intervention in the included studies ($n=7$)

Study	Arm	*N*	Permanence of volume (resorption)	Irregularities	Patient's satisfaction	Need intervention
Bullocks et al. 2011 [33]	DC + PRF	68	NR	0/68 (0%)	NR	NR
Castro-Govea et al. 2015 [28]	DC + PRF	45	Permanence was very excellent (88.9%), very good (6.7%), good (4.4%), poor or very poor (0%)	1/45 (2.2%)	Very satisfied (91.1%), satisfied (4.4%), somewhat satisfied (4.4%), dissatisfied or very dissatisfied (0%)	4/45 (8.9%)
Kovacevic et al. 2017 [34]	DC + PRF	48	No resorption	0/48 (0%)	NR	0 /48 (0%)
Gode et al. [3]	DC + PRF	19	Mean loss of cartilage graft thickness 0.58 ± 0.21 mm	NR	NR	0/19 (0%)
	DC	19	Mean loss of cartilage graft thickness 0.82 ± 0.35 mm	NR	NR	0/19 (0%)
Da S. Neto et al. 2020 [2]	DC + PRF	23	NR	1/23 (4.3%)	Satisfied > 80% 21/23 (91.3%)	NR
Attia et al. 2024 [17]	DC + PRF	12	Graft resorption rates were non-significantly lower in the	0/12 (0%)	Not satisfied (8.3%), satisfied (33.3%), very satisfied (58.3%)	NR
	DC	12	DC + PRF group compared to DC alone.	2/12 (16.7%)	Not satisfied (41.7%), satisfied (33.3%), very satisfied (25%)	NR
Mohebbi et al. 2024 [29]	DC + PRF	20	Volume loss 4.75%	3/20 (15%)	Dissatisfaction Score 10.45 ± 6.74	NR
	DC	20	Volume loss 14.42%	5/20 (25%)	Dissatisfaction score 12.25 ± 6.45	NR

DC: diced cartilage; N: number; NR: not recorded; PRF: platelet-rich fibrin

Table 5 Postoperative complications in the included studies ($n=7$)

Study	Arm	Edema	Hematoma	Erythema	Infection	Displacement	Extrusion	Scarring
Bullocks et al. 2011 [33]	DC + PRF	NR	NR	11/68 (16.2%)	0/68 (0%)	0/68 (0%)	0/68 (0%)	NR
Castro-Govea et al. 2015 [28]	DC + PRF	NR	NR	0/45 (0%)	0/45 (0%)	1/45 (2.2%)	0/45 (0%)	NR
Kovacevic et al. 2017 [34]	DC + PRF	NR	NR	0/48 (0%)	0/48 (0%)	1/48 (2.1%)	0/48 (0%)	NR
Gode et al. [3]	DC + PRF	Week1 mean supratip skin thickness was significantly lower in the DC + PRF group	0/19 (0%)	0/19 (0%)	0/19 (0%)	NR	NR	0/19 (0%)
	DC		0/19 (0%)	0 (0%)	0/19 (0%)	NR	NR	0/19 (0%)
Da S. Neto et al. 2020 [2]	DC + PRF	4/23 (17.4%)	0/23 (0%)	0/23 (0%)	0/23 (0%)	0/23 (0%)	0/23 (0%)	NR
Attia et al. 2024 [17]	DC + PRF	0/12 (0%)	0/12 (0%)	0/12 (0%)	0/12 (0%)	NR	NR	0/12 (0%)
	DC	5/12 (41.7%)	0/12 (0%)	0/12 (0%)	0/12 (0%)	NR	NR	0/12 (0%)
Mohebbi et al. 2024 [29]	DC + PRF	NR	NR	NR	NR	NR	NR	NR
	DC	NR	NR	NR	NR	NR	NR	NR

DC: diced cartilage; N: number; NR: not recorded; PRF: platelet-rich fibrin

of surgical trauma, as rhinoplasty techniques involve dissection of subcutaneous tissue and bone, as well as skin manipulation [37]. Corticosteroids are effective in reducing postoperative edema and ecchymosis [38, 39], but their prolonged use is associated with potentially serious complications that limit their clinical utility in rhinoplasty patients [37]. Therefore, controlling edema with PRF has significant clinical implications in reducing the need for corticosteroids.

The use of PRF in rhinoplasty has also been reported without using the DC cartilage technique, either by direct application to the osteotomy line [13] or by adding PRF to shaved cartilage [8]. However, in this systematic review and meta-analysis, we focused on the use of PRF with the DC technique. Despite the advantages of greater flexibility and minimal risk of distortion [40], DC is more liable to resorption due to decreased viability of chondrocytes with crushing [41]. Thus, wrapping DC with PRF may enhance the advantages of the DC technique while minimizing its disadvantages.

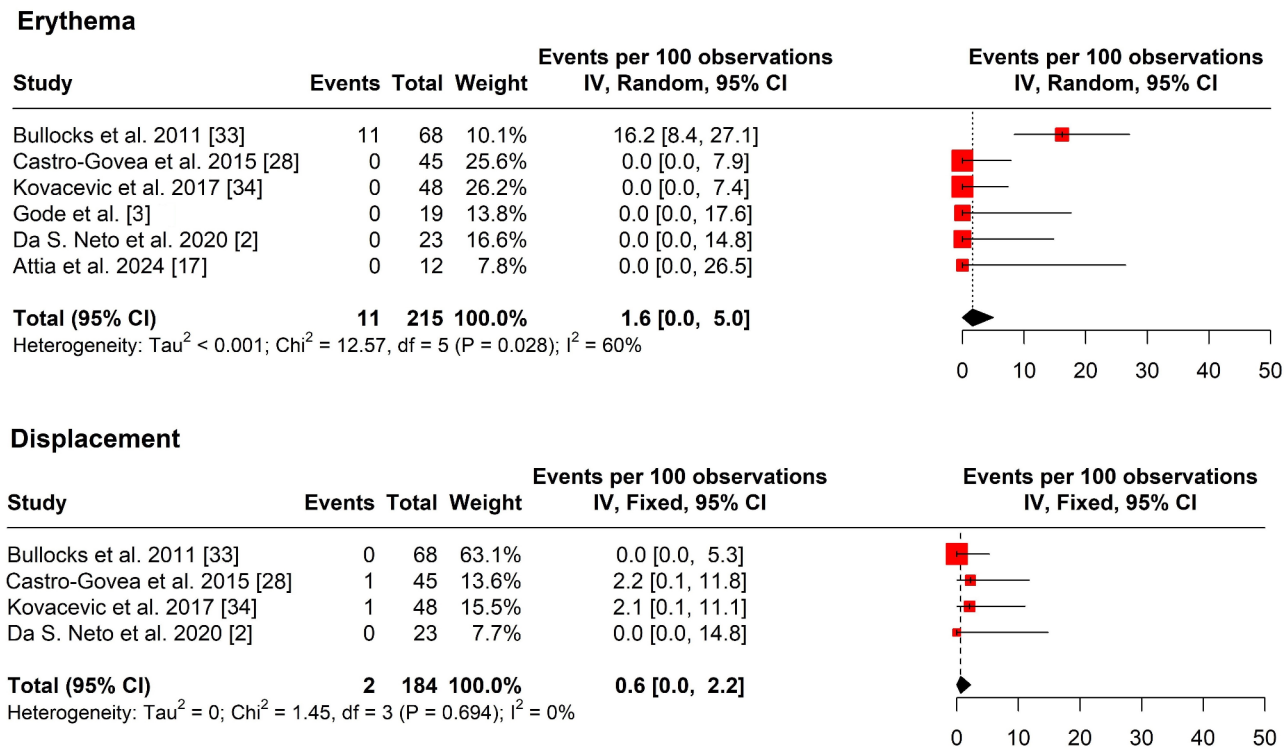

Fig. 4 Forest plot showing pooling of the studies' findings regarding erythema and graft displacement (presented as percentages). CI: Confidence interval

Our results are consistent with a previous systematic review that evaluated the development of postoperative complications after rhinoplasty using DC wrapped in blood products [42]. However, more recent studies were not included in the previous meta-analysis [2, 3, 29].

Overall completeness, applicability, and quality of the evidence

The results of the present systematic review and meta-analysis showed that the use of PRF with DC in rhinoplasty is associated with favorable postoperative outcomes. However, only three studies included a control group that underwent DC alone [3, 17, 29], and the selection and reporting of outcomes varied among the three studies. Therefore, we were unable to make a comparison between the two groups in this meta-analysis. Comparative studies are needed to determine whether the use of PRF with DC provides clinically significant benefits compared with DC alone.

In addition, the follow-up period was short in most studies [2, 3, 17, 29, 34], which limits the evaluation of the reliability of long-term aesthetic results. Furthermore, the included studies showed different levels of ROB, ranging from uncertain to high. All these factors may downgrade the evidence and indicate the presence of a knowledge gap that requires further high-quality randomized controlled clinical trials.

Furthermore, the lack of standardized outcome measures is another critical limitation. While cartilage resorption and patient satisfaction were commonly reported, metrics such as graft thickness retention and aesthetic grading were inconsistently documented. Future studies should adopt standardized protocols to facilitate meta-analytic comparisons and improve the quality of evidence.

The current systematic review and meta-analysis attempted to collect and synthesize the available evidence, but we only included studies published in English, although there may be relevant articles published in other languages.

Conclusions, implications for practice, policy, and future research

The addition of PRF to DC was associated with favorable postoperative outcomes and excellent patient satisfaction. The incidence of adverse events was very low. However, there is a paucity of comparative studies to confirm whether outcomes are significantly better with PRF compared to DC alone. Randomized controlled clinical trials with larger sample sizes and adequate follow-up are warranted.

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Declarations

Ethics approval Ethics approval and informed consent were not required for this systematic review and meta-analysis, as it involved secondary analysis of data from previously published studies. All data were extracted from studies that had already obtained their own ethics approval as indicated in their respective publications.

Registration This study was registered at the International Prospective Register of Systematic Reviews (PROSPERO) (ID: CRD42024584976, Date: 10-9-2024).

Standards of reporting This study was conducted following the principles of the Cochrane Handbook for Systematic Reviews of Interventions, version 6 and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

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