State of the Evidence for Preservation Rhinoplasty: A Systematic Review

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Abstract

Preservation rhinoplasty encompasses a number of techniques that minimize disruption of the native cartilaginous and soft tissue nasal architecture. These techniques have gained popularity resulting in an increase in publications relevant to preservation rhinoplasty. However, many studies that present patient outcomes are of low-level evidence and do not incorporate validated patient-reported outcome measures. While these studies do consistently report positive outcomes, there are few high-level comparative studies that support the theoretical benefits of preservation relative to structural rhinoplasty. As contemporary preservation rhinoplasty techniques will continue to evolve and become incorporated into clinical practice, there will be the need for parallel emphasis on robust clinical studies to delineate the value of these methods.

Keywords
- preservation rhinoplasty
- dorsal preservation
- structural preservation
- cartilage preservation
- subperichondrial dissection

Preservation rhinoplasty is the practice of maximizing the axis of tissue mobilization over resection. Modern preservation rhinoplasty includes (1) lateral crural preservation with an emphasis on suture modification, (2) subperichondrial dissection to preserve the soft-tissue envelope and nasal ligaments, and (3) dorsal preservation by treating the bony-cartilaginous midvault as a single unit during hump reduction (dorsal preservation rhinoplasty [DPR]).[1] Each of these techniques may be deployed in combination or independently. The anatomic and functional considerations of these methods have been previously described.[2–4]

These techniques are distinct from structural techniques, which are relatively more destructive in nature, and more prevalent.[5] While preservation rhinoplasty is not a new concept, there has been a resurgence of interest in both clinical and academic settings. Numerous studies report positive outcomes using preservation techniques; however, evidence-based outcomes for preservation rhinoplasty are lacking.

In the present study, we aim to systematically review and analyze the current body of preservation rhinoplasty literature, to better understand the strongest evidence for or against preservation techniques, and where additional research is required. To our knowledge, a study with this scope has never been published.

Methods

A comprehensive literature review was conducted on October 31, 2022, using the PubMed database. Three groups were established. The first group included variations of the search term "lateral crural preservation." The second group included variations of the search term "soft-tissue preservation." The final group included variations of the search term "dorsal preservation." A complete accounting of the search criteria may be found in ►**Appendix 1**. Each search was run separately, and all references were uploaded to Endnote reference management software where duplicates were removed.

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Article abstracts and titles were independently screened by two reviewers (T.S.O. and P.N.P.) The full text was included for review if the abstract clearly discussed one of the three preservation techniques noted earlier. If there was question about content of the reference, it was also included for full-text review. Disagreements were resolved via discussion between the two reviewers. The inclusion criteria were (1) quantifiable data for one of three preservation rhinoplasty categories (dorsal preservation, lateral crural preservation, soft-tissue preservation); (2) English language article; (3) full-text publication; (4) clinical trial, cohort study, case–control study, systematic review, or meta-analysis. Exclusion criteria included (1) cadaveric studies; (2) articles published as conference abstracts or posters; (3) no quantifiable data; (4) case report, letters, commentaries, or "How I Do It" articles.

We defined dorsal preservation as any technique that reduces the bony-cartilaginous complex in the process of hump reduction without disruption of the upper lateral cartilage attachments to the dorsal septum. References focused on techniques of dorsal preservation were included in the "dorsal preservation" group (Group 1). We defined soft-tissue preservation as any technique including subperichondrial dissection for the preservation of ligaments and other soft tissue. References focused on this technique were included in the "Soft Tissue Preservation" group (Group 2). Finally, we defined lateral crural preservation as any technique aimed at nasal tip refinement with minimal lateral crural resection. This included both grafting and suture techniques (e.g., lateral crural struts, turn-in flaps). All references focused on these techniques were included in the "Lateral Crural Preservation" group (Group 3). In this final group, emphasis was placed on tip refinement techniques without the need for complete lateral crural repositioning (to better compare it to lateral crural excisional techniques) and modifications made for functional reasons only were excluded. Each reference was assigned a level of evidence according to those established by the Oxford Centre for Evidence-Based Medicine (►**Table 1**).

Table 1 Oxford Centre for evidence-based medicine: level of evidence

Level of evidence	Study description
1a	Systematic review (with homogeneity) of randomized controlled trials
1b	Individual randomized controlled trial (with narrow confidence interval)
1c	All or none
2a	Systematic review (with homogeneity) of cohort studies
2b	Individual cohort study (including low-quality randomized controlled trial)
2c	Outcomes research; ecological studies
3a	Systematic review (with homogeneity) of case–control studies
3b	Individual case–control study
4	Case-series (and poor quality cohort and case–control studies)

Results

A total of 6,272 studies initially resulted using this search strategy. All 6,272 were uploaded into Endnote software and 1,524 duplicates were removed. The remaining 4,748 articles were title/abstract screened by two independent reviewers (T.S.O. and P.N.P.). A total of 107 articles were included for full-text review. A final reviewer (N.G.D.) performed full-text review according to our established inclusion/exclusion criteria. Seventy articles were included for data extraction. Data collected included year of publication, country of the associated institution, sample size, mean patient age (years), study type, level of evidence, study inclusion criteria, surgical intervention, primary outcome, open versus closed surgical approach, mean duration of follow-up (months), outcome results, complication rate, postoperative dorsal hump recurrence rate, and revision rate. A total of 46 studies were included in Group 1. Of these 46 studies, 9 studies had overlap with Group 2, 1 study had overlap with Group 3, and 5 studies were included in all the three groups. Thirty-one studies were included in the dorsal preservation category (Group 1 alone). The 46 total studies included in Group 1 had a mean sample size of 307 ± 939, a range of 16 to 5,660 patients, and a median sample size of 62 patients with a mean patient age of 27.5 ± 3.4 years. Group 2 consisted of 17 studies in total. Of these 17 studies, 9 studies had overlap with Group 1, 3 studies had overlap with Group 3, and 5 studies were included in all the three groups. Zero studies were included in the soft-tissue preservation group alone. The 17 total studies included in Group 2 had a mean sample size of 129 ± 112, a range of 25 to 520 patients, and a median sample size of 102 with a mean patient age of 26.9 ± 2.1. Group 3 consisted of 30 studies in total. Of these 30 studies, 1 had overlap with Group 1, 3 had overlap with Group 2, and 5 were included in all the three groups. Twenty-one studies were included in the lateral crural preservation group alone. The 30 total studies included in Group 3 had a mean sample size of 84 ± 72 patients, a range of 14 to 306 patients, and a mean sample size of 54 patients with a mean patient age of 29.1 ± 5.4 years. Study characteristics and outcomes for each group may be found in ►**Tables 2** to **4**.

Of note, the majority of studies in Groups 1 and 2 were published in 2019 or later (89.4%, 82.4%). However, 50% of studies included in Group 3 were published prior to 2019. Most studies were also published from institutions outside of North America with only 25.7% submitted by institutions within the United States or Canada. 11.4% of included references were level II evidence with 88.6% being level III or IV. No level I evidence was found. In total, 53% (37) studies reported standardized outcome measures. 47% (33) and 57% (40) of references included complication and revision rates, respectively.

Table 2 Evidence characteristics and outcomes—dorsal preservation technique

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
Alan et al[6]	1	2022	Turkey	34	23.7	Prospective cohort	III	SR vs. PR	Closed	NOSE, SCHNOS, rhinomanometric evaluation	12	***Rhinomanometric evaluation:*** **TNV** SR pre: 717.3 (148.5) SR 12 mo: 753.2 (92.4) PR pre: 692.6 (108.0) PR 12 mo: **758.5 (80.0) ($p = 0.031$)** **TNR** SR pre: 0.215 (0.051) SR 12 mo: 0.199 (0.033) PR Pre: 0.223 (0.049) PR 12 mo: 0.198 (0.024) **NOSE:** SR pre: 65.7 (23.4) SR 12 mo: **10.5 (7.0) ($p < 0.001$)** PR pre: 69.3 (19.3) PR 12 mo: **8.6 (4.4) ($p = 0.001$)** **SCHNOS-O:** SR pre: 13.3 (3.7) SR 12 mo: **1.5 (1.2) ($p < 0.001$)** PR pre: 14.0 (3.0) PR 12 mo: **1.9 (1.6) ($p = 0.001$)** **SCHNOS-C:** SR pre: 21 (7.5) SR 12 mo: **1.0 (0.8) ($p < 0.001$)** PR pre: 25.5 (5.3) PR 12 mo: **1.4 (0.9) ($p = 0.001$)**	1	NR	NR	NR
Azimov[8]	1	2021	Azerbaijan	210	27.8	Prospective cohort	IV	CDRT	Open: 58; Closed 152	Subjective, PE	18	Limited edema, more rapid patient recovery, no serious complications	0	NR	NR	NR
Cabbarzade[9]	1	2019	Azerbaijan	372	23	Retrospective cohort	III	DP vs. DR	Open: 350, Closed: 22	Photography, endoscopic examination, PE	15	NR	0	0.00%	NR	0.27%
Dewes et al[11]	1	2021	Brazil	3282	NR	Retrospective cohort	IV	SPAR	NR	Complications/revision rates	NR	31% SPAR-A, 43% SPAR_B	0	NR	NR	9.50%
Ferreira et al[13]	1	2021	Portugal	250	35.2	Randomized prospective cohort study	III	CDR vs. SRT	CDR: 87 closed, 38 open. SRT: 112 closed, 13 open	OAR, VAS	20	**VAS-C:** CDR pre: 3.66 (1.36) CDR 12 mo: 7.35 (2.13) SRT pre: 3.81 (1.29) SRT 12 mo: 8.45 (1.10) **Aesthetic improvement higher in SRT group ($p < 0.001$).**	1	1.20%	1.60%	3.60%

(*Continued*)

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
												OAR: CDR pre: 14.4 (3.5) CDR 12 mo: 7.8 (2.8) SRT pre: 13.5 (3.4) SRT 12 mo: 7.8 (3.1) **VAS- F:** Right side: CDR pre: 4.76 (1.64) CDR 12 mo: 7.43 (1.57) SRT pre: 4.98 (1.76) SRT 12 mo: 8.10 (1.57) Left side: CDR-pre: 5.00 (1.60) CDR 12 mo: 8.11 (1.29) SRT-pre: 4.69 (1.67) SRT-12 mo: 8.69 (1.32) **SRT significantly better than CDR at 1 y ($p = 0.001$)**				
Ferreira et al[14]	1	2016	Portugal	40	30.6	Prospective cohort	IV	SRT	Open: 10, closed: 30	Photographic evaluation of BTL, subjective	8.72	Very good BTL: 80%, good BTL: 15%, bad BTL: 5%. Subjective improvement in nasal function	0	NR	NR	NR
Ishida et al[15]	1	1999	Brazil	120	NR	Prospective cohort	IV	PR	NR	Subjective cosmetic and functional results	NR	All patients with thin and fair skin had satisfactory aesthetic and functional result	0	NR	15.00%	15.00%
Ishida et al[16]	1	2020	Brazil	48	27.6	Retrospective cohort	IV	PD	Open: 48, closed: 6	Subjective, complications/revision rates	NR	Nasal hump adequately corrected in 95.8% of patients	0	4.17%	2.08%	NR
Levin et al[19]	1	2020	Canada	NR	NR	Systematic review	II	PR (4 references) vs. SR (25 references)	3/4 closed, 1/4 NR	Various PROM	NR	Statistically significant improvement in 56% of SR (25 studies included) and 25% of PR studies (4 studies included)	1	NR	NR	NR
Neves and Arancibia-Tagle[20]	1	2021	Portugal, Spain	100	NR	Retrospective cohort	IV	Tetris concept technique vs. lateral Tetris technique vs. modified SPAR B	NR	Subjective, complications/revision rates	NR	Lateral Tetris technique indicated in tilted noses. SPAR-B technique in complex cases	0	NR	36.9% in SPAR B, 3.9% in Tetris	4.00%
Öztürk[21]	1	2022	Turkey	36	24.81	Retrospective cohort	IV	Combination PR: semi-LD and semi-PD	NR	ROE, patient satisfaction	19.8	**Median ROE:** Pre-op median: **55.5** 12-mo post-op: **91.00 ($p < 0.001$)** **Patient satisfaction:** 91.6%	1	NR	5.56%	0.00%

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
Öztürk[22]	1	2021	Turkey	64	23.8	Retrospective cohort	IV	Semi-LD vs. semi-PD	Closed	ROE, patient satisfaction	19.2	**Median ROE:** Pre-op median: **61.6** 12-mo post-op: **92.2** (**$p < 0.001$**) **Patient satisfaction:** 93.75%	1	NR	10.94%	0.00%
Öztürk[23]	1	2020	Turkey	51	23.2	Retrospective cohort	IV	LD technique	Closed	ROE, patient satisfaction	15.1	**Median ROE:** Pre-op median: **65.2** 12-mo post-op: **90.2** (**$p < 0.001$**) **Patient satisfaction:** 92%	1	0.00%	NR	0.00%
Öztürk[24]	1	2020	Turkey	62	27.2	Retrospective cohort	IV	PD without osteotomy	Closed	ROE, patency score, patient satisfaction	14.2	**Patient satisfaction:** 90.32%. **Patency score:** Pre-op: **6 (4–7)** 12-mo post-op: **8 (8–9)** (**$p = 0.003$**) **Median ROE:** Pre-op median: **68.5** 12-mo post-op: **90.5** (**$p = 0.001$**)	1	0.00%	NR	0.00%
Öztürk[26]	1	2021	Turkey	52	22.2	Retrospective cohort	IV	PD with ostectomy	Closed	ROE, patency score, patient satisfaction	15.1	**Median ROE:** Pre-op median: **63.4** 12-mo post-op **91.6** (**$p < 0.001$**) **Patient satisfaction:** 85%. **Patency:** Pre-op: **5.7** 12 mo post-op: **9.1** (**$p < 0.001$**)[a]	1	0.00%	NR	0.00%
Özücer and Çam [29]	1	2020	Turkey	22	29.3	Nonrandomized clinical trial	III	ADP rhinoplasty vs. conventional midvault technique	Closed	Mean angle of deviation, success rate	14.4	No significant difference in post-op mean angle of deviation or mean success rate between groups	0	NR	4.55%	NR
Patel et al[30]	1	2021	USA, Egypt	22	32.1	Retrospective cohort	IV	MSSM rhinoplasty +/− functional rhinoplasty	Open	SCHNOS-O, C, VAS-F, C	4	**VAS-F** (all patients) Pre-op: 4.05 (2.94) Post-op: 1.82 (1.82) (**$p = 0.003$**) **VAS-C** (all patients) Pre-op: 2.68 (1.70) Post-op: 8.95 (1.13) (**$p < 0.001$**) **SCHNOS-O** (all patients) Pre-op: 41.59 (31.11) Post-op: 21.82 (17.83) (**$p = 0.009$**) **SCHNOS-C** (all patients) Pre-op: 62.12 (21.14) Post-op: 6.96 (11.35) (**$p < 0.001$**)	1	0.00%	0.00%	NR

(*Continued*)

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
												VAS-F and SCHNOS-O did not change significantly in cosmetic operation alone				
Patel et al[31]	1	2022	USA, Egypt	163	NR	Retrospective matched cohort	III	SPR vs. CHR	Open	SCHNOS-O, C; VAS-F, VAS-C	NR	**SCHNOS-O:** *SPR group:* Pre-op: 31.1 (28.71) Post-op < 6 mo: **19.76 (19.84) ($p = 0.0030$)** Long-term follow-up: **12.3 (16.41) ($p < 0.0001$)** *CHR group:* Pre-op: 38.35 (34.66) Post-op < 6 mo: **19.95 (19.37) ($p < 0.0001$)** Long-term follow-up: **16.94 (20.2) ($p = 0.0006$)** **SCHNOS-C:** *SPR group:* Pre-op: 65.4 (18.4) Post-op < 6 mo: **7.64 (14.60) ($p < 0.0001$)** Long-term follow-up: **7.27 (11.42) ($p < 0.0001$)** *CHR group:* Pre-op: 65.44 (19.1) Post-op < 6 mo: **11.18 (14.29) ($p < 0.0001$)** Long-term follow-up: **11.63 (14.59) ($p < 0.0001$)** **VAS-C:** *SPR group:* Pre-op: 2.63 (1.66) Post-op < 6 mo: **8.92 (1.59) ($p < 0.0001$)** Long-term follow-up: **8.73 (2.1) ($p < 0.0001$)** *CHR group:* Pre-op: 3.05 (2.07) Post-op < 6 mo: **8.20 (2.29) ($p < 0.0001$)** Long-term follow-up: **8.25 (1.84) ($p < 0.0001$)** **VAS-F:** *SPR group:* Pre-op: 3.1 (2.89) Post-op < 6 mo: **1.90 (2.13) ($p = 0.004$)** Long-term follow-up:	1	NR	NR	NR

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
												1.13 (1.62) **($p = 0.02$)** CHR group: Pre-op: 3.72 (3.13) Post-op < 6 mo: 1.78 (2.04) **($p < 0.0001$)** Long-term follow-up: **1.41 (1.92)** **($p < 0.0001$)** **VAS-C scores at <6 mo post-op statistically higher in SPR group ($p = 0.03$).** No other significant difference between groups				
Patel et al[3]	1	2020	USA	16	NR	Prospective cohort	IV	DP rhinoplasty	NR	SCHNOS-O, C; VAS	4	**SCHNOS-O** Pre-op: 39.4 (29.7) Post-op: **20.3 (15.8)** **($p = 0.003$)** **SCHNOS-C:** Pre-op: 62.3 (18.0) Post-op: **6.9 (10.9)** **($p < 0.001$)** **VAS-C:** Pre-op: 2.6 (1.4) Post-op: **8.8 (1.1)** **($p < 0.001$)** **VAS-F:** Pre-op: 3.9 (3.0) Post-op: **1.94 (1.7)** **($p = 0.016$)**	1	NR	NR	NR
Patel et al[32]	1	2021	USA, Egypt	22	NR	Prospective cohort	IV	SSM +/− functional rhinoplasty	NR	SCHNOS-O, C	4	***SSM + functional:*** **SCHNOS-O** Pre-op: 66.5 (19.4) Post-op: **18.0 (14.0)** **($p < 0.001$)** **SCHNOS-C** Pre-op: 54.7 (24.9) Post-op: **11.3 (15.5)** **($p < 0.001$)** ***SSM – functional:*** **SCHNOS-C** Pre-op: 68.3 Post-op: **3.3** **($p < 0.001$)** No significant change in SCHNOS-O	1	NR	NR	NR
Pirsig and Konigs[33]	1	1988	Germany	100	NR	Prospective cohort	IV	WR	NR	Subjective cosmetic results	18	Good long-term results in 93%. Under correction in 6%. Overcorrection in 1%. Better results than classic osteotomy technique	0	NR	NR	NR

(*Continued*)

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
Rodrigues Dias et al[36]	1	2022	Portugal	54	34.5	Prospective cohort	II	Primary rhinoplasty with SRT	Open-10, Closed- 44	OAR, VAS-F	12	**OAR:** Mean pre-op: 13.4 (0.5) Mean 3-mo post-op: **9.2 (0.15)** Mean 9-mo post-op: **9 (0.5) ($p < 0.001$)** **VAS-F (worst breathing side):** Mean pre-op: 4.52 (0.22) Mean 3-mo post-op: **7.84 (0.19)** Mean 9-mo post-op: **8.2 (0.16) ($p < 0.001$)**	1	NR	NR	NR
Rodriguez et al[37]	1	2022	Spain	300	26	Retrospective cohort	IV	PR w/ recycled dorsum preservation technique	Open	Subjective, complications/revision rates	NR	**Subjective results:** 2 patients dissatisfied with scar. 50% extremely satisfied, 40% highly satisfied, 10% moderately satisfied	0	6.00%	NR	NR
Saban et al[2]	1	2018	France, USA, Italy Hungary	320	29	Retrospective cohort	IV	Dorsal reduction with PDO or LDO	NR	Complications/revision rates	29	PDO preferred for <4 mm reduction. LDO for >4 mm reduction	0	NR	0.63%	3.40%
Saban and de Salvador[48]	1	2021	France	352	NR	Retrospective cohort	IV	Full DP vs. DP + resurfacing vs. DP + bony cartilaginous disarticulation vs. traditional rhinoplasty	NR	Subjective, complications/revision rates, functional complaints questionnaire	12	Most benefit in groups: straight noses—Full DP. Tension noses: DP + resurfacing and/or Cottle variation. Kyphotic noses: cartilage only DP. Difficult noses: traditional rhinoplasties	0	NR	NR	9.94%
Santos et al[38]	1	2019	Portugal	100	32.8	Prospective, interventional, longitudinal study	II	SRT	Open: 18, closed: 82	OAR, VAS-F, VAS-C	12	**10-point VAS-C:** Pre-op: 3.67 (0.15) 3 mo: **8.1 (0.12) ($p < 0.001$)** 12 months: 8.44 (0.11) **($p < 0.001$)** **OAR:** Pre-op: 13.9 3 mo: 8.26 **($p < 0.001$)** 12 mo: 7.08 **($p < 0.001$)** **VAS-F right:** Pre-operative: 5.13 (0.25) 3 mo: 8.44 (0.16) **($p < 0.001$)** 12 mo: 8.62 (0.18) **($p < 0.001$)**	1	NR	NR	NR

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
												VAS-F left: Pre-operative: 4.49 (0.22) 3 mo: 8.29 (0.16) **($p < 0.001$)** 12 mo: 8.72 (0.14) **($p < 0.001$)**				
Stergiou et al[39]	1	2022	Switzerland, Italy, France	30	30.7	Prospective cohort	IV	PR	NR	ROE, complication/ revision rate, INV angle	8.4	**Radiological analysis—INV angle:** Pre-op: 20.77° ± 3.2° Post-operative: **21.82° ± 5.7°** **($p = 0.18$)** **Mean ROE post-op:** 18.4. High patient satisfaction in all cases	1	23.33%	NR	6.67%
Stergiou et al[40]	1	2022	Switzerland, Italy, France	58	32	Prospective cohort	IV	PR	Closed, hybrid open	ROE, radiological analysis	19.7	**Overall ROE converted score:** **Pre-op: 37.9 ± 9.2** **Post-op: 81.25 ± 14.17** **($p < 0.0001$)** **Radiological analysis:** Pre-op INV angle: 19.88 ± 3.3 Post-op INV angle: **22.04 ± 4.1,** **($p = 0.023$)** **ROE2 (subjective breathing):** Pre-op: 1.471 ± 0.90 Post-op: **3.1 ± 0.88;** **($p = 0.0001$)**	1	25.80%	NR	8.60%
Taş[42]	1	2020	Turkey	44	23.2	Prospective cohort	IV	DRT	Closed	ROE, subjective evaluation, pyramidal angle measurements, patency score	12	**Mean pyramidal angle:** Pre-op: 80. Post-op: **60.4** **($p < 0.001$)** **Mean ROE:** 90.1% patient satisfaction. **Patency score:** Pre-op: 5.1 **Post-op: 8.2** **($p < 0.001$)**	1	0.00%	0.00%	0.00%
Taş and Erden[43]	1	2021	Turkey	50	27.5	Prospective cohort	III	Open rhinoplasty with spreader graft vs. LD technique	Open-24, Closed- 26	NOSE, SNOT-22, VAS	6	***LD technique*:** **Nose:** Pre-op: 13.19 (5.32) Post-op: **3.81 (2.92)** **($p < 0.001$)** **Snot-22:** Pre-op: 41.77 (23.58) Post-op: **13.12 (11.51)** **($p < 0.001$)** **VAS:** Pre-op: 6.96 (2.27) Post-op: **2.00 (1.38)**	1	NR	NR	NR

(*Continued*)

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
												($p < 0.001$) ***Spreader technique:*** **Nose:** Pre-op: 13.42 (4.23) Post-op: **3.58 (2.63)** **($p < 0.001$)** **Snot-22:** Pre-op: 47.50 (19.76) Post-op: **14.58 (9.69)** **($p < 0.001$)** **VAS:** Pre-op: 7.38 (1.86) Post-op: **2.04 (1.12)** **($p < 0.001$)** **No significant difference between groups**				
Tham et al[44]	1	2022	USA	5660	NR	Systematic review and meta-analysis	II	PR	NR	Subjective, complications/revision rates	NR	Post-op rate of infection: 1.89%. Wide variety of functional outcomes—heterogeneity precluded further analysis. Prevailing method: Type 1 DP (impaction osteotomies of the nasal pyramid-LD/PD). Minority method: Type 2 DP (dorsal hump modulation of soft tissue without impact osteotomies)	0	3.02%	4.18%	3.48%
Almazov et al[7]	3	2022	Russia, Barcelona, Azerbaijan	134	28	Retrospective cohort	IV	PD vs. LD vs. Combination (with PIE)	Closed	ROE, patient satisfaction	12	**Median ROE:** Pre-op: 58.3 12 mo post-op: **92.5** **($p < 0.001$)** **Patient satisfaction:** 96%	1	NR	0.75%	0.75%
Erdal and Genç[12]	3	2022	Turkey	36	25.3	Retrospective cohort	IV	DP +/− transection of Pitanguy's midline ligament	Closed	Photograph analysis, ROE, subjective patient satisfaction. complications	9	**Supratip depression detected:** Preservation group: 4/6 (25%) Transection group: 0 **($p < 0.05$)** **Median ROE score:** Preservation group: 83 Transection group: 87 **Patient satisfaction score:** Transection group: 90% Preservation group: 87.5%	1	15.38%	NR	NR

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
Kosins[17]	3	2021	USA	100	29	Retrospective cohort	IV	DP + SSM vs. DP + cartilage- only PD + separate bony pyramid modification vs. DP + cartilage reduction + separate bony pyramid modification	Open	Complication/revision rates, technique	12	**Average lowering:** SSM: 4.5 mm, cartilage only PD: 2.5 mm, cartilage modification: 2 mm	0	1.00%	2.00%	0.00%
Öztürk[27]	3	2021	Turkey	45	24.2	Retrospective cohort	IV	Mix-down: PD + LD	Closed	ROE, patency score	14.1	**Median ROE:** Pre-op: 60.1 12 mo post-op: 92.2 ($p < 0.001$) **Patient satisfaction:** 92%. **Patency score:** Pre-op: 6.1 12 mo post-op: 9.3 ($p = 0.001$)	1	0.00%	NR	0.00%
Öztürk[28]	3	2021	Turkey	48	23.6	Retrospective cohort	IV	Partial PD or partial LD	Closed	ROE	14	**Median ROE:** Pre-op: 60.0 12 mo post-op: 93.6 ($p < 0.001$) **Patient satisfaction:** 92%	1	NR	NR	0.00%
Robotti et al[35]	3	2019	Italy, South Africa	41	NR	Prospective cohort	IV	Modified dorsal cartilaginous PD after component separation	Open	Subjective cosmetic results	6	All patients had favorable outcomes	0	0.00%	0.00%	0.00%
Taglialatela Scafati and Regalado-Briz[41]	3	2021	Italy, Mexico	107	28.7	Retrospective cohort	IV	PR + PIE osteotomy	Closed: 88, 19: combined	Subjective, complications/revision rates, RHINO score	18	**RHINO score:** Mean post-op: 85.6 (12.7) Significant increase (**$p < 0.001$**)	1	NR	3.74%	8.40%
Tuncel, Aydogdu[45]	3	2019	Turkey	520	NR	Retrospective cohort	IV	LD or PD	Closed	Subjective satisfaction, complication/revision rate	13	< 2 mm hump recurrence in 6.5%: 2–3 mm hump recurrence in 2.1%. 3–4 mm hump recurrence in 3.5%. Successful cosmetic results achieved	0	NR	12.12%	3.50%
Tuncel et al[47]	3	2021	Turkey	150	29.11	Retrospective cohort	IV	PD: dorsal hump under 4 mm vs. LD: dorsal hump over 4 mm	Closed	Subjective, photograph evaluation	12.68	PD for 67 cases. LD for 83 cases. All recurrent cases had a pre-op hump deformity over 4 mm. Correlation between preoperative hump height and hump recurrence	0	NR	5.30%	5.30%

(*Continued*)

Table 2 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Postoperative hump recurrence rate:	Revision rate:
Öztürk[25]	4	2021	Turkey	43	24.2	Retrospective cohort	IV	New suture technique	NR	ROE	15.8	**Median ROE:** Pre-op: 60.6 12 mo post-op: 90.8 **($p < 0.001$)** **Patient satisfaction:** 90.47%	1	0.00%	NR	0.00%
Cakir et al[10]	6	2012	Turkey	228	24.3	Retrospective cohort	IV	Subperichondrial dissection with repair of Pitanguy's midline ligament	Open	Subjective, complications/revision rates	9, 36	Limited edema, more rapid patient recovery, subperichondrial dissection easier in revision patients	0	12.72%	NR	5.26%
Kosins, Daniel[1]	6	2020	USA	100	27	Retrospective cohort	IV	PR-C or PR-P	Open	Surgical details, subjective cosmetic and functional outcomes, complication/revision rates	13	Details of surgical technique.	0	0.00%	0.00%	3.00%
Kosins[18]	6	2022	USA	100	28	Retrospective cohort	III	PR-open vs. PR-closed	Open: 56, closed: 44	Surgical details, complication/revision rates	12	Closed approach favored in minimal dorsal modification and for osseocartilaginous preservation. Open favored for extensive dorsal modifications, complex tip deformity, and tip augmentation	0	0.00%	2.00%	4.00%
Qaradaxi et al[34]	6	2022	Iraq	113	27.19	Prospective cohort	III	Subdorsal septal approach to manage **V**-shaped vs. **S**-shaped dorsum	NR	SCHNOS-C, O, operative time, complication/revision rates	NR	**Overall SCHNOS-O, C:** Significant improvement post-op. Obstructive improved more in **S**-shaped deformity	1	22.10%	13.30%	NR
Tuncel et al[46]	6	2022	Turkey	25	28.64	Prospective cohort	IV	DRF; mirrors technique of Robotti et al[35]	Open: 13, closed: 12	Nasolabial and nasoglabellar angles	10.3	**Nasoglabellar angle:** Pre-op: 136.3° Post-op: 138.8° **Nasolabial angle:** Pre-op: 89.8° Post-op: 95.4° ($p < 0.014$)	1	0.00%	0.00%	0.00%

Note: For abbreviations and footnotes, please see "Notes for Tables 2–4."

Table 3 Evidence characteristics and outcomes: soft-tissue preservation techniques

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
Almazov et al[7]	3	2022	Russia, Barcelona, Azerbaijan	134	28	Retrospective cohort	IV	PD vs. LD vs. Combination (with PIE)	Closed	ROE, patient satisfaction	12	**Median ROE:** Pre-op: 58.3 12 mo post-op: **92.5 ($p < 0.001$)** **Patient satisfaction:** 96%	1	NR	0.75%	0.75%
Erdal and Genç[12]	3	2022	Turkey	36	25.3	Retrospective cohort	IV	DP +/− transection of Pitanguy's midline ligament	Closed	Photograph analysis, ROE, subjective patient satisfaction. complications	9	**Supratip depression detected:** Preservation group: 4/6 (25%) Transection group: 0 **($p < 0.05$)** **Median ROE score:** Preservation group: 83 Transection group: 87 **Patient satisfaction score:** Transection group: 90% Preservation group: 87.5%	1	15.38%	NR	NR
Kosins[17]	3	2021	USA	100	29	Retrospective cohort	IV	DP + SSM vs. DP + cartilage-only PD + separate bony pyramid modification vs. DP + cartilage reduction + separate bony pyramid modification	Open	Complication/revision rates, technique	12	**Average lowering**: SSM- 4.5 mm, cartilage only PD: 2.5 mm, cartilage modification: 2 mm	0	1.00%	2.00%	0.00%
Öztürk[27]	3	2021	Turkey	45	24.2	Retrospective cohort	IV	Mix-down: PD + LD	Closed	ROE, patency score	14.1	**Median ROE:** Pre-op: 60.1 12 mo post-op: 92.2 ($p < 0.001$) **Patient satisfaction:** 92%. **Patency score:** Pre-op: 6.1 12 mo post-op: 9.3 ($p = 0.001$)	1	0.00%	NR	0.00%
Öztürk[28]	3	2021	Turkey	48	23.6	Retrospective cohort	IV	Partial PD or. partial LD	Closed	ROE	14	**Median ROE:** Pre-op: 60.0 12 mo post-op: 93.6 ($p < 0.001$) **Patient satisfaction:** 92%	1	NR	NR	0.00%
Robotti et al[35]	3	2019	Italy, South Africa	41	NR	Prospective cohort	IV	Modified dorsal cartilaginous PD after component separation	Open	Subjective cosmetic results	6	All patients had favorable outcomes	0	0.00%	0.00%	0.00%

(*Continued*)

Table 3 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
Taglialatela Scafati and Regalado-Briz[41]	3	2021	Italy, Mexico	107	28.7	Retrospective cohort	IV	PR + PIE osteotomy	Closed: 88, 19 combined	Subjective, complications/revision rates, RHINO score	18	**RHINO score:** Mean post-op: 85.6 (12.7) Significant increase (**$p < 0.001$**)	1	NR	3.74%	8.40%
Tuncel, Aydogdu[45]	3	2019	Turkey	520	NR	Retrospective cohort	IV	LD or PD	Closed	Subjective satisfaction, complication/revision rate	13	< 2 mm hump recurrence in 6.5%: 2–3 mm hump recurrence in 2.1%. 3–4 mm hump recurrence in 3.5%. Successful cosmetic results achieved	0	NR	12.12%	3.50%
Tuncel et al[47]	3	2021	Turkey	150	29.11	Retrospective cohort	IV	PD—dorsal hump under 4 mm vs. LD—dorsal hump over 4 mm	Closed	Subjective, photograph evaluation	12.68	PD for 67 cases. LD for 83 cases. All recurrent cases had a pre-op hump deformity over 4 mm. Correlation between preoperative hump height and hump recurrence	0	NR	5.30%	5.30%
Küçüker et al[49]	5	2014	Turkey	147	29.2	Prospective cohort	IV	Cartilage—saving PR	Open	Subjective, complications/revision rates	19.6	91.7% overall satisfaction rate. 86.3% functional satisfaction rate	0	NR	NR	1.36%
Öztürk[50]	5	2020	Turkey	190	24.3	Retrospective cohort	IV	Superior-based sliding flap technique	Closed	ROE, patency score	12	**Patient satisfaction:** 95%. **Patency scores:** Pre-op: 6.2 12 mo post-op: **8.8** (**$p < 0.001$**) **ROE:** Median 12 mo post-op score of 90.5	1	NR	NR	0.00%
Sazgar and Most[51]	5	2011	USA, Iran	102	NR	Prospective cohort	IV	lobular refinement w/ CHF vs. reduction of vertical height of LC + CHF vs. crural setback with CHF vs. horizontal and vertical reduction of LC + CHF	NR	Subjective cosmetic and functional results, complications	15	Satisfactory results achieved	0	0.00%	NR	0.98%
Cakir et al[10]	6	2012	Turkey	228	24.3	Retrospective cohort	IV	Subperichondrial dissection with repair of Pitanguy's midline ligament	Open	Subjective, complications/revision rates	9, 36	Limited edema, more rapid patient recovery, subperichondrial dissection easier in revision patients	0	12.72%	NR	5.26%

Table 3 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
Kosins and Daniel[1]	6	2020	USA	100	27	Retrospective cohort	IV	PR-C or PR-P	Open	Surgical details, subjective cosmetic and functional outcomes, complication/revision rates	13	Details of surgical technique	0	0.00%	0.00%	3.00%
Kosins[18]	6	2022	USA	100	28	Retrospective cohort	III	PR-open vs. PR-closed	Open: 56, closed: 44	Surgical details, complication/revision rates	12	Closed approach favored in minimal dorsal modification and for osseocartilaginous preservation. Open favored for extensive dorsal modifications, complex tip deformity, and tip augmentation	0	0.00%	2.00%	4.00%
Qaradaxi et al[34]	6	2022	Iraq	113	27.19	Prospective cohort	III	Subdorsal septal approach to manage **V**-shaped vs. **S**-shaped dorsum	NR	SCHNOS-C, O, operative time, complication/revision rates	NR	**Overall SCHNOS-O, C:** Significant improvement post-op. Obstructive improved more in **S**-shaped deformity	1	22.10%	13.30%	NR
Tuncel et al[46]	6	2022	Turkey	25	28.64	Prospective cohort	IV	DRF	Open: 13, closed: 12	Nasolabial and nasoglabellar angles	10.3	**Naso-glabellar angle:** Pre-op: 136.3° Post-op: 138.8° **Nasolabial angle:** Pre-op: 89.8° Post-op: 95.4° ($p < 0.014$)	1	0.00%	0.00%	0.00%

Note: For abbreviations and footnotes, please see "Notes for Tables 2–4."

Table 4 Evidence characteristics and outcomes: lateral crura preservation techniques

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
Abdelwahab et al[58]	2	2021	USA, Egypt	94	NR	Retrospective cohort	III	LCSG vs. mini-LCSG vs. LCO with/without additional support vs. cephalic trimming vs. cephalic turn-in flaps	NR	LWI, NOSE, VAS, SCHNOS	9	**Zone 1 LWI:** Significant improvement in LCO with/without support, LCSG and mini-LCSG ($p = 0.042$, $p = 0.041$, $p < 0.001$). **Zone 2 LWI:** Significant improvement in LCO with support, LCSG ($p = 0.022$, $p = 0.004$). **NOSE:** significant improvement in all subgroups analyzed for zone 2 ($p < 0.05$). **SCHNOS-C, VAS-C:** significant improvement in all subgroups ($p < 0.05$)	1	NR	NR	NR
Abdelwahab and Most[66]	2	2020	USA, Egypt	33	32	Retrospective cohort	IV	Mini-LCSG in cosmetic or combined rhinoplasty	NR	SCHNOS-C, O, NOSE, VAS, LWI	20	***Cosmetic group*:** **LWI - Zone 1:** Pre-op: 0.31 (0.47) Post-op: **0.00 (0.00) ($p = 0.003$)** **NOSE** Pre-op: 15.96 (15.94) Post-op: 13.85 (15.51) **SCHNOS-O** Pre-op: 15.19 (19.82) Post-op: 14.04 (16.85) **SCHNOS-C** Pre-op: 66.92 (18.50) Post-op: **9.61 (16.54) ($p = 0.001$)** **VAS-F** Pre-op: 1.23 (1.68) Post-op: 1.23 (1.21) **VAS-C** Pre-op: 2.50 (2.00) Post-op: **8.85 (1.52) ($p = 0.001$)** ***Combined group:*** **LWI- Zone 1:** Pre-op: 0.57 (0.53) Post-op: **0.00 (0.00) ($p = 0.03$)** **NOSE** Pre-op: 77.86 (14.96) Post-op: **23.92**	1	NR	NR	NR

Table 4 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
												(30.95) ($p = 0.003$) **SCHNOS-O** Pre-op: 82.86 (12.54) Post-op: **27.50 (31.12) ($p = 0.004$)** **SCHNOS-C** Pre-op: 65.24 (19.23) Post-op: **11.66 (10.83) ($p = 0.001$)** **VAS-F** Pre-op: 8.00 (1.29) Post-op: **3.00 (3.06) ($p = 0.008$)** **VAS-C** Pre-op: 4.57 (1.51) Post-op: 7.43 (3.64)				
Alkarzae and Bafaqeeh[61]	2	2020	SAU	120	23	Retrospective cohort	IV	Turn-in flap	Open	Subjective, complications/revision rates	24	Symmetrical reduction of LLC	0	0.00%	NR	5.00%
Boccieri and Marianetti[62]	2	2010	Italy	32	NR	Prospective cohort	IV	Barrel roll technique—rotation of lateral crus	NR	Rhinomanometric data, subjective aesthetic improvement, revision/complication rate	NR	Significant improvement in nasal airway resistance using rhinomanometric data. All displayed functional and aesthetic improvement	0	NR	NR	3.13%
Bulut[60]	2	2021	Turkey	30	31.6	Prospective cohort	IV	CLCA flap	Open	ROE, VAS	12	**ROE**: 93% satisfaction rate. **VAS-F:** Pre-op: 4.56 (1.53) 12 mo post-op: **9.0 (0.65) ($p < 0.001$)**	1	NR	NR	0%
Cabbarzade[72]	2	2022	Azerbaijan	94	34	Retrospective cohort	IV	Skin tensioning technique	Open	Subjective, complications/revision rates	24	All patients verbally stated satisfaction	0	0.00%	NR	NR
Darzi et al[71]	2	2021	Iran	54	26.32	Randomized controlled trial	II	LCC vs. MCC	Open	SCHNOS, nasolabial angle and projection	12	***Nasal tip projection:*** **Pre op:** MCC 64.08 (5.09) LCC 62.22 (4.64) **Post-op: 3 mo** MCC 62.90 (5.04) LCC 6216 (4.30) **Post op: 12 mo** MCC **61.03 (4.24) ($p = 0.003$)** LCC 61.16 (4.60) ***Nasal tip rotation:*** **Pre op:** MCC 90.45 (10.49) LCC 90.56 (11.43) **Post-op: 3 mo** MCC 104.51 (6.92) LCC 104.7 (10.21) **Post op: 12 mo** MCC **102.28 (6.15)**	1	0.00%	NR	0.00%

(*Continued*)

Table 4 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
												($p = 0.0001$) LCC **102.43 (10.06)** **($p = 0.0001$)** ***SCHNOS-O: % difference between 3 and 12 mo post-op*** MCC -31.92 (35.01) LCC -23.40 (28.13) ***SCHNOS-C: difference between 3 and 12 mo post-op*** MCC -51.15 (2.013) LCC -42.87 (20.52) **MCC resulted in significantly higher change in SCHNOS-C ($p = 0.046$)**				
Foda and Kridel[68]	2	1999	Egypt	28	32.5	Prospective clinical trial	II	LCS vs. LCO	Open	nasofacial angle, Goode ratio, nasolabial angle, rotation angle	6	**Goode-Ratio pre- and post-op mean difference:** LCS 0.06 (0.03) LCO **-0.05 (0.02)** **($p < 0.001$)** **Nasofacial angle pre- and post-op mean difference:** LCS 3.22 (1.52) LCO -3.80 (1.32) **Nasolabial angle pre- and post-op mean difference:** LCS 9.67 (6.64) LCO 12.80 (4.47) **Rotation angle pre- and post-op mean difference:** LCS 9.77 (1.63) LCO **12.40 (1.35)** **($p < 0.001$)**	1	NR	NR	NR
Foda[67]	2	2003	Egypt	306	26.5	Retrospective cohort	III	LCS vs. LCO vs. TING	Open	nasolabial angle, rotation angle, Goode ratio, nasofacial angle	12	**Nasolabial angle pre- and post-op mean difference:** LCO 11.8 (4.3) ($p < 0.001$) LCS 8.9 (4.5) ($p < 0.001$) TING 7.1 (4.6) ($p < 0.001$) **Rotation angle pre- and post-op mean difference:** LCO 13 (2.8) ($p < 0.001$) LCS 11 (1.4) ($p < 0.001$) TING 8.5 (1.8) ($p < 0.001$)	1	NR	NR	NR

Table 4 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
												LCO- significantly more rotation ($p < 0.001$) **Goode-Ratio pre- and post-op mean difference:** LCO -0.06 (0.03) ($p < 0.001$) LCS 0.07 (0.02) ($p < 0.001$) TING 0.02 (0.04) **Nasofacial angle pre- and post-op mean difference:** LCO -4.1 (1.4) ($p < 0.001$) LCS 3.2 (1.2) ($p < 0.001$) TING 0.4 (0.9)				
Foulad et al[57]	2	2017	USA	114	43	Retrospective cohort	IV	LCT method rhinoplasty	NR	Complications/revision rates	8.7	NR	0	1.80%	NR	5.30%
Gentile and Cervelli[69]	2	2022	Italy	35	NR	Randomized controlled trial	II	LCS + TING vs. cartilage grafts control group	NR	Subjective cosmetic and functional results	36	82.9% of patients showed excellent cosmetic and functional results in LCS + TING. 40% in control. Tip projection maintenance and contour restoring higher in LCS + TING group	0	NR	NR	NR
Ghazipour et al[70]	2	2008	Iran	60	26.2	Prospective clinical trial	II	Group A: Narrowing transdomal sutures + columellar strut. Group B: Narrowing transdomal sutures + columellar strut + LCS	Open	Nasofacial angle, Goode ratio, nasolabial angle	6	**Mean difference-Goode Ratio pre- and post-op:** Group A: -0.063 (0.02) ($p < 0.001$) Group B: -0.065 (0.018) ($p < 0.001$) **Mean difference-nasofacial angle pre- and post-op:** Group A: -4.34 (1.95) ($p < 0.001$) Group B; -2.107 (1.19) ($p < 0.001$) **Mean difference-nasolabial angle pre- and post-op:** Group A: -16.68 (5.48) ($p < 0.001$) Group B: -11 (4.89) ($p < 0.001$) **Group B: Significantly more increase in tip projection and rotation ($p < 0.05$)**	1	NR	NR	NR

(*Continued*)

Table 4 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
Gruber et al[56]	2	2010	USA	14	NR	Prospective cohort	IV	Rhinoplasty with preservation of lateral crus	Open	Subjective, complications/revision rates	NR	Bulbosity corrected in each case. No significant increase in alar- nostril axis measurement	0	NR	NR	21.43%
Langsdon et al[55]	2	2021	USA	20	NR	Retrospective cohort	IV	LCST	NR	nasolabial angle measurement	NR	Mean nasolabial angle: Pre-op: 86.9 Post-op: **98.5** **($p < 0.0001$)**	1	NR	NR	NR
Murakami et al[54]	2	2009	USA	18	NR	Prospective cohort	IV	Turn in flap	Open	Subjective, complications/revision rates	9	Satisfactory nasal tip refinement in all cases. Symmetric reduction of lower lateral cartilage in all cases	0	0.00%	NR	NR
Öztürk[52]	2	2020	Turkey	51	29.2	Retrospective cohort	IV	Sandwich technique with scroll ligament preservation	Closed	ROE, nasal patency, patient satisfaction	14.2	**Median ROE:** Pre-op: 70.1 12 mo post-op: **91.2 ($p = 0.002$)** **Patient satisfaction:** 92% **Patency score:** Pre-op: 9.4 12 mo post-op: **6.1 (= 0.003)**	1	0.00%	NR	0.00%
Paquet et al[65]	2	2016	USA	54	41.3	Prospective cohort	III	LCR	Open	photograph analysis and measurement, modified Gunter technique	11.3	**Mean anterior nostril apex:** Pre-op: 31.3° (8.9°) Post-op: 24.5° (6.8°) Net decrease all groups: **6.8°** **($p < 0.001$)** Net decrease (LCR only): **6.9** **($p < 0.001$)** Net decrease (LCR + LCSG): **6.7** **($p < 0.001$)**	1	NR	NR	NR
Sazgar[64]	2	2010	Iran	28	NR	Prospective cohort	IV	HRCH	Open	Subjective, complications/revision rates	14	Nasal tip fine and stable in all patients	0	0.00%	NR	0.00%
Sazgar[63]	2	2010	Iran	23	NR	Retrospective cohort	IV	LCST + cephalic turn in flap	Open	nasal tip rotation and projection	11	Increase in the degree of nasal tip rotation. Notable increase in the postoperative values of the nasolabial angle. Symmetric reduction of LLC	0	0.00%	NR	NR

Table 4 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
Tebbetts[53]	2	1994	USA	235	NR	Retrospective cohort	IV	no scoring, morselization, transection, or resection of rim strip	NR	Subjective, complications/revision rates	NR	NR	0	0.00%	NR	0.85%
Tellioglu and Cimen[59]	2	2007	Turkey	32	24	Prospective cohort	IV	Turn-in folding	Open	Subjective, complications/revision rates	NR	Satisfactory results were achieved	0	0.00%	NR	NR
Öztürk[25]	4	2021	Turkey	43	24.2	Retrospective cohort	IV	New suture technique	NR	ROE	15.8	**Median ROE:** Pre-op: 60.6 12 mo post-op: 90.8 (**$p < 0.001$**) **Patient satisfaction**: 90.47%	1	0.00%	NR	0.00%
Küçüker et al[49]	5	2014	Turkey	147	29.2	Prospective cohort	IV	Cartilage- saving PR	Open	Subjective, complications/revision rates	19.6	91.7% overall satisfaction rate. 86.3% functional satisfaction rate	0	NR	NR	1.36%
Öztürk[50]	5	2020	Turkey	190	24.3	Retrospective cohort	IV	Superior based sliding flap technique	Closed	ROE, patency score	12	**Patient satisfaction:** 95%. **Patency scores:** Pre-op: 6.2 12 mo post-op: **8.8** (**$p < 0.001$**) **ROE:** Median 12 mo post-op score of 90.5	1	NR	NR	0.00%
Sazgar and Most[51]	5	2011	USA, Iran	102	NR	Prospective cohort	IV	lobular refinement w/ CHF vs. reduction of vertical height of LC + CHF vs. crural setback with CHF vs. horizontal and vertical reduction of LC + CHF	NR	Subjective cosmetic and functional results, complications	15	Satisfactory results achieved	0	0.00%	NR	0.98%
Cakir et al[10]	6	2012	Turkey	228	24.3	Retrospective cohort	IV	Subperichondrial dissection with repair of Pitanguy's midline ligament	Open	Subjective, complications/revision rates	9, 36	Limited edema, more rapid patient recovery, subperichondrial dissection easier in revision patients	0	12.72%	NR	5.26%
Kosins and Daniel[1]	6	2020	USA	100	27	Retrospective cohort	IV	PR-C or PR-P	Open	Surgical details, subjective cosmetic and functional outcomes, complication/revision rates	13	Details of surgical technique	0	0.00%	0.00%	3.00%
Kosins[18]	6	2022	USA	100	28	Retrospective cohort	III	PR-open vs. PR-closed	Open-56, Closed- 44	Surgical details, complication/revision rates	12	Closed approach favored in minimal dorsal modification and for osseocartilaginous preservation. Open favored for extensive dorsal	0	0.00%	2.00%	4.00%

(*Continued*)

Table 4 (*Continued*)

Author(s)	Group[a]	Year	Country	No. of patients	Patient age (mean y)	Study type	Level of evidence	Surgical intervention	Approach	Primary outcome	Mean duration of follow-up (mo)	Result summary	Significant finding[b]	Complication rate	Post-op hump recurrence rate	Revision rate
												modifications, complex tip deformity, and tip augmentation				
Qaradaxi et al[34]	6	2022	Iraq	113	27.19	Prospective cohort	III	sub-dorsal septal approach to manage **V**-shaped vs. **S**-shaped dorsum	NR	SCHNOS-C, O, operative time, complication/revision rates	NR	**Overall SCHNOS-O, C:** Significant improvement post-op. Obstructive improved more in **S**-shaped deformity	1	22.10%	13.30%	NR
Tuncel[46]	6	2022	Turkey	25	28.64	Prospective cohort	IV	DRF	Open- 13, Closed- 12	Nasolabial and nasoglabellar angles	10.3	**Nasoglabellar angle:** Pre-op: 136.3° Post-op: 138.8° **Nasolabial angle:** Pre-op: 89.8° Post-op: 95.4° ($p < 0.014$)	1	0.00%	0.00%	0.00%

Note: For abbreviations and footnotes, please see "Notes for Tables 2–4."

Notes for Tables 2–4			
Groups[a]			
1	Group 1 only		
2	Group 3 only		
3	Groups 1 and 2		
4	Groups 1 and 3		
5	Groups 2 and 3		
6	All groups		
Abbreviations			
DP	Dorsal preservation technique	LCO	Lateral crural overlay
DR	Dorsal resection technique	CLCA	Cephalic lateral crural advancement
PR	Preservation rhinoplasty technique	LCC	Lateral crural cut + overlay
SR	Structural rhinoplasty technique	MCC	Medial Crural Cut + Overlay
PR-C	Complete preservation rhinoplasty	LCS	Lateral crural steal
PR-P	Partial preservation rhinoplasty	TING	Tongue in groove technique
SPR	Structural preservation rhinoplasty	LCT	Lateral crural tensioning

(*Continued*)

CHR	Conventional hump resection	LCST	Lateral crural setback technique
SPAR	Septum pyramidal adjustment and repositioning technique	LCR	Lateral crural repositioning
CDR	Component dorsal hump reduction	PIE	Piezoelectric instrument
CDRT	Cartilaginous dorsum repositioning technique	LC	Lateral crura
LD	Let-down technique	LLC	Lower lateral cartilage
PD	Push-down technique	INV	Internal nasal valve
SRT	Spare roof technique	NOSE	Nasal obstruction and symptom evaluation score
DRT	Dorsal roof technique	SCHNOS	Standardized cosmesis and health nasal outcomes survey (O = obstructive, C = cosmetic)
DRF	Dorsal roof flap	VAS	Visual analog scale (F = functional, C = cosmetic)
ADP	Asymmetric dorsal preservation	ROE	Rhinoplasty outcome evaluation score
SSM	Subdorsal strip method	OAR	Utrecht Questionnaire for Outcome Assessment in Aesthetic Rhinoplasty
MSSM	Modified subdorsal strip method	SNOT-22	Sinonasal Outcome Test-22
WR	Wedge resection	RHINO	Rhinoplasty health inventory and nose outcome score
CHF	Cephalic hinged flap	LWI	Lateral wall insufficiency score
HRCH	Horizontal reduction with a cephalic hinged flap	BTL	Brow-tip aesthetic line
LCSG	Lateral crural strut graft	PE	Physical exam
TNV	Total nasal volume	TNR	Total nasal resistance
Significant finding[b]			
1	Yes		
0	No		

Discussion

DPR has become increasingly popular among rhinoplasty surgeons since 2018 with descriptions of surgical techniques and outcomes increasing in the literature starting in 2019. Contemporary preservation rhinoplasty technique includes a combination of three independent components including reduction of the dorsal bony-cartilaginous complex, subperichondrial dissection with preservation of ligaments and the soft-tissue envelope, and minimal resection of lateral crura with innovative graft or suture techniques. Despite a renewed interest in contemporary preservation techniques, there is a lack of high-level evidence and appraisal of patient outcomes in the current literature. We aim to evaluate the current evidence-based literature available for the three independent components of the modern preservation technique.

Group 1: Dorsal Preservation Component

We defined the dorsal preservation component as any technique that reduces the bony-cartilaginous complex in the process of hump reduction without disruption of the dorsal vault or destruction of tissue. This group includes the largest number of references which is 46 in total, with 4 containing level II evidence (8.7%), 8 being level III evidence (17.4%), and 34 being level IV evidence (73.9%). Nine of these references are also included in Group 2 (19.6%), one in Group 3 (2.2%), and five in all the three groups (10.9%). Forty-two (91.3%) of these references were published in 2019 or later and only 9 (19.6%) were published by an academic institution located in the United States or Canada. Of the references reporting surgical details, 66.7% used closed approach for the majority of cases, with 33.3% open approach. Twenty-four (52.2%) cohort studies used validated patient-reported outcome measures (PROMs) to evaluate cosmetic and/or functional results following a variety of dorsal preservation techniques. PROMs used include the Utrecht Questionnaire for Outcome Assessment in Aesthetic Rhinoplasty (OAR), Visual Analog Scale—functional and cosmetic (VAS-C, VAS-F), Rhinoplasty Outcome Evaluation (ROE), Likert scale for nasal patency, Standardized Cosmesis and Health Nasal Outcomes Survey—cosmetic and obstructive (SCHNOS-C, SCHNOS-O), and the Rhinoplasty Health Inventory and Nasal Outcomes scale (RHINO). Please see the dorsal preservation group included in ►**Table 2** for all reference details.[1–3,6–48]

To our knowledge, only four studies directly compare dorsal preservation technique to conventional dorsal resection rhinoplasty.[6,13,31,43] Ferreira et al conducted a randomized prospective cohort study examining PROMs following component dorsal hump reduction (CDR) versus spare roof technique (SRT).[13] In 125 randomly selected patients undergoing primary rhinoplasty, compared to CDR, the SRT technique resulted in significantly more improvement in both the VAS-C (4.6 vs. 3.7, $p < 0.001$) and VAS-F (4.0 vs. 3.1, $p = 0.001$).[13] Additional comparative studies focus on traditional preservation techniques (e.g., let-down technique, push-down technique). Support for the let-down preservation rhinoplasty technique is provided by Taş and Erden with a prospective cohort study of 50 patients resulting in significant postoperative improvement in mean [SD] NOSE (13.2 [5.3] vs. 3.8 [2.9], $p < 0.001$), SNOT-22 (41.8 [23.6] vs. 13.1 [11.5], $p < 0.001$), and VAS scores (7.0 [2.3] vs. 2.0 [1.4], $p < 0.001$).[43] However, when compared to traditional open rhinoplasty with spreader graft, there was no significant difference in PROM between groups.[43] Alan et al also demonstrated no significant difference in NOSE or SCHNOS-O/C scores between a structural rhinoplasty and preservation rhinoplasty group in a prospective trial of 34 patients.[6] Similarly, Patel et al conducted a retrospective matched cohort study of 163 patients directly comparing structural preservation rhinoplasty to conventional hump resection.[31] No significant difference in SCHNOS-O or VAS-F was seen between groups at both short-term (<6 months) and long-term (>6 months) follow-up. VAS-C scores were significantly higher in the structural preservation group at short-term follow-up (8.9 [1.6] vs. 8.2 [2.3], $p = 0.03$), but this did not persist long-term.[31]

Of other noncomparative studies that include PROMs, evidence for use of the SRT was the most robust.[36,38] In the first 100 patients undergoing this technique, there was a significant improvement in mean aesthetic VAS-C scores at 3 and 12 months (3.7 [0.2] vs. 8.1 [0.1] vs. 8.4 [0.1], $p < 0.001$).[38] Complete preservation of all three components with the subdorsal septal approach has also resulted in significant improvement postoperatively for both **V**- and **S**-shaped nasal dorsum deformities, with obstruction improving more in the **S**-shaped group.[34] Patel et al also provided support for the use of the subdorsal strip method with or without functional rhinoplasty.[30,32] In 22 patients, VAS-F and SCHNOS-O did not significantly change following cosmetic preservation rhinoplasty alone. However, there was no deterioration in SCHNOS- O scores, suggesting that dorsal preservation techniques do not worsen nasal obstruction.[30,32]

Additional level IV studies demonstrate statistically significant improvement in cosmetic and functional outcomes based on ROE, patency Likert scale, SCHNOS-O/C, VAS-C/F, and RHINO scores following a variety of dorsal preservation techniques including let-down technique, push-down technique, suturing techniques, subdorsal strip method, and dorsal roof technique. However, none of these studies directly compare preservation rhinoplasty techniques to conventional resection.[3,7,12,21–28,40–42] The remaining references include subjective or photographic evaluation of cosmetic and/or functional outcomes as well as analysis of complication rate, postoperative dorsal hump recurrence, and revision rates.[1,2,8,10,11,14–17,20,33,35,37,39,45–48] Overall, the DPR techniques are reported to have a complication rate ranging from 0 to 25.80% with the majority of reported complications being minor.[1,9,10,12,13,16–18,23–27,30,34,35,37,39,40,44,46] Reported postoperative dorsal hump recurrence rates ranged from 0 to 36.9% with the most dorsal hump recurrence occurring following the classical septum pyramidal adjustment and repositioning (SPAR) approach in complex rhinoplasty cases.[1,2,7,13,15–18,20–22,29,30,34,35,41,42,44–47] Postoperative dorsal hump revision rates were reported by 25 studies and ranged from 0 to 15%.[1,2,7,9–11,13,15,17,18,20–28,35,40–42,44–48]

The most benefit was seen after dorsal preservation in straight noses with traditional rhinoplasty being suggested in difficult cases or in patients with thick skin across multiple references.[15,20,48]

Although there has been an increase in the number of references including PROMs following dorsal preservation techniques since 2019, many of these studies provide low levels of evidence. We identified only four studies that directly compare dorsal preservation techniques to conventional hump resection. Although numerous studies report high patient satisfaction following dorsal preservation techniques, three out of the four comparative studies included found no significant difference in PROMs between preservation rhinoplasty and conventional structural rhinoplasty. Further research should focus on high-level, prospective, comparative studies to fully understand the benefit, as well as the complication rate, of dorsal preservation techniques across different patient populations

Group 2: Soft-Tissue Preservation Component

We defined soft-tissue preservation as any technique including subperichondrial dissection for the preservation of ligaments and other soft tissue. This group includes the smallest number of references which is 17 in total, with 2 (11.8%) being level III evidence and 15 (88.2%) being level IV. Of these 17 references, all overlap with other groups, with 9 overlapping with Group 1 (52.9%), 3 overlapping with Group 3 (17.6%), and 5 being included in all the three groups (29.4%). Fourteen (82.4%) of these articles were published in 2019 or later and 4 (23.5%) were published by academic institutions in the United States. Of the references reporting surgical details, 53.3% used a closed approach rhinoplasty for the majority of cases, with 46.7% using an open approach. Please see the soft-tissue preservation group included in ►**Table 3** for all reference details.[1,7,10,12,17,18,27,28,34,35,41,45–47,49–51]

No studies included in this category directly compare preservation techniques to conventional structural rhinoplasty. The highest level of evidence is available for the subdorsal septal approach proposed by Qaradaxi et al.[34] The goal of this technique is nasal hump reduction with minimal dissection of the soft-tissue envelope of the nasal dorsum, which encompasses all three preservation techniques well.[34] In 113 prospectively analyzed patients, there was a significant improvement in overall SCHNOS-O/C scores following the use of this comprehensive preservation technique ($p < 0.001$). Improved subjective outcomes after osseocartilaginous preservation were also found after closed preservation rhinoplasty when directly compared to the open approach.[18] However, this retrospective analysis was based on subjective physician-graded outcomes and does not include statistically analyzed data.

Six additional, low-level, noncomparative studies use the RHINO score, ROE scale, and/or nasal patency Likert scale for the evaluation of cosmetic and functional outcomes following soft-tissue preservation techniques.[7,12,27,28,41,50] Notably, significant improvement in RHINO score ($p < 0.001$) and nasal patency scores (6.2 vs. 8.8, $p < 0.001$) following scroll and pyriform ligament preservation during rhinoplasty was demonstrated in two studies.[41,50] However, Erdal and Genç demonstrated no significant difference in ROE scores following DPR either with or without transection (87 vs. 83) of Pitanguy's midline ligament, although supratip depression was found to be higher in the preservation group when compared to conventional transection (25 vs. 0%, $p < 0.05$).[12]

The remaining studies in this group report subjective outcomes, complication rates, or revision rates with no statistically analyzed data. Overall, 10 included studies report complication rates ranging from 0.0 to 23.3% following preservation rhinoplasty techniques that include soft-tissue conservation.[1,10,12,17,18,27,34,35,46,51] No major complications or pollybeak deformities were reported.[12] One study found decreased edema following subperichondrial dissection with preservation of Pitanguy's midline ligament as well as more rapid patient recovery.[10] Subperichondrial dissection was also noted to be easier in revision rhinoplasty patients.[10] Fifteen studies also reported revision rates ranging from 0.0 to 8.40% with most patients reporting high cosmetic or functional satisfaction following soft-tissue preservation rhinoplasty techniques.[1,7,10,17,18,27,28,35,41,45–47,49–51]

Overall, the evidence for contemporary soft-tissue preservation techniques is severely lacking, with no studies that directly compare preservation techniques to conventional rhinoplasty. Prospective, comparative, longitudinal studies analyzing PROMs following a variety of soft-tissue preservation techniques will be imperative as preservation rhinoplasty techniques grow in popularity.

Group 3: Lateral Crural Preservation Component

We defined lateral crural preservation as any technique aimed at nasal tip refinement with minimal lateral crural resection. Techniques reviewed in this group include lateral crural steal (LCS), lateral crural overlay (LCO), tongue in groove technique (TING), lateral crural strut grafts (LCSG), cephalic turn-in flaps, and the cephalic hinged flap. Our focus for this section was on published literature that includes outcomes following lateral crural tensioning. We acknowledge that many additional techniques exist and that our search does not encompass all suture methods used in preservation rhinoplasty procedures. The group included 30 total references with 4 (13.3%) level II studies, 5 (16.7%) level III studies, and 21 (70%) level IV studies. Of the 30 references included in this group, 1 (3.3%) is included in Group 1, 3 (10%) are included in Group 2, and 5 (16.7%) are included in all the three groups. Of note, half of these references were published prior to 2019 and 37% were published by academic institutions located in the United States. Of the references reporting surgical details, 10% used a closed approach rhinoplasty for the majority of cases, with 90% utilizing an open approach. Please see the lateral crural preservation group included in ►**Table 4** for all reference details.[1,10,18,25,34,46,49–72]

To our knowledge, there are no references that directly compare lateral crural preservation techniques to conventional rhinoplasty. The highest level of evidence (level II) is currently available for LCS, LCO, and TING techniques.[68–71] Foda and Kridel first demonstrated rhinoplasty technique

with LCS or LCO for nasal tip repositioning in 1999.[68] In this prospective clinical trial, 28 patients had a significant increase in nasal tip projection and rotation following the LCS technique ($p < 0.001$), but only a significant increase in tip rotation following the LCO technique ($p < 0.001$). It was concluded that the LCO technique resulted in a significantly higher change in rotation (12.4 [1.4] vs. 9.8 [1.6], $p < 0.001$) when compared to LCS, and should be used for patients with severe tip underrotation.[68] Similarly, a significant difference in Goode ratio (-0.1 [0.01], $p < 0.001$), nasofacial angle (−2.1 [1.2], $p < 0.001$), and nasolabial angle (−11.0 [4.9], $p < 0.001$) was seen by Ghazipour et al with a prospective clinical trial for the treatment of underprojected nasal tip with LCS.[70] When compared to traditional suture techniques, the addition of LCS resulted in a significantly greater change in nasal tip projection and rotation ($p < 0.05$). Recently, references have assessed PROMs following the LCO, LCS, and TING techniques in primary preservation rhinoplasty.[69,71] Darzi et al demonstrated no significant difference in change in SCHNOS-O at 3 and 12 months postoperatively in the lateral crural cut and overlay group when compared to the medial crural cut and overlay group (−23.4 [28.1] vs. −31.9 [35.0]).[71] Gentile and Cervelli then demonstrated better tip projection maintenance and contour following primary preservation rhinoplasty with either LCS or TING techniques when compared to a traditional cartilage graft control group ($p < 0.001$).[69]

Seven additional references included PROMs in the analysis of lateral crural preservation techniques.[25,34,50,52,58,60,66] Significant improvement in ROE, nasal patency scores, SCHNOS-C/O, NOSE, and VAS-F/C was seen following the sandwich technique described by Öztürk, as well as the mini-LCSG, LCSG, cephalic lateral crural advancement (CLCA) flap, LCO technique, cephalic turn-in flap, and superior-based sliding flap technique with complete cartilage preservation.[25,50,52,58,60,66] Significant improvement was also seen in SCHNOS-O/C scores following a subdorsal septal approach encompassing all three preservation techniques.[34] Abdelwahab et al found a significant improvement in both SCHNOS-C and VAS-C ($p < 0.05$) for all lateral crural preservation techniques in cosmetic rhinoplasty.[58,66] Similarly, Öztürk and Bulutboth demonstrated a significant improvement in ROE score at 12 months following either the sandwich technique or CLCA flap.[52,60] Improvement in SCHNOS-O score was seen only in combined cosmetic and functional rhinoplasty with mini-LCSG, although there was an improvement in nasal patency Likert scale scores or VAS-F following both the sandwich technique and CLCA flap.[52,60,66]

The remaining references included in this group focus on subjective outcomes, complication rates, and revisions rates with no statistically significant data available.[1,10,18,46,49 51,53,54,56,57,59,61–64,72] Seventeen studies reported complication rates ranging from 0.00 to 22.10%.[1,10,18,25,34,46,51–53 54,57,59,61,63,64,71,72] Notably, the highest complication rate occurred following the subdorsal septal approach for the complete preservation of all three components in either **S**- or **V**-shaped nasal deformities.[34] Similarly, 16 studies reported low revision rates ranging from 0.00 to 5.3%.[1,10,18,25,46,49–52 53,57,60–62,64,71] A single study by Gruber et al demonstrated a high revision rate of 21.4% following a rhinoplasty technique with preservation of the lateral crus in 14 patients with alar retraction.[56]

Much of the evidence for lateral crural preservation techniques is not comparative and does not include validated PROMs. New, prospective, comparative studies focused on validated outcome measures such as the SCHNOS and VAS surveys are needed to better inform rhinoplasty surgeons on the best techniques for preservation of the lateral crura.

The objective of this study was to evaluate the current evidence-based literature available for the three independent components of the modern preservation technique. Our search strategy resulted in the identification of two systematic reviews summarizing PROMs, as well as complication and revision rates following preservation rhinoplasty. Tham et al found similar results to our current study in an analysis of 22 studies of the preservation rhinoplasty technique.[44] With grouped analysis of 18 studies, they determined overall complication rates, dorsal hump recurrence rates, and revision rates of 3, 4.2, and 3.5% respectively. Unfortunately, analysis of functional and cosmetic outcomes was not run due to heterogeneity in the wide variety of PROMs.[44] Levin et al similarly found a low number of studies quantifying patient satisfaction following a variety of preservation rhinoplasty techniques.[19] It is evident that critical analysis of long-term patient-reported cosmetic and functional outcomes is imperative as preservation rhinoplasty techniques become increasingly popular. Although numerous studies have reported positive patient outcomes following all three categories of preservation technique, the analysis of how long-term outcomes compare to conventional dorsal hump reduction techniques is needed.

Conclusions

There has been resurgence in interest in preservation rhinoplasty techniques since 2018. It is likely that contemporary preservation rhinoplasty techniques will continue to evolve and increase in popularity. However, there is still a significant lack of literature comparing preservation techniques to conventional structural rhinoplasty. Although studies have consistently reported positive outcomes following preservation technique and more recent studies have documented improvement in validation PROMs, further analysis of long-term outcomes is needed to better inform rhinoplasty surgeons of the most appropriate preservation technique for each patient population.

Conflict of Interest
None declared.

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Appendix 1

PubMed Search:

Dorsal Preservation Terms:

("Dorsal"[Title/Abstract] OR "dorsum"[Title/Abstract] OR "hump"[Title/Abstract] OR "nose"[Title/Abstract] OR "mid vault"[Title/Abstract] OR "nasal"[Title/Abstract]) AND ("Preservation"[Title/Abstract] OR "preserve"[Title/Abstract] OR "preserving"[Title/Abstract] OR "push down"[Title/Abstract] OR "let down"[Title/Abstract])

Soft Tissue Preservation Terms:

("Rhinoplasty"[MeSH Terms] OR "rhinoseptoplasty"[Title/Abstract] OR "nose"[Title/Abstract] OR "nasal"[Title/Abstract]) AND ("Preservation"[Title/Abstract] OR "preserving"[Title/Abstract] OR "preserve"[Title/Abstract]) AND ("Ligament"[Title/Abstract] OR "soft tissue"[Title/Abstract] OR "subperichondrial"[Title/Abstract])

Lateral Crural Preservation Terms:

("Nose"[Title/Abstract] OR "nasal"[Title/Abstract] OR "ala"[-Title/Abstract] OR "alar"[Title/Abstract] OR "lateral crura"[-Title/Abstract] OR "lateral crural"[Title/Abstract] OR "nasal cartilage"[Title/Abstract] OR "lateral crus"[Title/Abstract]) AND ("strut" [Title/Abstract] OR "overlay" [Title/Abstract] OR "tension" [Title/Abstract])