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Rib Grafts in Rhinoplasty: A Systematic Review and Meta-analysis of Autologous, Fresh-frozen, and Irradiated Cartilage

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Background: Costal cartilage (CC) is a widely used graft material in rhinoplasty, harvested from autologous (ACC) or cadaveric sources, such as fresh-frozen (FFCC) or irradiated homologous costal cartilage (IHCC). Although all graft types carry risks of infection, warping, and revision surgery, their comparative safety profiles remain uncertain.

Methods: A systematic review was performed in accordance with PRISMA guidelines. Multiple databases were searched from inception to April 2025 for studies evaluating outcomes of ACC, FFCC, or IHCC in rhinoplasty. Primary outcomes included infection, warping, and revision surgery. Data were pooled using random-effects proportional meta-analysis with heterogeneity assessed with I^2.

Results: Of 3109 records, 25 studies (n = 2322 patients) met inclusion criteria (ACC = 775, FFCC = 1076, and IHCC = 471). Infection rates were low across all graft types (1%–2%), with low heterogeneity. Warping was similarly infrequent (1%–3%), though moderate heterogeneity was observed across ACC studies. Revision rates demonstrated greater variability, ranging from 1% in FFCC to 7% in ACC and IHCC, with high heterogeneity and funnel plot asymmetry. Post hoc power analyses supported noninferiority of all graft types with respect to infection and warping.

Conclusions: Infection and warping are rare complications across graft types, suggestive of comparable safety profiles. Revision outcomes appeared most favorable with FFCC but were limited by heterogeneity and study design. These findings are suggestive of comparable safety profiles among ACC and cadaveric CC grafts. Higher-quality, prospective controlled studies with standardized outcome reporting and follow-up time are required to better inform graft selection. *(Plast Reconstr Surg Glob Open 2026;14:e7875; doi: 10.1097/GOX.0000000000007875; Published online 29 June 2026.)*

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INTRODUCTION

Rhinoplasty is among the most frequently performed operations in plastic surgery.[1] Cartilage grafts are often used to achieve structural and aesthetic goals while preserving long-term nasal airway function.[2] Although autologous septal cartilage is regarded as the most ideal donor source, there are numerous settings in which it may be unavailable or inadequate—most notably in revision rhinoplasty where substantial graft material is necessary and the septum may have been compromised by the initial procedure. In these situations, costal cartilage (CC) is a widely used graft source, as it offers reliable strength and

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abundant volume compared with auricular cartilage and is generally preferred over synthetic implants, which pose higher risks of infection and extrusion.[3]

Despite these advantages, the optimal source of CC remains debated. Autologous CC (ACC) has long been regarded as the gold standard due to its biocompatibility and durability. However, harvesting ACC requires an additional operative site and increased surgical time, and can result in harvest-related complications such as pneumothorax, pain, and hypertrophic scarring.[4] To circumvent these challenges, cadaveric grafts, including irradiated homologous CC (IHCC) and fresh-frozen CC (FFCC) have been used. These options eliminate donor-site morbidity and simplify operative workflow but are still associated with the same postoperative complications as ACC.[5] The long-term reliability of cadaveric CC grafts remains a subject of ongoing debate, with conflicting results reported across the literature.

The evidence regarding cadaveric grafts, particularly IHCC, has been inconsistent. Early reports suggested increased complication rates with IHCC, although these studies included grafts in multiple head and neck sites rather than rhinoplasty specifically.[6] In contrast, more recent work has demonstrated low complication rates in rhinoplasty patients.[7–9] Some investigators have found no difference in warping or resorption rates between IHCC and ACC, whereas others find it resorbs more when used in structurally demanding grafts.[7,10] Experienced surgeons remain divided, as some caution against using IHCC for load-bearing grafts like columellar struts and septal extensions, whereas others argue that warping is less problematic with IHCC because the graft has already stabilized after harvest.[11–13]

FFCC has been investigated in several series, with generally favorable results. Pascali et al analyzed over 650 revision rhinoplasties and reported that FFCC and ACC were safe to use, with no significant differences in short- or long-term complication rates; importantly, warping was more common with ACC than FFCC.[14] Hanna et al similarly found that infection, warping, and resorption rates with FFCC grafts were comparable to ACC grafts, supporting its use as a convenient, donor-site–sparing option.[15] Although these findings are encouraging, the quantity of high-quality comparative studies on FFCC remains limited, and its long-term safety relative to ACC and IHCC has yet to be definitively established.

Systematic reviews and meta-analyses similarly highlight these uncertainties. Some have found no significant differences in infection, resorption, or revision between ACC and IHCC, whereas others suggest IHCC may carry a lower risk of warping but otherwise performs equivalently.[16–18] Overall, the literature is limited by small sample sizes, retrospective designs, heterogeneous definitions of outcomes, and variable follow-up. Evidence on FFCC remains especially sparse, and to our knowledge, no studies have pooled evidence to compare all 3 graft types in parallel.

To address this gap, we conducted a systematic review and meta-analysis comparing ACC, FFCC, and IHCC. This study aimed to pool evidence to clarify complication rates across graft types, thereby providing a more robust foundation to guide graft selection in clinical practice and inform surgical planning for this frequently performed procedure.

Takeaways

Question: Do autologous, fresh-frozen, and irradiated costal cartilage grafts differ in complication rates when used in rhinoplasty?

Findings: This systematic review and meta-analysis of 25 studies (2322 patients) found low and comparable infection and warping rates across graft types, whereas revision rates were more variable, with lower pooled rates for fresh-frozen cartilage.

Meaning: Autologous and cadaveric costal cartilage grafts have broadly comparable safety profiles, supporting individualized graft selection rather than reliance on historical assumptions.

STUDY POPULATION AND METHODS

Search Methods

The methodology was designed and registered in PROSPERO (CRD420251075974). The study was conducted in accordance with the PRISMA guidelines. A comprehensive search of four electronic databases, including MEDLINE, Embase, Cochrane, and Scopus, was performed from database inception to April 2025. Reference lists of included and relevant studies were also screened to identify additional articles not captured in the initial search. (**See table, Supplemental Digital Content 1**, which displays the complete search strategy, **https://links.lww.com/PRSGO/E990**.)

Selection Criteria

Both title and abstract screening, as well as full-text review, were performed by 2 independent reviewers (V.T. and K.L.), with disagreements resolved by 2 other reviewers (S.D. and E.R.). All studies reporting on patients aged 18 years or older undergoing primary or revision rhinoplasty requiring CC grafting were included. Studies with follow-up duration of less than 12 months were excluded. A breakdown of exclusion criteria is detailed in the PRISMA diagram (Fig. 1).

Data Collection

Full texts of 192 articles were reviewed, and the following data points were collected: patient demographics (sample size, sex, age, comorbidities, and number of previous rhinoplasties) and surgical outcomes (infection, revision, warping, resorption, extrusion, and follow-up). Graft survival and donor-site morbidity data were extracted when available.

Statistical Analysis

Study data were analyzed using R version 4.5.0 (R Foundation for Statistical Computing, Vienna, Austria).

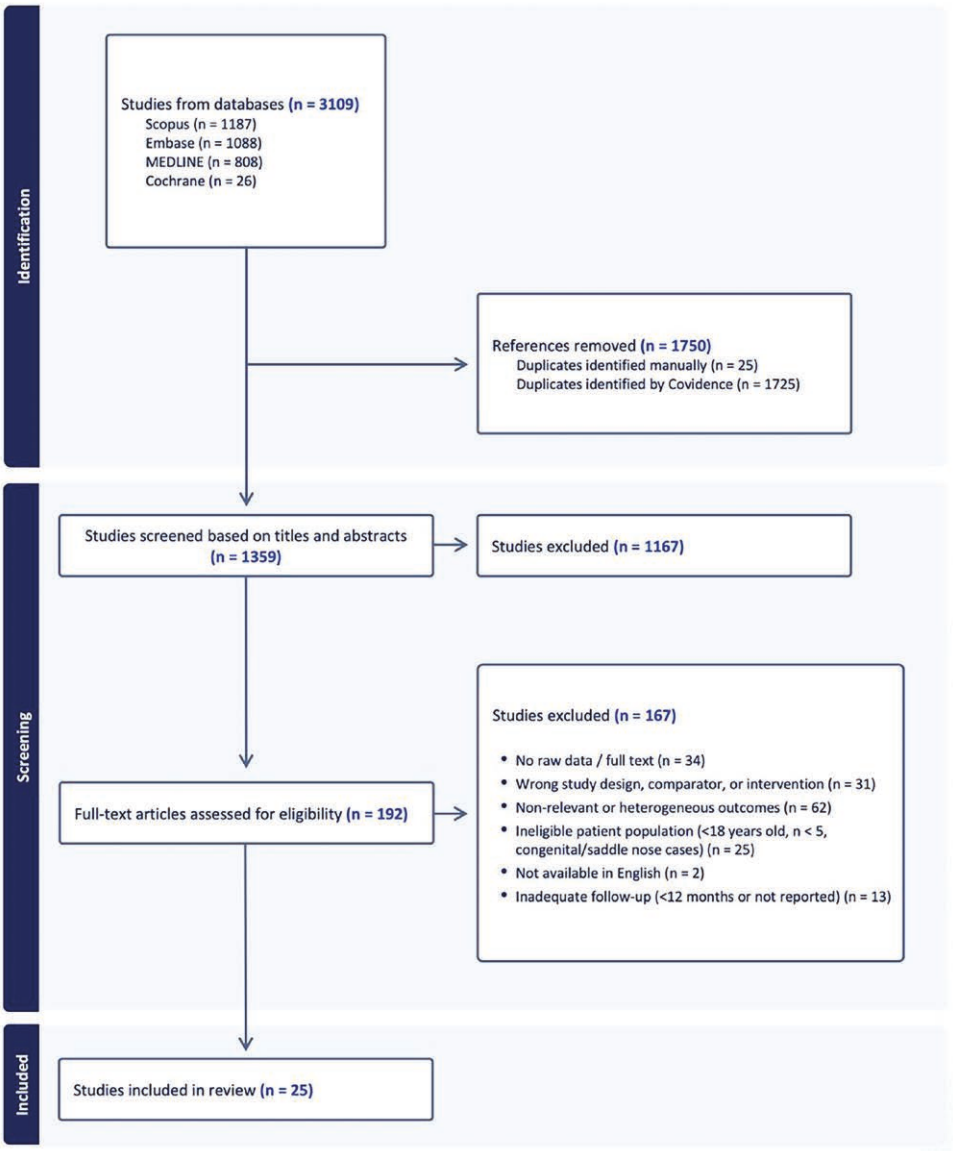

Fig. 1. PRISMA flow diagram of article screening process.

For each outcome, the number of events and the total number of patients at the endpoint were extracted to calculate proportions with corresponding 95% confidence intervals (CIs). Where clinically similar studies were available, results were pooled in meta-analyses using a random-effects inverse variance model for binomial proportions. Studies not reporting a given outcome were excluded from that outcome's analysis. Interstudy heterogeneity was assessed using the Cochrane Q, I^2 statistic, and tau-squared (τ^2) values; a Q test $P < 0.01$ and $I^2 > 75\%$ were considered indicative of significant heterogeneity, with negative I^2 values set to 0. Funnel plots were generated for each primary outcome to assess publication bias. Risk of bias was evaluated using the Newcastle–Ottawa Scale (NOS) for prospective and retrospective cohort studies and the Joanna Briggs Institute Critical Appraisal Checklist for Case Series for retrospective case series. (**See table, Supplemental Digital Content 2**, which displays the risk of bias assessment of cohort studies based on the NOS tool, **https://links.lww.com/PRSGO/E991**.) (**See table, Supplemental Digital Content 3**, which displays the risk of bias assessment of case series studies based on the Joanna Briggs Institute Critical Appraisal Checklist for Case Series, **https://links.lww.com/PRSGO/E992**.) The overall certainty of the evidence was assessed according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework. (**See table, Supplemental Digital Content 4,** which displays the GRADE overall assessment of certainty of evidence, **https://links.lww.com/PRSGO/E993**.) Full citation details are available in Supplemental Digital Content 5. (**See table, Supplemental Digital Content 5**, which displays the full citation details of included studies [n = 25], **https://links.lww.com/PRSGO/E994**.)

RESULTS

Twenty-five studies met eligibility criteria (Fig. 1). Patient demographics and study characteristics, including detailed distribution of graft type utilization across the included studies, are presented in Table 1 and Supplemental Digital Content 6, respectively. (**See table, Supplemental Digital Content 6**, which displays the study characteristics and CC graft types used. LOE, level of evidence, **https://links.lww.com/PRSGO/E995**.)

Study Characteristics

A total of 2322 patients underwent rhinoplasty across all included studies and 775 patients (34%) with ACC, 1076 patients (46%) with FFCC, and 471 patients (20%) with IHCC. Studies originated from North America, East Asia, Europe, and Turkey, reflecting diverse surgical practice settings and patient populations.

Overall, the quality of included studies was moderate. Most evidence was derived from retrospective case series and cohort studies, with limited prospective data. Risk-of-bias assessment demonstrated variability in methodological rigor, particularly with respect to outcome definition, follow-up duration, and control of confounding variables, which may contribute to observed heterogeneity across outcomes.

Patient Demographics

Among the pooled cohort, the mean age was 34 years old (calculated across studies reporting mean age), and the mean follow-up was 24 months (excluding studies where only categorical follow-up was specified). Most patients were woman (n = 1700). Most cases were revision rhinoplasties (n = 1809), whereas 417 patients underwent primary procedures, and 96 cases did not specify operative history. When reported, grafts were most used for columellar strut (n = 491), dorsal onlay (n = 444), shield graft (n = 284), alar batten (n = 266), spreader graft (n = 227), and septal extension graft (n = 277). Other graft applications, including diced cartilage, lateral crural onlay, and elongation spreaders, were less frequently described.

SURGICAL OUTCOMES

Infection

Fourteen studies reporting on ACC grafts, encompassing 722 patients, demonstrated a pooled infection rate of 2.0% (95% CI, 1%–3%). No statistical heterogeneity was observed ($I^2 = 0\%$, $P = 0.46$). Funnel plot analysis demonstrated approximate symmetry, with a small number of studies reporting higher rates but no evidence of systematic publication bias. (**See figure, Supplemental Digital Content 7**, which displays the ACC infection rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/E996**.) For IHCC, 5 studies including 471 patients yielded a pooled infection rate of 1% (95% CI, 0%–2%), also without evidence of heterogeneity

Table 1. Patient Demographics Across Included Studies

	Total	ACC		FFCC		IHCC	
Characteristic	**N**	**N**	**%**	**N**	**%**	**N**	**%**
No. patients	2322	775	34	1076	46	471	20
Mean follow-up (mo)	24*						
Sex							
Men	481	185	38	152	32	144	30
Women	1700	504	30	682	40	514	30
Not specified	143†	43	30	0	0	79	55
Mean age (y)	34‡						
Rhinoplasty history							
Primary rhinoplasty	417	182	44	77	18	158	38
Has undergone previous rhinoplasty	1809	533	29	974	54	302	17
Not specified	96§	25	26	0	0	0	0
Graft use							
Columellar strut	491	228	47	252	51	11	2
Dorsal onlay	444	192	43	189	43	63	14
Shield	284	131	46	129	46	24	8
Alar batten	266	111	42	148	56	7	2
Spreader	227	115	51	92	40	20	9
Lateral crural onlay	165	77	47	83	50	5	3
Onlay tip	154	50	32	80	52	24	16
Extended/elongation spreader	136	64	47	72	53	0	0
Septal extension	277	57	21	114	41	106	38
Diced cartilage	362	180	50	159	44	23	6
Other	201	43	21	16	8	142	71
Not specified	1076	426	40	592	55	58	5

*One study did not report mean follow-up (only specified >1 y) and thus was not included in the overall mean follow-up calculation for our cohort.
†Twenty-one additional patients not specified by graft type.
‡Two studies did not report mean age (either median or range was provided) and thus were not included in the overall mean age calculation for our cohort.
§Seventy-one additional patients not specified by graft type.

($I^2 = 0\%$, $P = 0.91$). The funnel plot distribution was symmetrical, suggesting that infection is a rare complication across IHCC cohorts. (**See figure, Supplemental Digital Content 8**, which displays the IHCC infection rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/E997**.) FFCC infection rates were similarly low, with 5 studies including 794 patients demonstrating a pooled rate of 1% (95% CI, 0%–3%), with moderate heterogeneity that did not reach statistical significance ($I^2 = 41.9\%$, $P = 0.14$). Funnel plots for FFCC studies were approximately symmetrical, further supporting the robustness of these findings. (**See figure, Supplemental Digital Content 9**, which displays the FFCC infection rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/E998**.) Across all graft types, infection was an uncommon outcome, typically occurring in 3% or less of patients, with consistent findings across study designs and sample sizes (Table 2).

Revision

Revision rate demonstrated greater variability across graft types. Eleven studies of ACC, representing 602 patients, reported a pooled revision rate of 7% (95% CI, 3%–11%), with substantial heterogeneity ($I^2 = 74.6\%$, $P < 0.0001$). Funnel plots for ACC revision outcomes demonstrated moderate asymmetry, suggestive of small study effects or possible publication bias. (**See figure, Supplemental Digital Content 10**, which displays the ACC revision rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/E999**.) IHCC, reported across five studies and 471 patients, showed a pooled revision rate of 7% (95% CI, 0%–14%) with similarly high heterogeneity ($I^2 = 74.8\%$, $P = 0.003$). Funnel plots again revealed asymmetry, indicating variability likely attributable to small study sizes, differences in follow-up duration, and surgical technique. (**See figure, Supplemental Digital Content 11**, which displays the IHCC revision rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/E1000**.)

In contrast, FFCC grafts yielded substantially lower revision rates, with 5 studies including 794 patients reporting a pooled revision proportion of 1% (95% CI, 0%–1%), with moderate heterogeneity ($I^2 = 54.8\%$, $P = 0.065$). The funnel plot for FFCC was largely symmetrical, with the exception of 1 small outlier study reporting higher revision rates. (**See figure, Supplemental Digital Content 12**, which displays the FFCC revision rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/F2**.) Among the included studies, 17 of 25 reported at least partial information regarding indications for revision surgery. Five studies cited predominantly cosmetic or aesthetic reasons for reoperation, whereas 12 attributed revisions primarily to graft-related complications, including warping, resorption, infection, or graft malposition. Due to heterogeneity in reporting and limited sample sizes within subcategories, these data could not be pooled quantitatively, precluding meaningful cause-specific stratification. Taken together, revision rates were consistently higher for ACC and IHCC compared to FFCC, though the high degree of between-study heterogeneity necessitates cautious interpretation (Table 2).

Warping

Nine studies of ACC (560 patients) demonstrated a pooled warping rate of 3% (95% CI, 1%–6%), with moderate heterogeneity ($I^2 = 54.2\%$, $P = 0.026$). Funnel plots revealed mild asymmetry, consistent with small-study effects, and variation likely reflected differences in carving technique, surgical approach, and follow-up duration. (**See figure, Supplemental Digital Content 13**, which displays the ACC warping rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/F3**.) Warping rates for IHCC were lower: 3 studies including 392 patients yielded a pooled rate of 1% (95% CI, 0%–2%) with no heterogeneity ($I^2 = 0\%$, $P = 0.82$). Funnel plots were symmetrical, underscoring the consistency of this finding across available studies. (**See figure, Supplemental Digital Content 14**,

Table 2. Summary of Pooled Complication Rates by Graft Type

Graft Type	Outcome	Studies (n)	Sample Size (N)	Pooled Proportion (95% CI)	I^2 (%)	Heterogeneity *P*	Publication Bias (Funnel Plot)
IHCC	Infection	5	471	0.01 (0.00–0.02)	0	0.91	Symmetrical; no major bias
	Revision	5	471	0.07 (0.00–0.14)	74.8	0.003	Some asymmetry; possible small-study effects
	Warping	3	392	0.01 (0.00–0.02)	0	0.82	Symmetrical; no major bias
FFCC	Infection	5	794	0.01 (0.00–0.03)	41.9	0.14	Symmetrical; no major bias
	Revision	5	794	0.01 (0.00–0.01)	54.8	0.065	Largely symmetrical; one small high-rate study
	Warping	4	484	0.01 (0.00–0.03)	43.4	0.15	Symmetrical; no major bias
ACC	Infection	14	722	0.02 (0.01–0.03)	0	0.46	Approx. symmetrical; few small high-rate studies
	Revision	11	602	0.07 (0.03–0.11)	74.6	<0.0001	Some asymmetry; possible small-study effects
	Warping	9	560	0.03 (0.01–0.06)	54.2	0.026	Some asymmetry; possible small-study effects

which displays the IHCC warping rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/F4**.) Similarly, FFCC demonstrated low warping rates: 4 studies with 484 patients yielded a pooled rate of 1% (95% CI, 0%–3%) and moderate heterogeneity ($I^2 = 43.4\%$, $P = 0.15$), with symmetrical funnel plots indicating minimal risk of publication bias. (**See figure, Supplemental Digital Content 15**, which displays the FFCC warping rate forest [A] and funnel plot [B], **https://links.lww.com/PRSGO/F5**.) Overall, warping was infrequent across all graft types, occurring in less than 3% of patients, though slightly more commonly in ACC compared with IHCC and FFCC (Table 2).

Donor-site Morbidity

Donor-site morbidity was relevant only for ACC grafts and was infrequently described in detail. Reported complications included donor-site pain; hypertrophic scarring or keloid formation; infection; and, rarely, pneumothorax. However, these outcomes were neither consistently defined nor systematically collected across studies, precluding pooled analysis.

Graft Survival

Longer-term graft survival was evaluated in only a minority of studies, often using clinical follow-up or radiographic assessment. Outcomes were inconsistently defined, with some studies reporting gross clinical stability, whereas others documented resorption or warping noted at revision surgery. Due to the heterogeneous and sparse reporting, meta-analysis was not feasible. Overall, available data suggest that graft survival is generally favorable across graft types, though limited reporting prevents definitive conclusions.

DISCUSSION

ACC has historically been favored as the ideal structural grafting material when septal cartilage is insufficient or inadequate. Despite the long-held belief that ACC provides superior graft quality in rhinoplasty, its perceived benefits with regards to maximizing long-term structural integrity and minimizing the risk of warping, infection, and revision do not appear to be consistently corroborated across recent clinical studies comparing it to cadaveric alternatives. This is a crucial distinction to make when approaching revision rhinoplasty, as ACC harvest not only increases procedural complexity and operative time, but also carries well-documented donor-site morbidity, including the risk of pain, hypertrophic scarring, chest wall deformity, and pneumothorax.

Cadaveric CC, processed either as FFCC or IHCC, has emerged as a compelling alternative to ACC, offering abundant graft volume without donor-site morbidity and with a potentially shorter operative time. IHCC adoption had historically been stalled by reports of elevated warping, resorption, infection, and extrusion, particularly with early processing techniques that relied on high-dose gamma irradiation, compromising structural integrity and resilience. Recent literature challenges these historical concerns, as improvements in aseptic procurement and tissue processing and banking have reduced complication rates. Our findings echo those of other systematic review and meta-analyses, which reported similarly low infection and warping rates with IHCC, comparable to ACC.[16,19] FFCC is a newer cadaveric alternative, with good structural integrity and matrix preservation, without jeopardizing sterility. Recent clinical studies demonstrate satisfying long-term results.[20] Our clinical experience supports that FFCC can be reliable when properly sourced and manipulated. Presliced cartilage, once thawed, reveals any inherent warping tendency, whereas larger specimens that are carved on the back table can also be allowed to settle into their eventual configuration before strategically selecting the appropriate piece for the right location and graft design in relation to the patient's native nasal structural anatomy. Furthermore, our clinical experience suggests that choosing more yellow specimens, which is identified through visual inspection through the sterile packaging window, typically from older donors with more calcified ribs, promotes more stable and sturdier grafts. This again has to be balanced with the eventual graft design and location targeted, to avoid undue stiffness, for example, in the case of a septal extension graft.

With regard to the meta-analysis, high between-study heterogeneity was observed for multiple outcome measures. This level of heterogeneity suggests substantial variability among included studies, likely due to differences in patient populations, surgical techniques, outcome definitions, and methodologies. Such heterogeneity does not necessarily reflect poor study quality, but rather the presence of true differences across studies. These findings highlight the importance of interpreting pooled estimates with caution and considering the clinical and methodological diversity across studies. Post-hoc power analyses were performed to assess the robustness of the pooled data in detecting differences in infection, warping, and revision rates across the three surgical techniques studied. Simulations indicated limited power to detect very subtle differences, which is expected given the rarity of infection, warping, and revision events and modest effect sizes. Nevertheless, the current sample sizes and study numbers provide reasonable support for the noninferiority of ACC, IHCC, and FFCC grafts in terms of infection and warping risk. Regarding revision rates, there was greater variability, with pooled proportions ranging from 1% in FFCC to 7% in ACC and IHCC groups, and higher between-study heterogeneity. Potential explanations for the comparably lower revision rate with FFCC include differences in processing and preservation that may enhance structural stability, the ability to visualize warping tendencies before implantation, and a potentially reduced immune response compared with IHCC grafts.[15] However, further histological studies are required to better understand the underlying physiology. Heterogeneity in revision rates may reflect procedural and technical differences rather than graft material alone.

Although 13 studies reported some form of patient-reported outcome measures, heterogeneity in measurement tools and reporting precluded synthesis.

Despite this, the overlapping CIs and the limited power to detect small-to-moderate differences indicate that observed differences should be interpreted cautiously. Importantly, no definitive evidence points to a superior technique with regards to revision risk, based on the current data.

Although statistical power limitations inherent to rare event meta-analyses constrains detection of very small differences, the existing evidence is suggestive of comparable safety profiles across the three surgical techniques for infection, warping, and revision outcomes. Future larger-scale studies may enhance sensitivity to subtle differences. Until then, these findings should be interpreted as aggregate safety profiles across heterogeneous real-world practice and provide reassurance that ACC, FFCC, and IHCC grafts offer similarly acceptable risk profiles in clinical practice. Selection should therefore be individualized, taking into account patient anatomy and preferences, local resources, and the surgeon's practice setting and experience. Cost may also influence graft selection, as cadaveric cartilage involves tissue procurement expenses, whereas ACC harvest increases operative time. However, these economic factors were not systematically evaluated in the included studies. Nevertheless, the findings support a patient-centered, context-specific approach to graft selection rather than one dictated by long-held perceptions of relative safety as the types of grafting materials, surgical techniques, and related evidence have significantly evolved over the years. The inclusion of recent studies with modern processing techniques enhances the relevance of this systematic review to contemporary practice.

This study is not without limitations. Publication bias and variability in study methodology, patient demographics, surgical techniques, and outcome definitions introduce heterogeneity across the included literature. This lack of granular reporting regarding operative indication, graft function, number of prior operations, prior alloplastic complications, and clinical complexity precluded meaningful stratification of outcomes by surgical setting and limits interpretation of pooled comparisons across heterogeneous patient cohorts. Rhinoplasty outcomes are highly technique-dependent, yet these factors were inconsistently reported. Further, most studies were retrospective case series or cohorts, with only a minority employing prospective designs, limiting the overall strength of evidence. Key outcomes such as resorption, extrusion, donor-site morbidity, and patient-reported satisfaction were also inconsistently reported and often lacked standardized definitions, precluding quantitative synthesis. Differences in graft harvesting, carving, and preparation techniques, as well as variation in follow-up duration, may further confound surgical outcomes.

Despite these limitations, this review has several notable strengths. It represents one of the largest syntheses to date, encompassing over 2,300 patients across 25 studies, and is the first to systematically evaluate ACC, FFCC, and IHCC within a single comparative meta-analytic framework. Established meta-analytic methods, funnel plot evaluation, and GRADE certainty ratings were employed to enhance rigor and transparency. Together, these strengths provide a comprehensive and methodologically robust assessment of CC graft safety in rhinoplasty while highlighting critical areas for future prospective, standardized research.

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DISCLOSURES

R.G.R. is a consultant for MTF Biologics. The other authors have no financial interest to declare in relation to the content of this article.

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