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# Dorsal Preservation versus Component Dorsal Hump Reduction Rhinoplasty: An Assessment of Patient-reported Outcomes

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**Background:** The literature on patient-reported outcomes (PROs) discussing dorsal preservation rhinoplasty (DPR) and component dorsal hump reduction (CDHR) is scarce. This study aims to fill the gap in PROs between these techniques.
**Methods:** A systematic review was conducted to investigate PROs of DPR and CDHR. A proportion meta-analysis was conducted using Stata statistical software.
**Results:** A total of 25 studies met our inclusion criteria, pooling 1706 participants, with 13 studies on CDHP and 12 studies on DPR. Overall satisfaction rates were high, varying from 84% to 100% across studies. A subgroup analysis revealed that both techniques exhibited equally high satisfaction with no statistical differences ($P = 0.18$). A random-effects model revealed that about two of 100 treated patients underwent revisions across our cohort (95% interquartile range: 0–4). Notably, the CDHR technique was associated with a significant 53.7-point reduction in the Standardized Cosmesis and Health Nasal Outcomes Survey (SCHNOS)-cosmetic domain [95% confidence interval (CI): −62.7 to −44.8, $P < 0.001$], along with a meaningful improvement in SCHNOS-obstructive scores by −27.3 points (95% CI: −50.5 to −4.04, $P = 0.02$). Conversely, the DPR was linked to a 55.3-point reduction in the SCHNOS-cosmetic domain (95% CI: −60.7 to −49.9, $P < 0.001$), and a −19.5 point change in the SCHNOS-obstructive domain (95% CI: −27.9 to −11.1, $P < 0.001$).
**Conclusion:** Although PROs are comparable, the literature suggests that CDHR outcomes may be better than DPR in alleviating obstructive symptoms, potentially offering an evidence-based choice for addressing functional concerns in rhinoplasty.
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## INTRODUCTION

Rhinoplasty, one of the most common plastic surgery procedures in the United States, with more than 352,000 operations conducted in 2020, possesses a rich history, underscoring its longstanding relevance.[1,2] The techniques and approaches to rhinoplasty have evolved significantly since its conception, reflecting advancements in surgical knowledge, technology, and understanding of aesthetic principles for many years. As opposed to other aesthetic procedures, rhinoplasty has a special role in enhancing not only form but also the function of the nose, which has important implications for breathing quality.[3] For that reason, patient-reported outcomes (PROs), including nasal obstructive symptom relief, overall shape, and symmetry from various angles, are critical in evaluating the success of the procedure.[4]

Emerging first in the late 19th and early 20th centuries, dorsal preservation rhinoplasty (DPR) garnered attention through the works of distinguished surgeons such as Drs.

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*All relevant information for this systematic review are either part of the article, figures, tables, and digital supplemental content. Any additional information can be found on the PROSPERO protocol for this article. If any further information is required or unclear, the reader is more than welcome to contact the corresponding author for clarifications.*



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Goodale, Cottle, and Lothrop.[5] Many years after it was first described, there has been a recent expanding range of indications and approaches for DPR.[5] The burgeoning interest is, in part, propelled by the procedure's approach to lowering the entire dorsum of the nose to decrease dorsal prominence.[6] Despite growing interest in DPR, there is not yet a consensus within the surgical community regarding the functional outcomes of this technique, indicating a realm of uncertainty that necessitates further investigation.

On the other end, component dorsal hump reduction (CDHR) has a long and well-established history in rhinoplasty, otherwise termed as structural rhinoplasty.[7] Most patients undergoing cosmetic rhinoplasty require dorsal hump reduction and, as a result, varying degrees of middle-third restructuring.[8,9] Conventional hump resection causes disruption of these anatomical components. In contrast, methods such as CDHR focus on maintaining the integrity of the upper lateral cartilages through a phased approach to the correction of the nasal dorsum.[5,10]

Direct comparative studies on PROs for CDHR versus DPR have not yet been described. The purpose of this systematic review was to compare PROs of these two techniques. The findings of this study will not only provide evidence-based insights into the PROs but also guide surgeons in decision-making for their patients.

## Takeaways

**Question:** How do dorsal preservation rhinoplasty (DPR) and component dorsal hump reduction (CDHR) compare in terms of patient-reported outcomes (PROs)?

**Findings:** A comprehensive analysis of 25 studies with 1706 patients showed high satisfaction rates (84%–100%) for both DPR and CDHR. No significant difference in satisfaction was found ($P$ = 0.18). CDHR significantly reduced SCHNOS-cosmetic scores (53.7 points) and improved SCHNOS-obstructive scores (27.3 points), indicating superior cosmetic and functional outcomes. DPR also reduced SCHNOS-cosmetic scores (55.3 points) but had a lesser impact on SCHNOS-obstructive scores.

**Meaning:** Both techniques satisfy patients, but CDHR may offer superior functional outcomes.

## METHODS

Our study protocol was prospectively registered with PROSPERO (study no ID: CRD42022384939).[11] This systematic review followed the PRISMA statement guidelines.[12,13]

### Eligibility Criteria

Criteria for included studies were defined as male or female patients who were 18 years of age or older and had undergone either DPR or CDHR/resection rhinoplasty. The full eligibility criteria are accessible at PROSPERO.[11]

### Search Strategy

A comprehensive research review using subject headings, controlled vocabulary, and keywords was conducted on January 13, 2023, on MEDLINE/OVID, Web of Science, and the Cochrane Central Register for studies published up to 2021. Our full-text search strategy is accessible at PROSPERO.[11] (**See appendix, Supplemental Digital Content 1**, which displays the search strategy. **http://links.lww.com/PRSGO/D454**.)

### Study Selection

The search results were uploaded into Covidence to conduct study selection.[14] Two independent reviewers performed a two-screening process for study selection (N.J. and N.M.A.). First, titles and abstracts were screened. A third reviewer (J.A.F.) moderated the discussion if discordances were present, and a joint decision was made. Then, a full-text analysis was performed by the same two reviewers (N.J. and N.M.A.). The third reviewer (J.A.F.) moderated the discussion if disagreement was present, and a joint final decision was made.

### Data Extraction/Synthesis

The variables extracted were first author, year of publication, age of the population, sex, DPR and CDHR (conventional hump resection) rhinoplasty, expected/evaluated outcome, study type, study date, total sample size, complications, and time to readmission. The authors attempted to meticulously evaluate all pertinent information regarding the technical aspects and operative protocols from the analyzed studies. This includes determining whether any adjunctive or supplementary procedures were conducted alongside the primary rhinoplasty, which was discerned through an examination of the studies' methodologies and supplemental content. Additionally, it is important to point out that different authors might have their own interpretations of what constitutes preservation rhinoplasty versus component dorsal hump resection. Even within the bounds of procedure types, there are inherent differences in technique that must be acknowledged. Therefore, our study should be considered with an understanding of these limitations.

### Quality Assessment

To assess the risk of bias, we utilized the National Institutes of Health quality assessment tool.[15]

### Statistical Analysis

All analyses were conducted in Stata (version 16, College Station, Tex.). Variables with a skewed distribution were summarized with medians [interquartile range (IQR)]. Mean changes from baseline were approximated based on the reported baseline and follow-up scores and used a correlation of 0.5. Means and SDs were approximated from figures and available statistics (eg, median, IQR).[16] Within individual studies, uncertainty around point estimates for proportions was represented by exact Clopper–Pearson 95% confidence intervals (CIs).

We used a random-effects model to summarize estimates across studies, accounting explicitly for the between-study heterogeneity.[17] For the main analysis of proportion outcomes, we used an inverse-variance model via a variance-stabilizing transformation of the proportions.[17] We applied the Freeman–Tukey transformation because several estimates were extreme proportions (ie, 0% or 100%). Summary estimates were obtained via restricted maximum likelihood.[18] A previous investigation showed that the Freeman–Tukey transformation could provide misleading results in some scenarios due to potential problems with the back-transformation.[19] To test the robustness of our results for proportion outcomes, we performed a sensitivity analysis applying a multilevel logistic mixed-effects regression model.[20] Parameters were estimated via maximum likelihood estimation. The random-effects components were estimated via mean-variance adaptive Gauss–Hermite quadrature with 10 integration points. For continuous outcomes, we used an inverse-variance random-effects model with the restricted maximum likelihood estimator of the between-study variance. Treatment effects were summarized via the mean difference with 95% CIs.

Whenever feasible, we conducted subgroup analyses and formally examined differences between the surgical techniques using a chi-square test with one degree of freedom.[21] We tested the presence of statistical heterogeneity among study estimates via Cochran *Q* test[22] and quantified the between-study variance with the $I^2$ statistic.[23] A *P* value of less than 0.05 was considered statistically significant heterogeneity for the *Q* test.[22] To facilitate the interpretation of the heterogeneity, we used 95% predictive intervals, which describe a range with a 95% probability of containing the future estimates to be estimated in a new study or setting, considering the observed heterogeneity and the uncertainty in the current study estimates.[24]

We examined the presence of small-study bias and publication bias using modified funnel plots.[25] These plots compared proportions, transformed to the Freeman–Tukey double-arcsine scale, on the horizontal axis with the

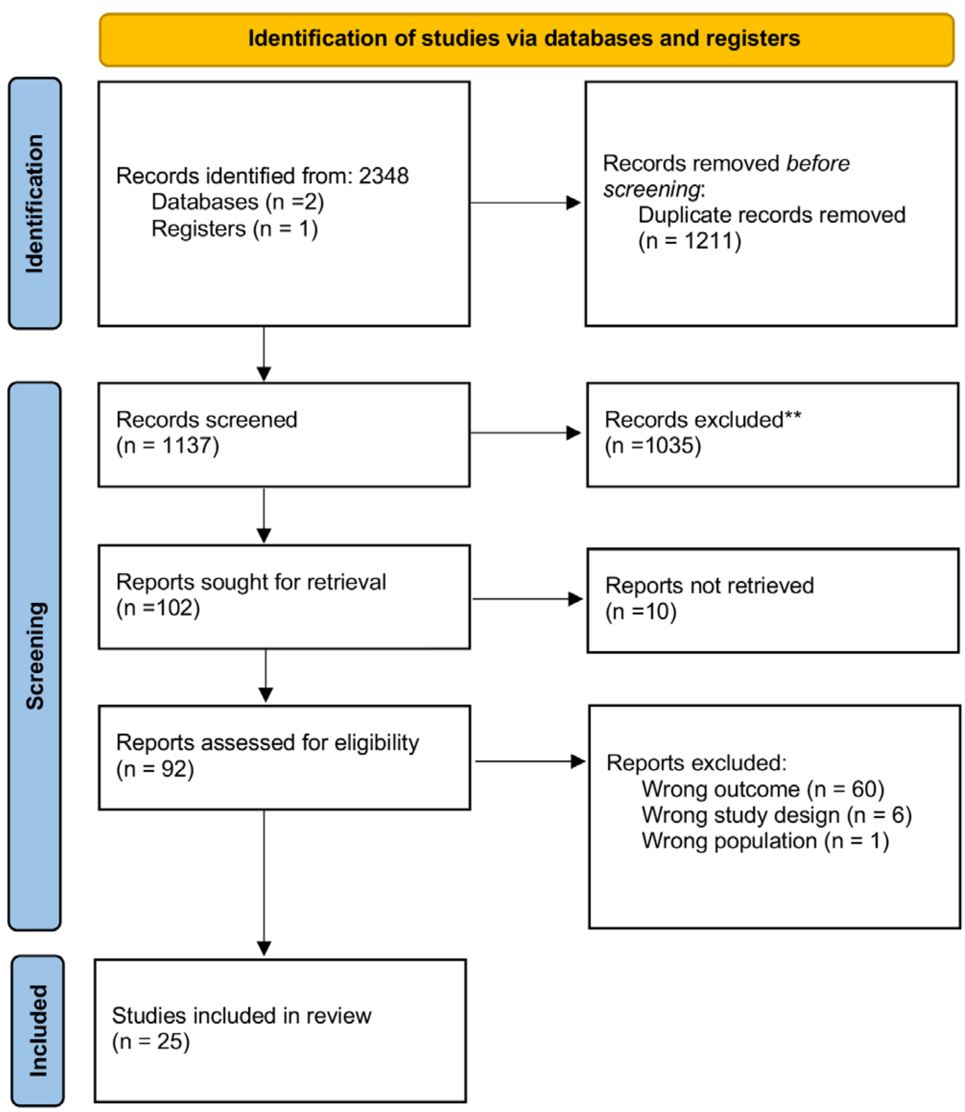


**Fig. 1.** PRISMA flow chart. **All records manually excluded, no software automated exclusion used.

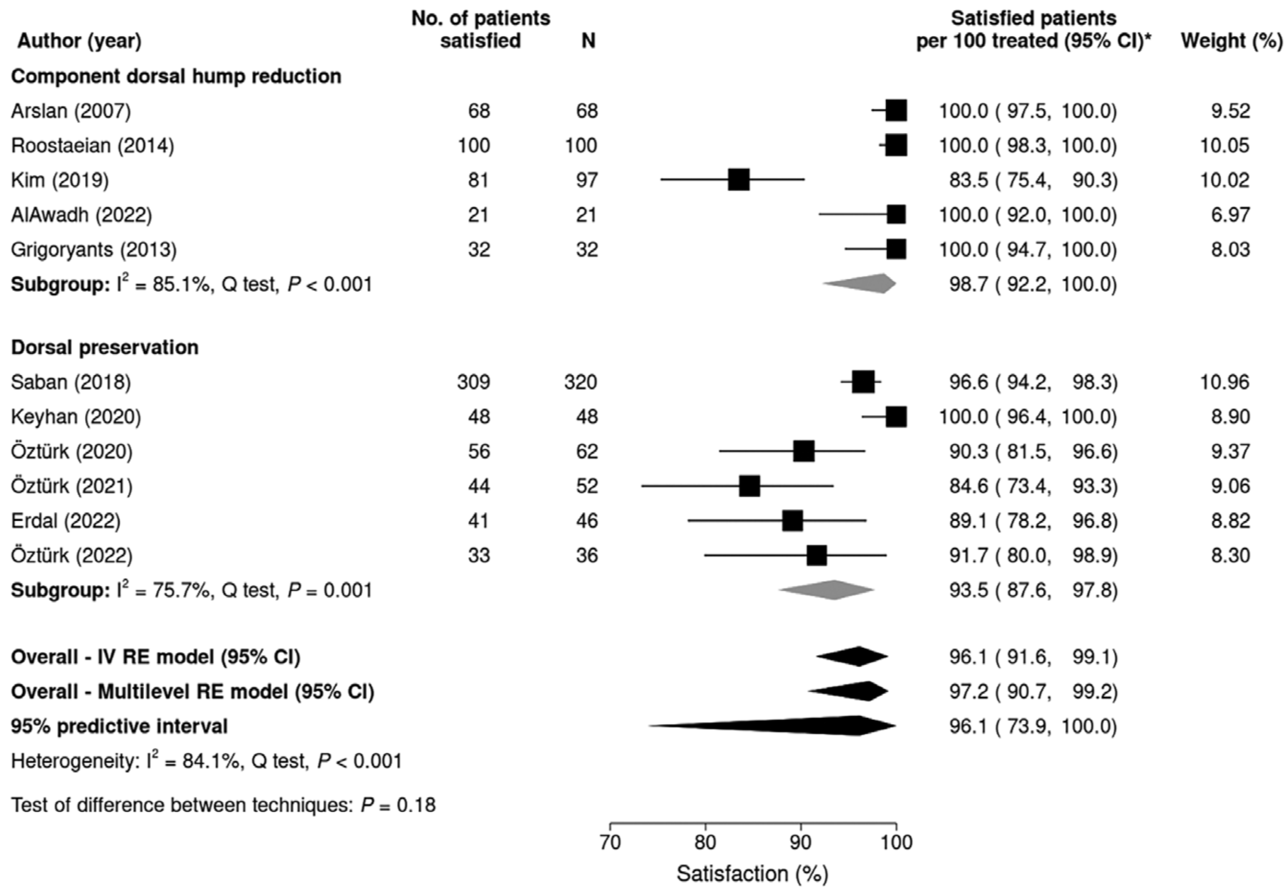


**Fig. 2.** Patient satisfaction stratified by technique. RE, random effect. *See methodology for confidence interval calculation.

study sample size on the vertical axis. In addition, we used the Egger test.[26] Two-sided $P$ values of less than 0.05 were considered statistically significant evidence of funnel plot asymmetry.[26]

## RESULTS

A total of 1137 articles were identified, 25 studies of which met our inclusion criteria, pooling 1706 participants, with 13 studies on CDHP and 12 studies on DPR (Fig. 1).[27–51] (**See table, Supplemental Digital Content 2**, which displays the study characteristics. **http://links.lww.com/PRSGO/D455**.) All procedural details and postoperative protocols of the included studies can be found in Supplemental Digital Content 3. (**See table, Supplemental Digital Content 3**, which displays the technique and postoperative protocols. **http://links.lww.com/PRSGO/D456**.)

### Satisfaction Rates

Eleven studies with 882 participants contributed data regarding satisfaction.[27–37] The median (IQR) sample size was 52 participants (36–97). Figure 2 presents satisfaction rates by study and surgical technique. Overall, satisfaction rates were substantially high, varying from 84% to 100% across studies. Using a random-effects model, the data indicate that approximately 96 of 100 treated patients were satisfied, with a 95% CI extending from 92 to 99. Results from the mixed-effects logistic model rendered similar results (Fig. 2).

There was evidence of statistical heterogeneity across estimates ($I^2$ = 84.1%, Cochran $Q$ test, $P$ < 0.001). Based on the available evidence, the true satisfaction rate in future studies or settings will fall within the range of 73.9%–100%, with a 95% probability. In an analysis of subgroups, satisfaction rates were equally high for both CDHR and DPR techniques, with no significant difference between the two approaches ($P$ = 0.18) (Fig. 2).

Figure 3A presents the funnel plot. Visual inspection indicates no evidence of funnel plot asymmetry, corroborated by the Egger test ($P$ = 0.82).

### Revision Rates

Nineteen studies with 1523 participants and 64 revisions contributed data regarding revision rates.[27–30,32,34–36,38–48] The median (IQR) sample size was 62 participants (38–107).

Figure 4 shows revision rates by study and technique. Overall, revision rates were generally low, varying from 0% to 23.3% across studies. Using a random-effects model, the data indicate that approximately two of 100 treated patients underwent revisions, with a 95% CI extending from 0 to 4. Results from the mixed-effects

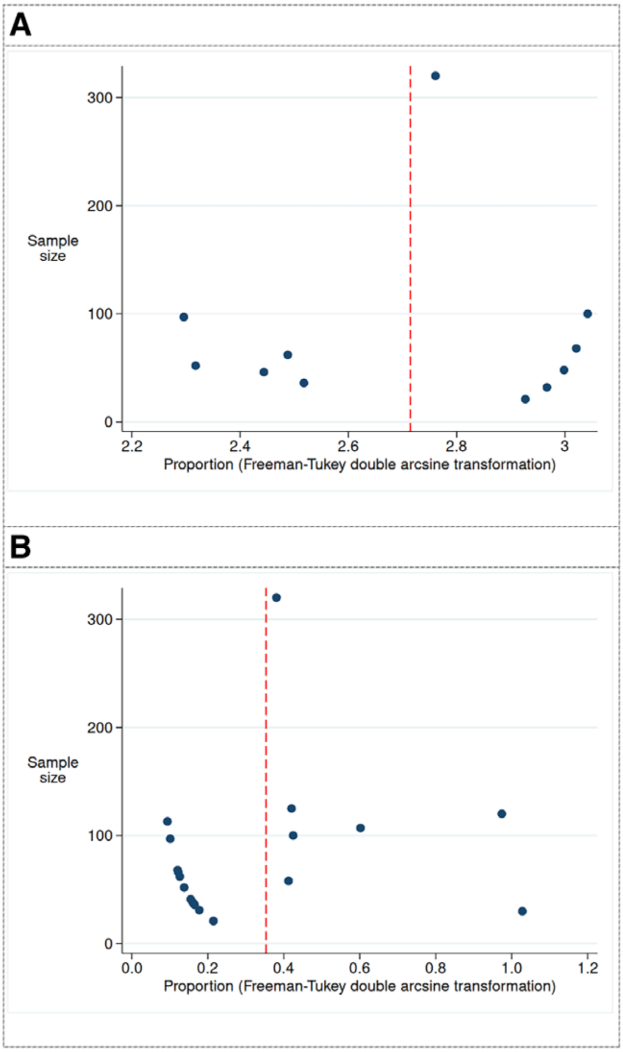


**Fig. 3.** Funnel plot of the included studies. A, Satisfaction. B, Revision.

logistic model corroborated the results of the main analysis (Fig. 4).

There was evidence of statistical heterogeneity across estimates ($I^2 = 82.7\%$, Cochran $Q$ test, $P < 0.001$). Based on the available evidence, the true revision rate in future studies or settings falls between 0% and 16.7%, with a 95% probability. In an analysis of subgroups, revision rates were similar for both CDHR and DPR techniques, with no significant difference between the two approaches ($P = 0.54$) (Fig. 4). Figure 3B shows the funnel plot, indicating no evidence of asymmetry upon visual inspection.

#### *CDHR: Rhinoplasty Outcome Evaluation*

Three studies encompassing 241 participants contributed to the validated rhinoplasty outcome evaluation (ROE) scores in the CDHR technique.[30,38,49] These studies had follow-ups of 6, 12, and 35.6 months.[30,38,49] Overall, the CDHR technique was associated with a statistically and clinically significant increase of 25.7 points (95% CI: 13–38.5, $P < 0.001$) in the ROE scores (Fig. 5). There was evidence for statistical heterogeneity ($I^2 = 98.5\%$, Cochran $Q$ test, $P < 0.001$), which may be considered clinically not relevant due to the substantial improvements observed consistently across all three studies.

#### *CDHR: Standardized Cosmesis and Health Nasal Outcomes Survey—Cosmetic and Standardized Cosmesis and Health Nasal Outcomes Survey—Obstructive*

Two studies contributed data for the Standardized Cosmesis and Health Nasal Outcomes Survey cosmetic (SCHNOS-C) and obstructive (SCHNOS-O) domains. The follow-ups were 9 and 3.6 months, respectively.[43,50]

Figure 6A shows that the CDHR technique was associated with a clinically and statistically significant 53.7-point reduction in the SCHNOS-C domain (95% CI: −62.7 to −44.8, $P < 0.001$). No statistical heterogeneity was observed ($I^2 = 5.9\%$, Cochran $Q$ test, $P = 0.30$).

Figure 6B shows the corresponding estimates for the SCHNOS-O scores, supporting that the CDHR technique was also associated with a significant improvement in the obstructive scores (mean change: −27.3 points; 95% CI: −50.5 to −4.04, $P = 0.02$). The $I^2$ value was 47.5% and Cochran $Q$ test gave a $P$ value of 0.17.

#### *Dorsal Preservation: SCHNOS-C and SCHNOS-O*

Two studies contributed data for the SCHNOS-C and SCHNOS-O domains. The follow-ups were 3.9 and 3.6 months, respectively.[50,51]

Figure 7A shows that the DPR technique was associated with a clinically and statistically significant 55.3-point reduction in the SCHNOS-C domain (95% CI: −60.7 to −49.9, $P < 0.001$). No statistical heterogeneity was observed ($I^2 = 0\%$, Cochran $Q$ test, $P = 0.97$).

Figure 7B shows the corresponding estimates for the SCHNOS-O domains, supporting that the DPR technique was also associated with a significant improvement in the obstructive score (mean change: −19.5; 95% CI: −27.9 to −11.1, $P < 0.001$). The $I^2$ value was 0% and Cochran $Q$ test gave a $P$ value of 0.94.

## DISCUSSION

In plastic surgery, rhinoplasty stands as a testament to the discipline's evolution, balancing aesthetics with functionality. This systematic review meticulously delineates the outcomes of two surgical techniques: CDHR and DPR. Our findings underscore high satisfaction rates, a testament to the technical finesse inherent in both procedures. The cardinal outcome of this systematic review was PROs, gauged by various tools such as the ROE and the SCHNOS. Alongside satisfaction, the functional scores were analyzed to better understand the surgical outcomes. A significant finding from the data appeared to be higher functional outcomes associated with the CDHR technique. The CDHR technique was associated with a noteworthy reduction in the SCHNOS-C domain, along with a meaningful improvement in SCHNOS-O scores, rendering it a viable technique from a functional standpoint. Conversely, the DPR was linked to a similar reduction in the SCHNOS-C domain but a lesser change in the SCHNOS-O domain.

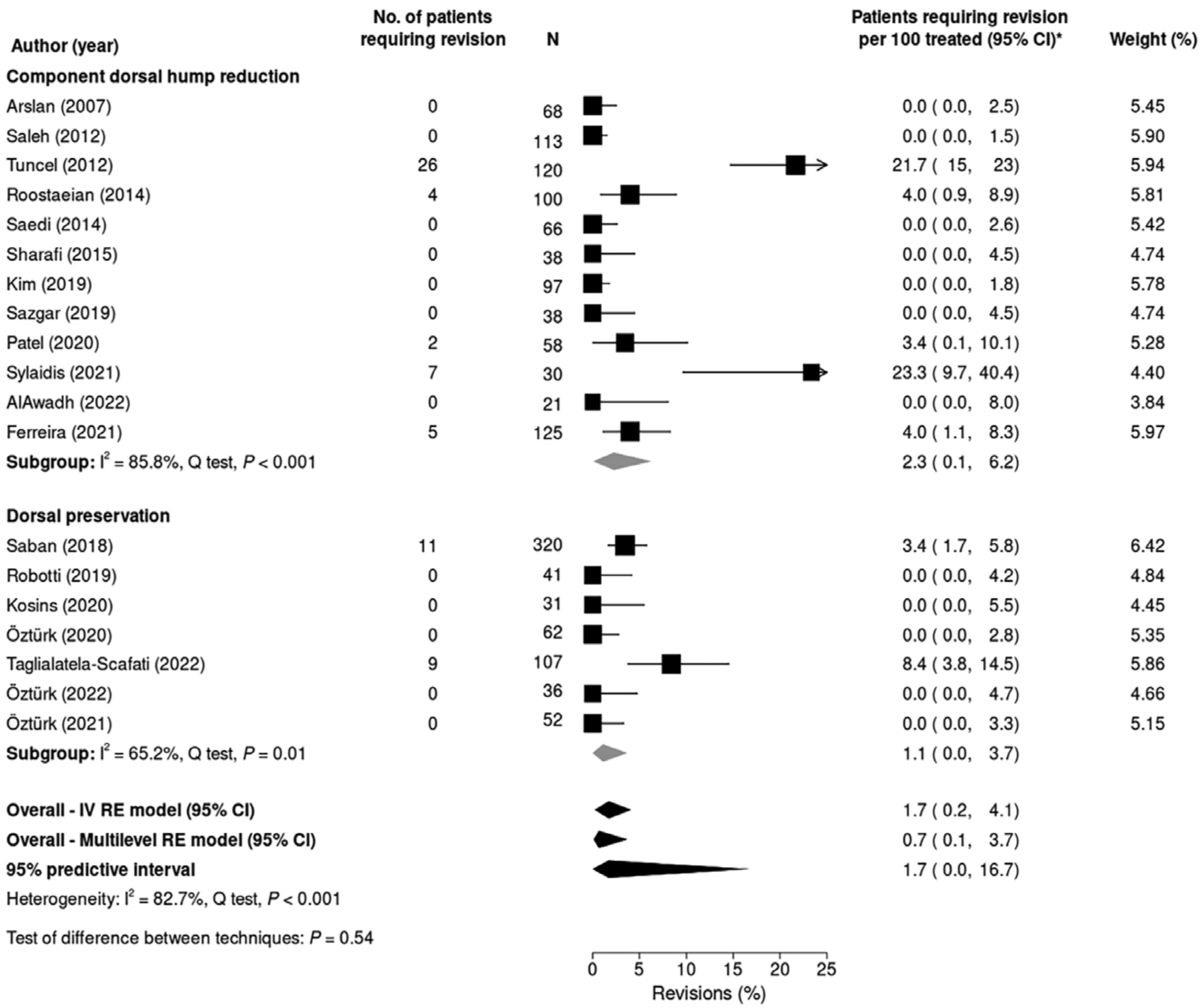


**Fig. 4.** Revision rate stratified by technique. RE, random effect. *See methodology for confidence interval calculation.

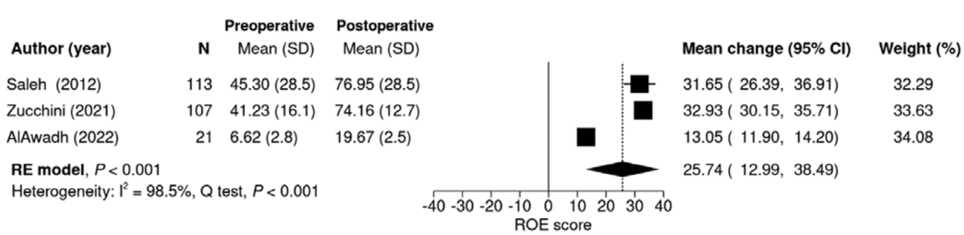


**Fig. 5.** Rhinoplasty outcome evaluation for CDHR. RE, random effect.

These findings underscore the fact that while aesthetic outcomes are analogous, objective PROs imply that component dorsal hump resection renders superior functional outcomes compared with DPR. In addition, functional improvement may be more marked with component dorsal hump resection, which also may involve midvault reconstruction.

Our results align with a systematic review by Desisto et al[52] on preservation rhinoplasty techniques. They demonstrated, akin to our findings, that DPR, as a newer technique, manifests favorable PROs both in the cosmetic and functional domains, albeit with a caveat. These authors observed that although a multitude of studies report positive outcomes, there is a lack of high-level comparative studies to support the theoretical advantages of preservation over structural rhinoplasty, which emphasized the need for robust clinical studies to validate the benefits of this newer technique. Recently published studies have equipped us to undertake

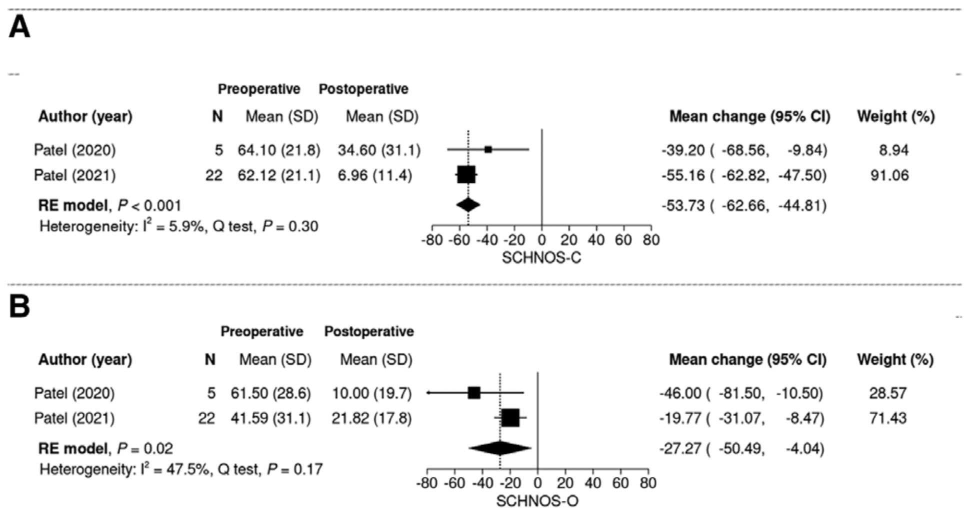


**Fig. 6.** Standardized cosmesis and health nasal outcomes survey for CDHR. A, SCHNOS-C. B, SCHNOS-O. RE, random effect.

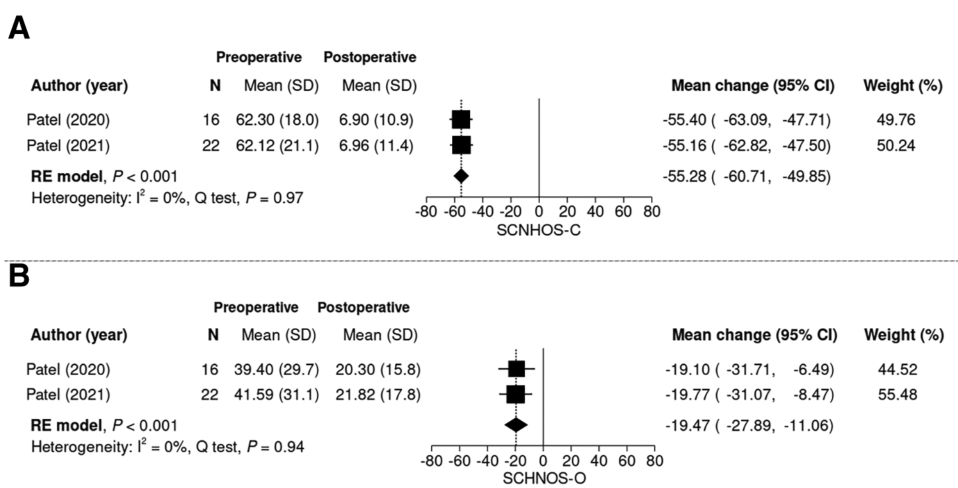


**Fig. 7.** Standardized cosmesis and health nasal outcomes survey for DPR. A, SCHNOS-C. B, SCHNOS-O. RE, random effect.

this comparative analysis, revealing that although DPR possesses a comparable cosmetic profile, it may not offer the same amelioration in obstructive symptoms as CDHR, thereby necessitating a more nuanced understanding and perhaps, a re-evaluation of technique selection predicated on individual patient requisites and clinical objectives.[52]

The constantly evolving nature of rhinoplasty is further highlighted by studies such as those by Zucchini et al[49] and Elemam et al.[53] The former study found a better aesthetic outcome with the use of an osteotome in dorsal hump reduction, whereas the latter showcased the aesthetic superiority of hump remodeling and reinsertion techniques. These studies, along with the discussed findings, emphasize the importance of aligning surgical techniques with patient objectives. For patients with primary cosmetic concerns, using DPR could yield comparable results to CDHR, making it a viable option. However, for those with significant functional concerns, DPR may not be the most effective technique, reinforcing the need for a more tailored approach in technique selection based on individual patient needs and clinical objectives.

### Limitations

We recognize certain limitations warranting consideration during the interpretation of these findings. Initially, the paucity and quality of the encompassed studies presented a challenge for the study, with a predominance of studies being retrospective or observational in nature, potentially introducing bias and confounding elements. Second, a variation in the definition and assessment of satisfaction across studies was noted, with some using subjective or unvalidated instruments. To mitigate these limitations, the review channeled its analytical endeavors toward examining ROE and SCHNOS scores to obtain more objective results while still elucidating the subjective satisfaction delineated in the studies. Additionally, notable heterogeneity was noted in the studies concerning patient demographics, surgical methodologies, follow-up durations, and outcome reporting, which may impinge upon the generalizability and comparability of the findings. Future research should aim to conduct more rigorous and standardized studies or reviews on rhinoplasty satisfaction using objective and validated tools, such as PROs or quality-of-life questionnaires. Moreover, future research could explore other factors that may influence rhinoplasty satisfaction, such as patient characteristics (eg, age, sex, ethnicity), surgeon factors (eg, skill, experience), surgical factors (eg, technique, revision), and postoperative factors (eg, complications, recovery). Furthermore, the relatively short follow-up period, primarily ranging from 3 to 4 months, in some of the analyzed studies may not sufficiently capture the long-term efficacy and patient satisfaction of rhinoplasty procedures. Consequently, we advocate for extended follow-up durations in subsequent investigations to ensure a more robust evaluation of surgical outcomes. Another limitation of our study arises from the exclusive reliance on a limited set of PROs—specifically subjective satisfaction, ROE, and SCHNOS scores—highlighting the need for future research to embrace a more diversified array of validated PROs for a comprehensive assessment of patient outcomes. Finally, it is important to note that studies were grouped as either CDHP or DPR based on the included studies' own definitions of these broader categories. Inherent differences exist between how surgeons define these procedures, and inter-study variability in technique must be acknowledged.

## CONCLUSIONS

Although PROs are comparable between both techniques, based on objective measurements, the literature suggests that CDHR outcomes may be better than DPR in alleviating subjective respiratory obstructive symptoms, potentially offering an evidence-based choice for addressing functional concerns in rhinoplasty. This systematic review showed that both CDHR and DPR techniques are effective methods for enhancing the nasal outcomes of patients who undergo rhinoplasty. Both techniques achieved high satisfaction rates, low revision rates, and significant improvements in the cosmetic and functional domains of the SCHNOS and ROE scores. Both techniques achieved high satisfaction rates, low revision rates, and significant improvements in the cosmetic and functional domains of the SCHNOS and ROE scores.

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## DISCLOSURES

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## REFERENCES

1. Shaye DA. The history of nasal reconstruction. *Curr Opin Otolaryngol Head Neck Surg*. 2021;29:259–264.
2. Report PSs. Available at https://www.plasticsurgery.org/documents/News/Statistics/2020/plastic-surgery-statistics-full-report-2020.pdf. Accessed September 9, 2023.
3. Çakır B, Doğan T, Öreroğlu AR, et al. Rhinoplasty: surface aesthetics and surgical techniques. *Aesthet Surg J*. 2013;33:363–375.
4. Sena Esteves S, Gonçalves Ferreira M, Carvalho Almeida J, et al. Evaluation of aesthetic and functional outcomes in rhinoplasty surgery: a prospective study. *Braz J Otorhinolaryngol*. 2017;83:552–557.
5. Lee J, Abdul-Hamed S, Kazei D, et al. The first descriptions of dorsal preservation rhinoplasty in the 19th and early- to mid-20th centuries and relevance today. *Ear Nose Throat J*. 2021;100:713–719.
6. Stevens MR, Ghasemi S, Mashhadi Akbar Boojar F, et al. Dorsal preservation rhinoplasty: a literature review. *Am J Cosmet Surg*. 2023;40:10–21.
7. Rohrich RJ, Muzaffar AR, Janis JE. Component dorsal hump reduction: the importance of maintaining dorsal aesthetic lines in rhinoplasty. *Plast Reconstr Surg*. 2004;114:1298–1308; discussion 1309.
8. Palhazi P, Daniel RK, Kosins AM. The osseocartilaginous vault of the nose: anatomy and surgical observations. *Aesthet Surg J*. 2015;35:242–251.
9. Santos M, Monteiro D, Coutinho M, et al. Caucasian Mediterranean patients seeking rhinoplasty-anthropometric measurements and prevalence of major deformities. *Clin Otolaryngol*. 2019;44:581–587.
10. Sadick H, Rowe-Jones JM, Gassner HG. Nuances in component nasal hump reduction. *J Plast Reconstr Aesthet Surg*. 2018;71:178–184.
11. Dorsal preservation versus component dorsal hump reduction (conventional hump resection) rhinoplasty aop-roASRoT, assessment of patient-reported outcomes. 2022. Available at https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=384939. Accessed September 9, 2023.
12. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
13. Harrar H, Myers S, Ghanem AM. Art or science? An evidence-based approach to human facial beauty a quantitative analysis towards an informed clinical aesthetic practice. *Aesthetic Plast Surg*. 2018;42:137–146.
14. Babineau J. Product review: covidence (systematic review software). *J Can Health Libr Assoc*. 2014;35:68–71.
15. National Heart L, Institute B. Study quality assessment tools. Available at https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools. Accessed September 9, 2023.
16. Wan X, Wang W, Liu J, et al. Estimating the sample mean and standard deviation from the sample size, median, range and/or interquartile range. *BMC Med Res Methodol*. 2014;14:135.
17. Borenstein M, Hedges LV, Higgins JP, et al. A basic introduction to fixed-effect and random-effects models for meta-analysis. *Res Synth Methods*. 2010;1:97–111.
18. Barendregt JJ, Doi SA, Lee YY, et al. Meta-analysis of prevalence. *J Epidemiol Community Health*. 2013;67:974–978.

19. Schwarzer G, Chemaitelly H, Abu-Raddad LJ, et al. Seriously misleading results using inverse of Freeman-Tukey double arcsine transformation in meta-analysis of single proportions. *Res Synth Methods*. 2019;10:476–483.
20. Lin L, Chu H. Meta-analysis of proportions using generalized linear mixed models. *Epidemiology*. 2020;31:713–717.
21. Dias S, Sutton AJ, Welton NJ, et al. Evidence synthesis for decision making 3: heterogeneity–subgroups, meta-regression, bias, and bias-adjustment. *Med Decis Making*. 2013;33:618–640.
22. Pereira TV, Patsopoulos NA, Salanti G, et al. Critical interpretation of Cochran's Q test depends on power and prior assumptions about heterogeneity. *Res Synth Methods*. 2010;1:149–161.
23. Huedo-Medina TB, Sánchez-Meca J, Marín-Martínez F, et al. Assessing heterogeneity in meta-analysis: Q statistic or I2 index? *Psychol Methods*. 2006;11:193–206.
24. IntHout J, Ioannidis JP, Rovers MM, et al. Plea for routinely presenting prediction intervals in meta-analysis. *BMJ Open*. 2016;6:e010247.
25. Hunter JP, Saratzis A, Sutton AJ, et al. In meta-analyses of proportion studies, funnel plots were found to be an inaccurate method of assessing publication bias. *J Clin Epidemiol*. 2014;67:897–903.
26. Sterne JA, Sutton AJ, Ioannidis JP, et al. Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ*. 2011;343:d4002.
27. Arslan E, Aksoy A. Upper lateral cartilage-sparing component dorsal hump reduction in primary rhinoplasty. *Laryngoscope*. 2007;117:990–996.
28. Roostaeian J, Unger JG, Lee MR, et al. Reconstitution of the nasal dorsum following component dorsal reduction in primary rhinoplasty. *Plast Reconstr Surg*. 2014;133:509–518.
29. Kim BK, Han J. Use of an augmentation spreader graft for management of nasofacial angle in patients with pseudo-hump. *Ann Plast Surg*. 2019;82:369–374.
30. AlAwadh IH, Bogari A, Assiri H, et al. A novel technique for spreader flap by folding the dorsal hump in patients undergoing primary rhinoplasty. *J Craniofac Surg*. 2022;33:2653–2658.
31. Grigoryants V, Baroni A. The use of short spreader grafts in rhinoplasty for patients with thick nasal skin. *Aesthetic Plast Surg*. 2013;37:516–520.
32. Saban Y, Daniel RK, Polselli R, et al. Dorsal preservation: the push down technique reassessed. *Aesthet Surg J*. 2018;38:117–131.
33. Keyhan SO, Fallahi HR, Adham G, et al. Concomitant dorsal preservation rhinoplasty and orthognathic surgery: a technical note. *J Oral Maxillofac Surg*. 2020;78:1630.e1–1630.e10.
34. Öztürk G. Push-down technique without osteotomy: a new approach. *Aesthetic Plast Surg*. 2020;44:891–901.
35. Öztürk G. Push down technique with ostectomy. *Ann Chir Plast Esthet*. 2021;66:329–337.
36. Öztürk G. Hybrid preservation rhinoplasty: combining mix-down and semi let-push down techniques. *J Craniofac Surg*. 2022;33:1885–1889.
37. Erdal AI, Genç IG, Manav S, et al. Fixation of the cartilaginous vault with barbed suture in closed-approach high-septal-resection dorsal preservation rhinoplasty. *Facial Plast Surg*. 2023;39:125–129.
38. Saleh AM, Younes A, Friedman O. Cosmetics and function: quality-of-life changes after rhinoplasty surgery. *Laryngoscope*. 2012;122:254–259.
39. Tuncel U. Rhinoplasty in the Black Sea region. *J Craniofac Surg*. 2012;23:1355–1357.
40. Saedi B, Amali A, Gharavis V, et al. Spreader flaps do not change early functional outcomes in reduction rhinoplasty: a randomized control trial. *Am J Rhinol Allergy*. 2014;28:70–74.
41. Sharafi M, Jalessi M, Adamson PA. Newly designed upper lateral cartilage flap for preventing depression of the keystone area in large-nose septorhinoplasty. *JAMA Facial Plast Surg*. 2015;17:399–404.
42. Sazgar AA, Razmara N, Razfar A, et al. Outcome of rhinoplasty in patients undergoing autospreader flaps without notable dorsal hump reduction: a clinical trial. *J Plast Reconstr Aesthet Surg*. 2019;72:1688–1693.
43. Patel PN, Kandathil CK, Most SP. Outcomes of combined anterior septal reconstruction and dorsal hump reduction. *Laryngoscope*. 2020;130:E803–E810.
44. Sylaidis P. Reduction rhinoplasty re-endorsed: when conservative and measured. *JPRAS Open*. 2021;30:53–60.
45. Ferreira MG, Santos M, Carmo DOE, et al. Spare roof technique versus component dorsal hump reduction: a randomized prospective study in 250 primary rhinoplasties, aesthetic and functional outcomes. *Aesthet Surg J*. 2021;41:288–300.
46. Robotti E, Chauke-Malinga NY, Leone F. A modified dorsal split preservation technique for nasal humps with minor bony component: a preliminary report. *Aesthetic Plast Surg*. 2019;43:1257–1268.
47. Kosins AM, Daniel RK. Decision making in preservation rhinoplasty: a 100 case series with one-year follow-up. *Aesthet Surg J*. 2020;40:34–48.
48. Taglialatela Scafati S, Regalado-Briz A. Piezo-assisted dorsal preservation in rhinoplasty: when and why. *Aesthetic Plast Surg*. 2022;46:2389–2397.
49. Zucchini S, Brancatelli S, Piccinato A, et al. Evaluation of surgical outcome in rhinoplasty: a comparison between rasp and osteotome in dorsal hump removal. *Ear Nose Throat J*. 2021;100:436S–442S.
50. Patel PN, Abdelwahab M, Most SP. A review and modification of dorsal preservation rhinoplasty techniques. *Facial Plast Surg Aesthet Med*. 2020;22:71–79.
51. Patel PN, Abdelwahab M, Most SP. Dorsal preservation rhinoplasty: method and outcomes of the modified subdorsal strip method. *Facial Plast Surg Clin North Am*. 2021;29:29–37.
52. DeSisto NG, Okland TS, Patel PN, et al. State of the evidence for preservation rhinoplasty: a systematic review. *Facial Plast Surg*. 2023;39:333–361.
53. Elemam A, Dewidar HM, Shawky A, et al. Outcome after dorsal hump resection versus hump remodeling and re-insertion: a randomized controlled trial. *Egypt J Ear Nose Throat Allied Sci*. 2022;23:1–9.