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REVIEW ARTICLE Open Access

# Pediatric septoplasty impact on nasal breathing and when to consider a revision surgery-A meta-analysis study

Amr Nabil Rabie[1], Marwa Mohamed El Begermy[1], Ahmed Adel Attia El Shalma[1] and Michael Fadel[1*]

## Abstract

**Background** Some children with a deviated nasal septum show no symptoms, but up to 30% have breathing problems. Septal deviation is usually caused by microtrauma during delivery, but in severe cases, trauma is the main cause. Many people fail to recognize septal damage after trauma, &children with untreated septal abnormalities often have severe problems. Thus, we can see why symptoms increase with age.

**Objective** Through the available literature, this review seeks to establish the effect of nasal septoplasty among pediatric patients on nasal breathing and the need for revision surgery.

**Subjects and methods** Prospective and retrospective studies published in peer-reviewed journals including clinical trials, cohort studies, cases, and cross-sectional.

**Results** Five studies. 4, 5, 6, 8, 9 151 people assessed NOSE pre- and post-pediatric septoplasty. The pooled mean NOSE score difference between pre- and postoperative evaluations was -50.26 (95% CI, -62.55 to -37.97), showing a substantial decrease. In Saeed et al. (Ann Coll Med Mosul June 45(1):70-79, 2023), mean differences ranged from -71 points (95% CI, -75.41 to -66.59) to -30 points in Lee (2017). Surgicalft benefits were regularly shown. Each year of follow-up did not substantially lower NOSE score improvement by 0.39 (SE = 0.29; $P = 0.17$; $I^2 = 89.6\%$) in a meta-regression analysis in children, NOSE score improvement increased by 6.36 per year (SE = 1.14; $P = < 0.001$; $I^2 = 34.45\%$). In meta-regression research on revision rates following pediatric septoplasty, each year of follow-up raised the rate by 0.13 (SE 0.02; $P < 0.001$; $I^2 = 4.78\%$). However, revision rates were not significantly associated with each year of pediatric age (coefficient, -0.39; SE 0.22; $P = 0.075$; $I^2 = 86.25\%$).

**Conclusion** This comprehensive meta-analysis shows that septoplasty improves nasal airway function and obstruction in children. NOSE Scale disease-specific QOL improved significantly after pediatric septoplasty. According to the meta-regression analysis, each year of follow-up time resulted in a 0.39 drop in NOSE score improvement (SE = 0.29; $P = 0.17$; $I^2 = 89.6\%$). Each year of pediatric age increased NOSE score improvement by 6.36.

**Keywords** CBCT: Cone-beam computed tomography, NSD: Nasal septum deviation, OSA: Obstructive sleep apnea

## Background

A deviated nasal septum is frequently responsible for breathing difficulties in children, and while it may not always show noticeable symptoms, it affects up to 30% of pediatric [1]. Microtrauma sustained during childbirth is one of the primary reasons for septal deviation; in more severe cases, trauma is the primary cause. Usually, a non-corrected septal deviation in the pediatric population

*Correspondence:
Michael Fadel
dr.michael1986@med.asu.edu.eg
[1] Department of Otolaryngology, Faculty of Medicine, Ain Shams University, Next to Al-Nour Mosque, 38 Abbassia Square, Cairo, Egypt

worsens with growth. This may explain the increase in the symptoms with age [2]. Since pediatric septoplasty improves quality of life, it is becoming more widely accepted as the primary therapy for nasal obstruction in children [3, 4]. Nasal obstruction in children can result in craniofacial deformity, sleep-disordered breathing, and symptomatic nasal congestion. This affects quality of life, reduces focus and attention span, and impacts sleep quality and duration [5]. Despite the concern that surgical intervention on a developing septum can influence the normal growth of the face and nose, The majority of recent research suggests that surgical management delaying in case of deviated septum may result in abnormal facial growth, misalignment of teeth, and deterioration of their respiratory issues [6]. Septoplasty in children can be performed safely in some cases with little risk of long-term facial deformity [4]. According to some studies, septal surgery can be performed on children as young as 6 years old, and in some cases of severe airway obstruction, it may even be considered for newborns. A conservative approach to cartilage scoring and resection is often preferred to avoid disrupting the primary nasal and midface growth centers, and this helps prevent the need for revision surgery later in the patient's life [7]. Recently, disease-specific quality-of-life tools have been employed for evaluation of septoplasty outcomes. Stewart et al. developed and validated the Nasal Obstruction Symptom Evaluation (NOSE) scale [8].

## Main text

### Aim of the work

This review aims to show the effect of nasal septoplasty among pediatric patients on nasal breathing and the need for revision surgery based on the available literature.

### Patients and methods

Retrospective and prospective studies published in peer-reviewed journals, such as cohort studies, clinical trials, cases, and cross-sectional. The inclusion criteria were: the pediatric population < 18 years old, studies identification from 2000 till September 2023, articles in English language, and articles included at least one of the outcomes. The exclusion criteria were: the adult population, non-English language articles, and articles with none of the outcomes included.

### Data extraction

Two reviewers will extract the data independently and cross-check it.

### Statistical consideration

For quantitative data, the review will calculate odds ratios (for categorical outcome data) or standardized mean differences (for continuous data) and their corresponding 95% confidence intervals. These measures will be calculated using the data generated by each included randomized controlled trial. If appropriate with available data, outcomes from matching Groups of studies will be pooled into a statistical meta-analysis employing Review Manager Software from the Cochrane Collaboration. To test the heterogeneity among the combined studies, a chi-square test will be employed. In situations where there is substantial variability in the effect measure across the studies being compared, we will use a random effects analysis, which is described by DerSimonian and Laird [9]. The random effect analysis accounts for the Interstudy variation. Since the test for homogeneity has low power, we will report the results of the random effects analysis even if there is no statistically significant evidence of heterogeneity. All statistical analysis for pooling the studies will be conducted on the STATA statistical Software, release 14.0 (Stata Crop. 2015, College Station, Texas, USA). We will assess the risk of bias by assessingCochrane's risk of bias and will deal with publication bias by using a funnel plot. Deduplication will be by the removal of identical records retrieved frommultiple databases.

### Description of included studies

The identification process began with a search of various databases, resultingin a total of 304 records. After removing duplicate records, 176 records werescreened for eligibility. Of these, 94 records were excluded, leaving 82 reportssought for retrieval. However, 31 reports were not retrieved, leaving 51 reports assessed for eligibility. Of the 51 reports assessed, 42 were excludedfor various reasons, including non-English language ($n=4$), adult/geriatric-population ($n=16$), adoption of surgical techniques other than septoplasty ($n=12$), or absent assessment of either NOSE scores or revision rates ($N=10$). The remaining 9 reports were included in the review, with reports of thesestudies included in the current analysis.

## Results

### Outcome measures

#### *NOSE Evaluation*

A total of five studies 4,5,6,8,9 including 151 patients reported NOSE evaluation pre- and post-pediatric septoplasty. The pooled mean difference in NOSE score between pre- and postoperative evaluations was -50.26 (95% CI, -62.55 to -37.97), suggesting a statistically significant reduction in NOSE scores post-surgery. Notably, the heterogeneity was high among studies, with an $I^2$ statistic of 93% and a $Tau^2$ of 207.12, indicating variability in effect estimates. The range of mean differences varied from -71 points (95% CI, -75.41 to -66.59) in the

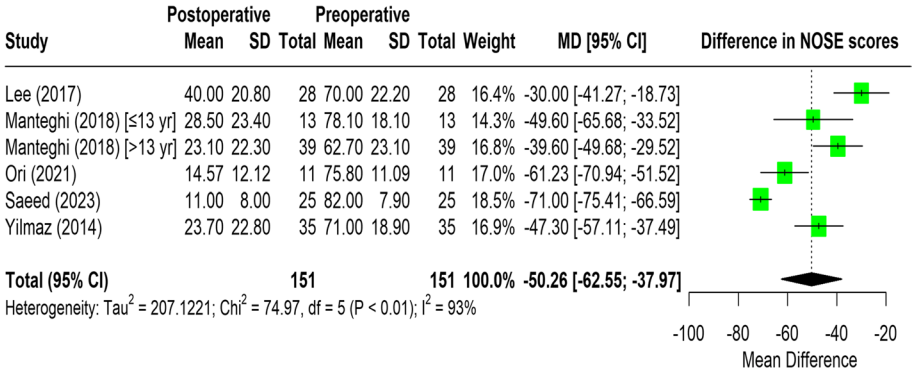


**Fig. 1** Forest plot demonstrating the effect sizes of septoplasty on pediatric NOSE scores

study by Saeed et al. [10] to -30 points (95% CI, -41.27 to -18.73) in the study of Lee [11]. The direction of the effect was consistent across studies, all favoring postoperative improvements (Fig. 1).

In a sensitivity analysis performed using the leave-one-out method to assess the robustness of the meta-analysis results for the effects of pediatric septoplasty on NOSE scores, the pooled mean differences remained consistently negative, indicating postoperative improvements regardless of which study was omitted. The analysis revealed a range in the mean differences from -54.40 points (95% CI, -66.01 to -42.79) when omitting the Lee [11] study to -45.55 points (95% CI, -56.1 to -35.0) when excluding the Saeed et al. [10] study. The overall pooled mean difference across the sensitivity analyses was -50.26 (95% CI, -62.55 to -37.97). This consistency in findings, irrespective of individual study exclusion, suggests further confidence in the conclusion that pediatric septoplasty is associated with significant reductions in NOSE scores postoperatively (Fig. 2). The narrow range in mean differences observed across the sensitivity analyses indicates the stability and reliability of the pooled effect estimate. Visual inspection of the funnel plot, which plots the mean differences against their standard errors for studies evaluating pre- and postoperative NOSE scores after pediatric septoplasty, suggests a symmetrical pattern, indicating the absence of publication bias (Fig. 3). The publication bias in the studies assessing NOSE scores was further investigated by the results of Eager's test (Table 1), which demonstrated a statistically non-significant publication bias ($p=0.51$).

In the meta-regression analysis examining predictors for improvement in NOSE scores (Table 2), each additional year of follow-up duration was associated with a non-significant decrease of 0.39 in the NOSE score improvement (SE = 0.29; $P=0.17$; $I^2=89.6\%$). Alternatively, for every additional year in pediatric age, there was a significant increase of 6.36 in the NOSE score improvement (SE = 1.14; $P=<0.001$; $I^2=34.45\%$).

**Table 1** Eager's test results investigating the publication bias in the studies assessing Pre- and Post-operative NOSE evaluation (*N*=5)

| Egger's test | Intercept | SE (Intercept) | t | P |
|---|---|---|---|---|
| | -42.88 | 10.13 | -0.71 | 0.51 |

## Revision

A total of six studies including 3323 pediatric patients reported postoperative revision following pediatric septoplasty. The overall revision rate was estimated at 2.31% (95% CI, 0.71% to 7.24%). Notably, the rates among the included studies varied significantly. For instance, Saeed et al. [10] reported the highest revision rate at 12.00% (95% CI, 2.55% to 31.22%), while Yilmaz et al. [12] observed no revisions, denoted by a rate of 0.00% (95% CI, 0.00% to 10.00%). There was substantial heterogeneity among the included studies, as indicated by a high $I^2$ value of 91% and a significant Chi2 statistic (56.42, df = 5, $P<0.01$) (Fig. 4).

The sensitivity analysis employing the leave-one-out approach was conducted to assess the robustness of the pooled estimates of revision rates following pediatric septoplasty. This involved systematically omitting each study and recalculating the overall effect to determine the influence of individual studies on the pooled estimate. The revised events per 100 observations (patients) ranged from 1.03 [0.69; 1.55] when omitting Bishop et al. [4] to 4.46 [2.93; 6.74] when omitting Raghavan and Carr [13], suggesting variability in the individual study contributions. Only the study of Raghavan and Carr [13] demonstrated deviation from the original 95% confidence interval of the pooled revision rate (Fig. 5). This suggests

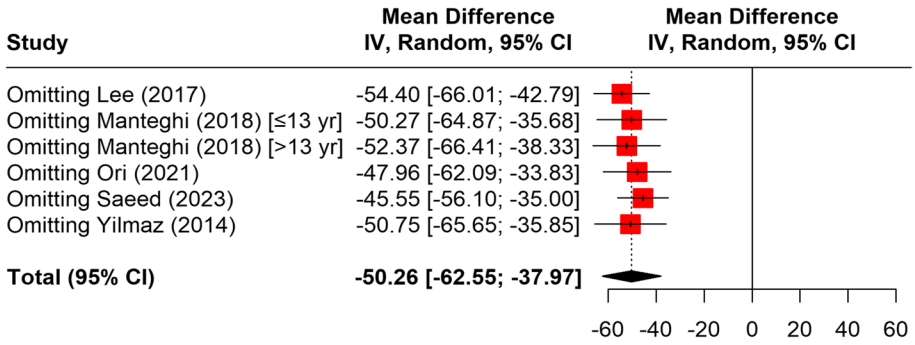


**Fig. 2** Leave-one-out sensitivity analysis of the included studies assessing NOSE scores (*N* = 5)

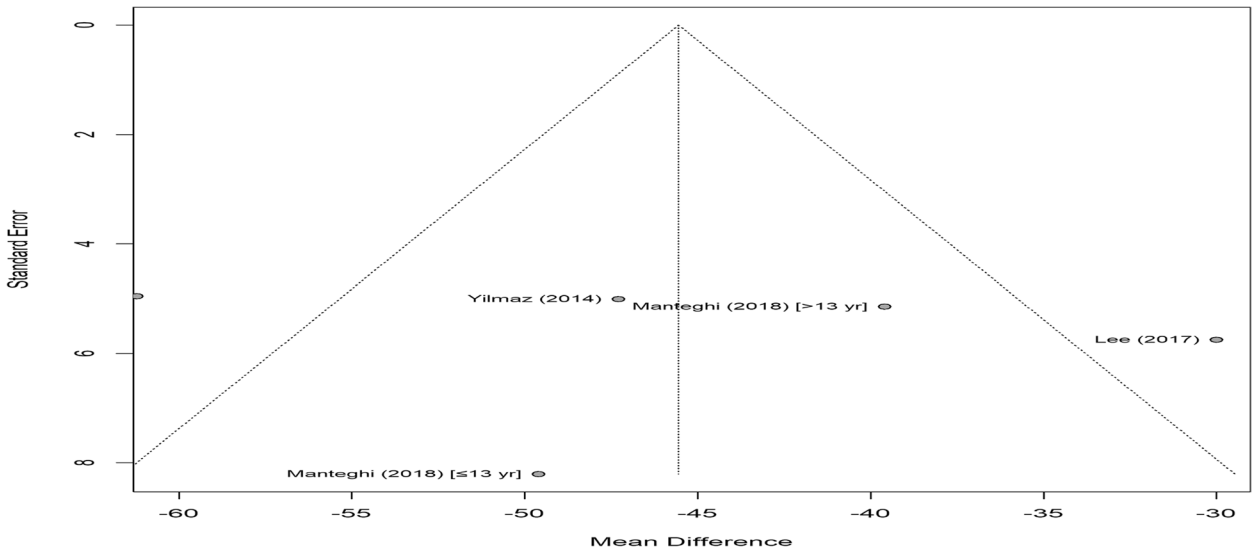


**Fig. 3** Funnel plot of the studies assessing post-operative NOSE evaluation

**Table 2** Meta-regression predictors of improvement of NOSE scores

| Variable | Coefficient | Standard error | I2 | *P*-Value |
|---|---|---|---|---|
| **Follow-up duration (Years)** | -0.39 | 0.29 | 89.6% | 0.17 |
| **Pediatric age (years)** | 6.36 | 1.14 | 34.45% | **< 0.001** |

that a pooled revision rate of 4.46% (95% 2.93–6.74%) is a more reliable estimate of postoperative revision.

The funnel plot presented visualizes the relationship between the logit-transformed proportion of revision rates following pediatric septoplasty and the standard error across the included studies. As is evident from the plot, it appears to be mostly symmetric, suggesting a low risk of publication bias. Furthermore, the results of Eager's test (Table 3) confirmed the absence of a statistically significant publication bias in the studies assessing revision rate ($p = 0.81$). In the meta-regression analysis assessing predictors of revision rates following pediatric septoplasty (Table 4), each additional year of follow-up duration was associated with a statistically significant increase of 0.13 in the revision rate (SE 0.02; $P < 0.001$; $I^2 = 4.78\%$). However, each additional year in pediatric age was inversely associated with revision rates, but this association was not statistically significant (coefficient, -0.39; SE 0.22; $P = 0.075$; $I^2 = 86.25\%$).

## Discussion

Corrective nasal surgery in the pediatric population may be indicated for severe nasal obstruction or posttraumatic deformity [14]. However, nasal septoplasty has historically been avoided in children because of anxiety regarding adverse impacts on facial and nasal growth due to the potential disruption of nasal growth centers [15]. The septal cartilage is a key component in the growth and development of the middle part of the face. Specifically,

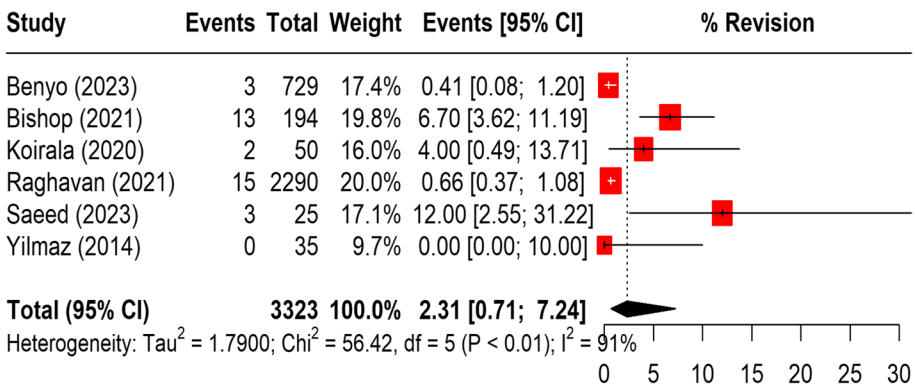


**Fig. 4** Forest plot demonstrating the effect sizes of septoplasty on postoperative revision rates

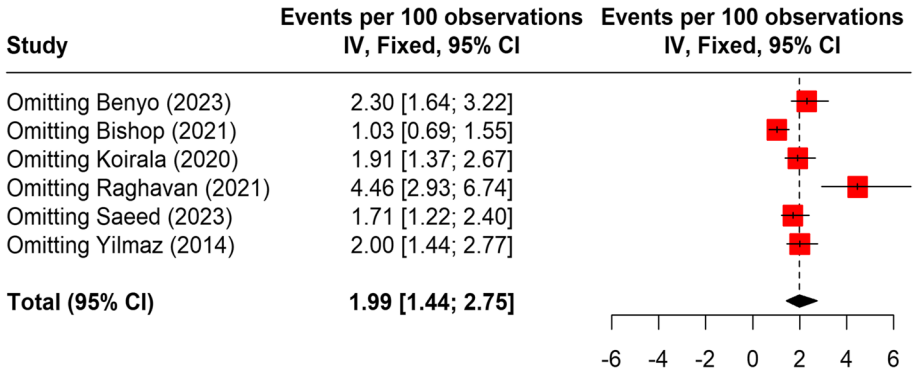


**Fig. 5** Leave-one-out sensitivity analysis of the included studies assessing Revision rates (*N* = 6)

**Table 3** Eager's test results investigating the publication bias in the studies assessing revision rates post pediatric septoplasty (*N* = 6)

| Egger's test | Intercept | SE (Intercept) | t | P |
|---|---|---|---|---|
| | -4.2 | 1.33 | 0.26 | **0.81** |

**Table 4** Meta-regression predictors of revision rates following pediatric septoplasty

| Variable | Coefficient | Standard error | I2 | *P*-Value |
|---|---|---|---|---|
| **Follow-up duration (Years)** | 0.13 | 0.02 | 4.78% | **< 0.001** |
| **Pediatric age (years)** | -0.39 | 0.22 | 86.25% | 0.075 |

the sphenospinal zone increases maxilla outgrowth, while the sphenodorsal zone increases the height and length of the nasal bones [16, 17]. As a result, surgeons have adopted a cautious attitude toward the correction of nasal septal deformities in the pediatric population, often electing to wait until puberty to perform the procedure [15, 18]. Based on the completion of nasal growth, safe timeframes for nasal surgery have been estimated to be 16 years for boys and 14 years for girls [16]. However, some studies have demonstrated that pediatric septoplasty can be done safely with little risk of long-term facial deformity in some patients [14, 19, 20]. In addition to the benefits of improved nasal function, studies have reported enhancements in the quality of life for pediatric patients undergoing this treatment [11, 12]. Authors have employed this data to advocate for early corrective surgery to deliver harmonious growth and avert craniofacial sequelae of mouth breathing [12, 16].

Some studies have indicated that septal surgery can be safely performed in children as young as 6 years old, and in cases of severe airway obstruction, it may even be considered for neonates [15, 17]. A conservative approach to cartilage scoring and excision is sufficient to avoid disrupting the principal nasal and midface growth centers and thereby eliminate the need for revision surgery later in life [16, 21]. Given that the effectiveness and safety of Corrective nasal surgeries in the pediatric population were still unclear, further study is needed. Because of the conservative approach of septoplasty in the

pediatric population, the effectiveness of this conservative surgery via improvement of breathing hence the decreased need for revision surgery is under consideration. Herein, we conducted this systematic review and meta-analysis to study the effect of nasal septoplasty among pediatric patients on nasal breathing and the need for revision surgery. The current systematic review and meta-analysis included nine studies [1–9], Involving 3374 child patients. The standard timing of septoplasty in children remains a quandary. Given concerns about delayed nasal development, early intervention to address septal deformities is crucial. The mean age varied across studies and ranged from 9.4 years to 15.8 years. Similarly, inareviewby Saniasiaya& Abdullah [22], patients were aged between four and 17 years of age.

In the current study, the proportion of male participants ranged from 57.3% in Ori [23] to 96% in Saeed et al. [10], suggesting male predominance. A recent review by Saniasiaya& Abdullah [22] found that males have a higher prevalence (66%) of developing nasal septum deformities. Likewise, a systematic review by Gupta et al. [24] on rhinoplasty in pediatric patients found that the majority of patients were male, comprising 67% of the study population. Because boys are more likely to sustain nasal trauma, the male preponderance has been linked to the incidence of trauma in boys [24].

Indications for septoplasty in children include severely deviated nasal septum, obstructive sleep apnea, cleft lip and nose, traumatic septal deformity, septal hematoma, and septal abscess [25]. In the current systematic review and meta-analysis, the indication for septoplasty, and nasal obstruction, either congenital or resulting from trauma, was a primary indication across most studies.

Like our results Lawrence [15] in their review showed that nasal obstruction was the most common indication for septoplasty among pediatrics. Also, a recent review by Saniasiaya& Abdullah [22] found that the primary cause of conventional septoplasty among pediatrics is deviated nasal septum, which accounts for 57% of cases causing nasal obstruction.

The current systematic review and meta-analysis showed that the most common surgical technique was conventional septoplasty. Saniasiaya& Abdullah [22] found that conventional septoplasty is an effective and safe treatment approach for addressing a deviated nasal septum in children. They also stated that conventional septoplasty was the most common surgical technique, and further surgeries like myringotomy, grommets, and adenoidectomy adenotonsillectomy turbinoplasty were conducted when indicated.

### Postoperative complications

In the current systematic review and meta-analysis, most of the included studies reported no incidence of major or minor postoperative complications. However, Benyo [26] reported that postoperative complications were relatively rare, occurring in just 0.6% of cases. Significant risk factors for complications were asthma and BMI ($P=0.035$ and $P=0.028$, respectively). Interestingly, the study found no significant association between a patient's age at the time of surgery and unfavorable surgical results. Bishop et al. [4] evaluated a pediatric cohort with amean age of 14.6 years. Of these, 6.7% required revision septoplasty. Notably, younger patients exhibited a higher need for revision (14.0% vs. 4.2%, $P=0.02$). However, there was no significant difference in complications between the younger and older cohorts.

The recent review by Saniasiaya& Abdullah [22] reported no incidence of perioperative complications or major postoperative complications as well as no need for revision surgeries. Minor complications, including notable residual symptoms such as septal abscess, septal hematoma, and synechiae, epistaxis which were alleviated with immediate therapy were reported. Similarly, a systematic review by Gupta et al. [24] on pediatric rhinoplasty displayed no significant complications and no nasal or midfacial growth defect was mentioned. Minor complications that existed were reported to correspond with surgical indications.

A recent systematic review by Althobaiti et al. [25] assessed common causes of failed septoplasty. It concluded that in addition to inadequate separation and resection of the bony-cartilaginous junction, suboptimal correction of caudal deviation, iatrogenic injury caused by surgery, and underdiagnosis of nasal valve abnormalities could result in primary septoplasty failure.

### Outcome Measures

#### *Nasal obstruction symptom evaluation score (NOSE) evaluation*

The current systematic review and meta-analysis included a total of five studies4, 5, 6, 8, 9 including 151 patients who reported NOSE evaluation pre- and post-pediatric septoplasty. The pooled mean difference in NOSE score between pre- and postoperative evaluations was -50.26 (95% CI, -62.55 to -37.97), suggesting a statistically significant reduction in NOSE scores post-surgery. Manteghi et al. [27] showed that there was a statistically significant decrease in NOSE scores from pre-(median = 75) to post-operative (median = 20) in the septoplasty-treated pediatrics ($z=-5.9$, $p<0.001$). Also, Ori et al. [23] showed that there was a significant improvement in NOSE scores postoperative control ($p<0.001$), the NOSE questionnaire before ($75.80 \pm 11.09$) and after

surgery (14.57 ± 12.12). As well, Saeed et al. [10] revealed a significant improvement in postoperative NOSE scores in comparison to pre-operative ones at three months and one year post-operatively with P-values < 0.001. The pre-operative NOSE scale mean was 82.0 ± 7.9. The value of 3 months postoperative NOSE Scale mean was 21.8 ± 14.05. Finally, the value of the 1-year postoperative NOSE scale mean was 11.0 ± 8.0.

Furthermore, Yilmaz et al. [12] assessed the results of septoplasty surgery and its impact on patient's quality of life and postoperative patient satisfaction using VAS and NOSE scores. When questioned, the patients and their parents stated that three months after septoplasty, their NOSE ratings had significantly improved when compared to their preoperative levels ($p < 0.001$). The average NOSE scores were 71.0 ± 18.9 at baseline, 22.6 ± 19.7 at 3 months, and 23.7 ± 22.8 at 12 months post-surgery. Furthermore, patient satisfaction correlated with improvement of the NOSE score ($p = 0.003$).

The pooled mean difference in NOSE score between pre- and postoperative evaluations was -50.26 (95% CI, -62.55 to -37.97), suggesting a statistically significant reduction in NOSE scores post-surgery. The range of mean differences varied from -71 points (95% CI, -75.41 to -66.59) in the study by Saeed et al. [10] to -30 points (95% CI, -41.27 to -18.73) in the study of Lee et al. [11].

The pooled mean differences remained consistently negative, indicating postoperative improvements regardless of which study was omitted. The analysis revealed a range in the mean differences from -54.40 points (95% CI, -66.01 to -42.79) when omitting the Lee et al. [11]. study to -45.55 points (95% CI, -56.1 to -35.0) when excluding the Saeed et al. [10] study. The overall pooled mean difference across the sensitivity analyses was -50.26 (95% CI, -62.55 to -37.97). This consistency in findings, irrespective of individual study exclusion, suggests further confidence in the conclusion that pediatric septoplasty is associated with significant reductions in NOSE scores postoperatively. The narrow range in mean differences observed across the sensitivity analyses indicates the stability and reliability of the pooled effect estimate.

In line with the current study, Alessandri-Bonetti et al. [28] in one recent systematic review and meta-analysis assessed the efficacy of Septoplasty in adult patients with nasal obstruction. This meta-analysis included a total of 2577 patients (mean age = 33.3 years; $n = 1456$, 95% CI: 30.4–36.2), of which 65.1% were male. The pooled baseline NOSE means score was 68.1 ($n = 2577$, 95% CI: 64.3–71.9). The pooled mean difference in NOSE score at the 6-month follow-up compared to baseline was − 48.8 ($n = 1730$, 95% CI: − 54.6 to − 42.9).

Moreover, Floyd et al. [29] in a systematic review and meta-analysis of 16 studies evaluating functional rhinoplasty outcomes with the NOSE score showed that the patients have moderate to severe nasal obstructive symptoms at baseline. The NOSE scores were significantly improved at 3–6, 6–12, and ≥ 12 months, with absolute reductions of 50 points (95% CI, 45- 54), 43 points (95% CI, 36–51), and 49 points (95% CI, 39–58), respectively. However, all of the analyses showed high heterogeneity.

In the meta-regression analysis examining predictors for improvement in NOSE scores, each additional year of follow-up duration was associated with a non-significant decrease of 0.25 in the NOSE score improvement (SE = 0.42; $P = 0.55$; $I^2 = 97.21\%$). Similarly, for every additional year in pediatric age, there was a non-significant increase of 0.51 in the NOSE score improvement (SE = 3.66; $P = 0.89$; $I^2 = 95.75\%$).

The above results supported the long-term durability of septoplasty among pediatrics, as the follow-up years have no significant impact on the NOSE score. Also, the age of pediatrics has no significant impact on the outcome assessed by the NOSE score. This was supported by Manteghi et al. [27] who showed that allergic rhinitis, prior nasal surgery, nasal trauma, age, and gender did not have significantly affecton NOSE score change.

#### Revision rate

The current systematic review and meta-analysis included a total of 6 studies including 3323 pediatric patients. The overall revision rate following pediatric septoplasty was estimated at 2.31% (95% CI, 0.71% to 7.24%). Notably, the rates among the included studies varied significantly. For instance, Saeed et al. [10] reported the highest revision rate at 12.00% (95% CI, 2.55% to 31.22%), while Yilmaz et al. [12] observed no revisions, denoted by a rate of 0.00% (95% CI, 0.00% to 10.00%). There was substantial heterogeneity among the included studies, as indicated by a high I2 value of 91% and a significant Chi2 statistic (56.42, df = 5, $P < 0.01$).

The sensitivity analysis employing the leave-one-out approach was conducted to assess the robustness of the pooled estimates of revision rates following pediatric septoplasty. The revised events per 100 observations (patients) ranged from 1.03 [0.69; 1.55] when omitting Bishop et al. [4] to 4.46 [2.93; 6.74] when omitting Raghavan and Carr [13], suggesting variability in the individual study contributions. Only the study of Raghavan and Carr [13] demonstrated deviation from the original 95% confidence interval of the pooled revision rate (Fig. 6). This suggests that a pooled revision rate of 4.46% (95% 2.93–6.74%) is a more reliable estimate of postoperative revision.

The recent review by Saniasiaya& Abdullah [22] showed that there was no need for revision surgeries

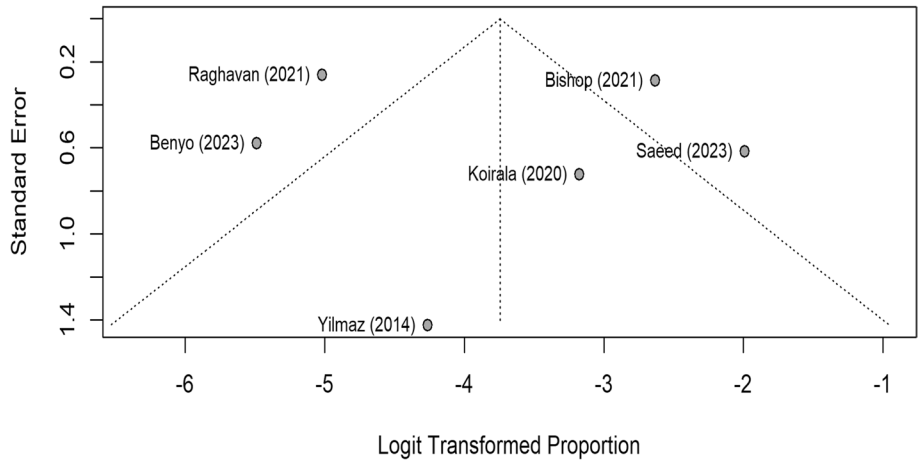


**Fig. 6** Funnel plot of the studies assessing revision rate

post-conventional septoplasty in children. A recent cohort study by Shah et al. [30] found that pediatric patients were more likely to undergo revision surgery compared to adult patients. Similarly, Shah et al. [30] in a cohort study suggested that pediatric patients are more likely to receive revision surgery than their adult counterparts (9.4% vs. 1.1% respectively).

In the meta-regression analysis assessing predictors of revision rates following pediatric septoplasty, each additional year of follow-up duration was associated with a statistically significant increase of 0.13 in the revision rate (SE 0.02; $P<0.001$; $I^2=4.78\%$). However, each additional year in pediatric age was inversely associated with revision rates, but this association was not statistically significant (coefficient, -0.39; SE 0.22; $P=0.075$; $I^2=86.25\%$).

The above results suggested that the need for revision septoplasty was increased with time of follow-up. This may be explained by nasal and facial growth. Pediatric septoplasty is usually delayed until the end of nasal growth, which is approximately the age of 17 to 18 years in boys and 15 to 16 years in girls [24].

However, in contrast to the current study Bishop et al. [4] revealed that younger patients exhibited a higher need for revision (14.0% vs. 4.2%, $P=0.02$). However, there was no significant distinction in complications among the younger and older cohorts.

Although ours is a unique meta-analysis of pediatric septoplasty, there is a need for further studies. The standardized surgical techniques, the usage and duration of a nasal splint, and the nasal packing must be clearly defined and delineated. Additionally, a consistent assessment of both subjective and objective outcomes should be described. These parameters will allow for improved management of children's deviated nasal septa.

## Conclusion

The recent systematic review and meta-analysis found that septoplasty is an effective treatment for nasal obstruction and improves nasal airway function in pediatric patients. Pediatric septoplasty resulted in significant improvement in disease-specific QOL as measured by the NOSE Scale with a significant increase in NOSE score improvement with every additional year in pediatric age. Thepooled septoplasty revision rate was 4.46%. It was revealed that the longer the follow-up the higher the need for revision surgery.

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**Authors' contributions**
AR, MB and AS analyzed and interpreted the patient data regarding pediatric septoplasty, AR and AS contributed to the original conception, study design, data collection, and manuscript drafting and revision. MF contributed to the original conception, and manuscript revision, and agreed to be accountable for all aspects of the work. All authors read and approved the final manuscript.

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**Availability of data and materials**
All data generated or analyzed during this study are included in this published article [and its supplementary information files].

## Declarations

**Ethics approval and consent to participate**
Approval from the scientific research ethics committee of faculty of medicine Ain Shams University was obtained before starting the study.

**Consent for publication**
Not applicable "as our manuscript does not contain data from any individual person".

**Competing interests**
The authors declare that they have no competing interests.

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