

# Secondary Cleft Rhinoplasty: A National Survey of Surgical Practice by Accredited Cleft Palate Teams

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**Background:** Patients with cleft lip often undergo a primary rhinoplasty at the time of lip repair, and further surgical correction with secondary cleft rhinoplasty (SCR) is often warranted for improved form and function. The purpose of this study was to better elucidate current practice patterns and trends for how SCR is performed in the United States.

**Methods:** We administered a survey to team surgeons affiliated with cleft lip and palate care teams approved by the American Cleft Palate Craniofacial Association (ACPA).

**Results:** We received responses from 40 ACPA-approved teams for a response rate of 20.7%, with 59 total ACPA team surgeons completing the survey. 88.1% of surgeons perform intermediate cleft rhinoplasties. Among those who perform an intermediate cleft rhinoplasty, the mean age at which they would first consider the procedure is  $5.83 \pm 2.66$  years. The mean age for consideration of definitive cleft rhinoplasty was  $15.86 \pm 1.73$  years. In both unilateral and bilateral cleft lips, a closed approach was more common in intermediate rhinoplasty, while an open approach was more common in definitive rhinoplasty ( $P < 0.001$ ). The use of autologous grafts was more common in definitive rhinoplasty ( $P < 0.001$ ), with 65% of respondents utilizing autologous grafts in greater than three-quarters of their procedures.

**Conclusions:** When comparing intermediate with definitive cleft rhinoplasty, we found significant increase in the use of open techniques, autologous cartilage use for augmentation of the nasal tip, dorsal nasal support, and columellar support. The considerable variability among surgeons highlights the lack of consensus regarding SCR. (*Plast Reconstr Surg Glob Open* 2022;10:e4644; doi: [10.1097/GOX.0000000000004644](https://doi.org/10.1097/GOX.0000000000004644); Published online 9 November 2022.)

## INTRODUCTION

The cleft nasal deformity is a dynamic abnormality affected by congenital anatomic aberrancy, surgical scarring, and growth-related changes.<sup>1</sup> The nasal deformity is characterized by a shortened columella, depressed nasal tip, bilateral dislocation of the alar cartilage, eversion of the alar bases, and nasal obstruction.<sup>2</sup> Many patients with cleft lip undergo a primary rhinoplasty at the time of cleft

lip repair. Further surgical correction with secondary cleft rhinoplasty (SCR) is often warranted for improved form and function. The rate of SCR ranges from 35%–74%.<sup>3–6</sup>

SCR is a broad category that encompasses all rhinoplasties following primary cleft rhinoplasty at the time of cleft lip repair. Among secondary procedures, intermediate and definitive rhinoplasties are the most described. Intermediate rhinoplasty includes procedures that take place before patients have completed nasal and midfacial growth, which is completed by age 18. Nasal airway obstruction secondary to caudal deviation of the septum is a common indication for intermediate rhinoplasty. Furthermore, intermediate rhinoplasties can help correct aesthetic deformities not addressed during primary cleft rhinoplasty. This includes nasal tip correction and alar repositioning.<sup>1,7,8</sup> The popularity of intermediate cleft rhinoplasty is decreasing, as more surgeons complete primary cleft rhinoplasty at the time of lip repair. However, intermediate repair remains an important procedure for patients who require intervention before definitive repair.<sup>7</sup>

Definitive rhinoplasty is meant to be a cleft patient's final nasal reconstruction and is usually done after

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maxillary and nasal growth is completed and the patient has undergone appropriate surgical adjustment of the underlying skeletal base.<sup>9</sup> At this point, surgeons can operate without concern for the need to accommodate future nasal and midfacial growth, allowing them to perform a more aggressive correction. The goals of definitive rhinoplasty in each cleft patient are to achieve lasting symmetry and definition and to manage nasal airway obstruction.

Although there is a general consensus regarding the technical details of primary rhinoplasty, the timing and techniques of SCR remain variable.<sup>1</sup> The purpose of this study was to elucidate current practice patterns and trends in SCR among American Cleft Palate-Craniofacial Association (ACPA) team surgeons in the United States.

### METHODS

The ACPA cleft team database was utilized to obtain contact information for 193 cleft program coordinators.<sup>10</sup> The teams cataloged in this database had voluntarily applied for review and were found to have met the Standards for Approval of Cleft Palate and Craniofacial Teams.<sup>11</sup> Program coordinators of all cleft teams certified by the ACPA were requested to forward a survey to the surgeons on their teams. Responses were collected and data were exported through Qualtrics software (Qualtrics, Provo, Utah). These data were analyzed using SPSS (IBM Statistics for Macintosh, Version 27.0. Armonk, N.Y.)<sup>12</sup> to elucidate general practice patterns and evaluate differences in timing and technique between intermediate and definitive cleft rhinoplasties.

Data were analyzed using descriptive and inferential statistics. The Mann Whitney U test was conducted to compare independent continuous variables. The Wilcoxon signed rank test was used to compare medians of paired variables on a continuous scale. Chi-square tests of homogeneity and independence were conducted to determine significant associations and differences. Chi-square goodness of fit tests compared nominal variables from a single category.

### Takeaways

**Question:** What are the current patterns and trends in secondary cleft rhinoplasty?

**Findings:** We administered a survey to surgeons affiliated with cleft care teams approved by the American Cleft Palate Association (ACPA). When comparing intermediate versus definitive cleft rhinoplasty, we found significant increase in the use of open techniques, autologous cartilage use for augmentation of the nasal tip, dorsal nasal support, and columellar support. Nonautologous materials consisting of absorbable plates and cadaveric cartilage were more common in intermediate rhinoplasty.

**Meaning:** The considerable variability in practice patterns of cleft surgeons highlights the need for further outcomes data for specific techniques in secondary cleft rhinoplasty.

### RESULTS

We received responses from 40 ACPA-approved teams for a response rate of 20.7%, with a total of 59 ACPA team surgeons completing the survey. The average number of years in practice for our respondents was  $17.7 \pm 11.6$  years. A majority of respondents practiced for less than 20 years (Fig. 1). 88.1% of responding surgeons perform intermediate cleft rhinoplasties, and 93.2% of surgeons perform definitive cleft rhinoplasties. Among those who perform intermediate cleft rhinoplasty, the mean age at which they would first consider the procedure is  $5.83 \pm 2.66$  years (Table 1). For definitive cleft rhinoplasty, the average age at which they would first consider the procedure was  $15.86 \pm 1.73$  years. The median percentage of SCR cases during which respondents perform septoplasty was significantly higher in definitive repair than intermediate (98% versus 10%;  $P < 0.001$ ). The most common indication for septoplasty was nasal airway obstruction.

In both unilateral and bilateral cleft lips, a closed approach was more common in intermediate rhinoplasty, while an open approach was more common in

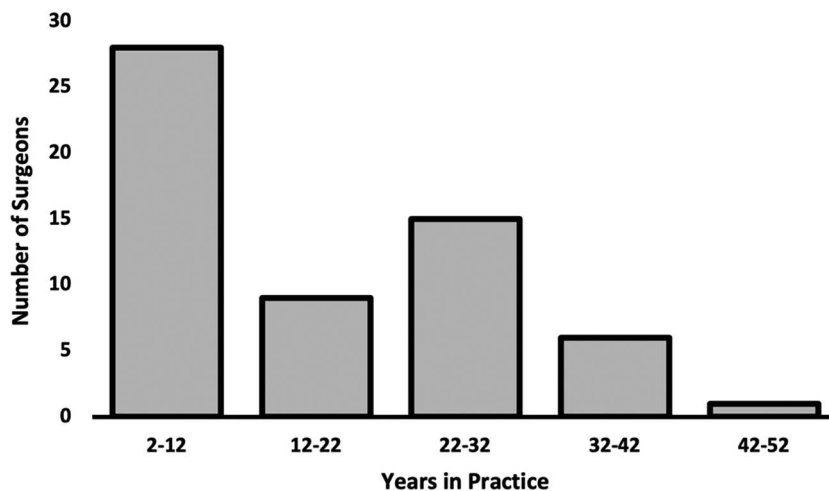


Fig. 1. Distribution of surgeons by years in practice (n = 59).

**Table 1. Age of Procedure in Secondary Cleft Rhinoplasty**

Item	Intermediate, n = 52	Definitive, n = 55	P
Age procedure is first considered (mean ± SD)	5.83±2.66	15.86±1.73	N/A
Percentage of cases where septoplasty is performed			
Median	10%	98%	<0.001*
Indication for septoplasty, n (%)			
Aesthetic	7 (29)	13 (26)	0.757
Nasal airway obstruction	14 (58)	33 (66)	
Other	3 (13)	4 (8)	
Total	24	50	

\*P < 0.05

**Table 2. Surgical Approach in Secondary Cleft Rhinoplasty**

Item	Intermediate, n = 52	Definitive, n = 55	P
Preferred surgical approach in unilateral repair			
Closed	18	1	<0.001*
Open	34	54	
Preferred surgical approach in bilateral repair			
Closed	14	2	<0.001*
Open	38	53	
Technique to elevate depressed alar cartilage and rim, n (%)			
Chondromucosal V-Y advancement	36 (19)	26 (10)	0.058
Columellar strut	21 (11)	43 (17)	
Alar rim and/or batten grafts	26 (13)	44 (18)	
Tip-defining intradomal sutures	44 (23)	51 (20)	
Tip onlay grafts	23 (12)	42 (17)	
Intercartilaginous sutures to secure LLC to ULC	35 (18)	38 (15)	
Other	7 (4)	8 (3)	
Technique to address short columella in bilateral cleft lip, n (%)			
Bilateral forked flaps	15 (20)	14 (17)	0.894
V-Y advancement flaps from upper lip	16 (21)	18 (21)	
Cronin (V-Y) advancement flaps from nasal floor and alae	5 (7)	9 (11)	
Bilateral reverse (combined U incisions and V-Y plasty)	14 (19)	17 (20)	
Mulliken technique (bilateral alar dome cinch)	25 (33)	26 (31)	
Technique for columellar lengthening, n (%)			
Columellar strut graft	21 (40)	43 (78)	<0.001
Suture only	32 (60)	12 (22)	

LLC, lower lateral cartilage; ULC- upper lateral cartilage. \*P < 0.05.

definitive rhinoplasty ( $P < 0.001$ ) (Table 2). When asked about specific techniques to address the depressed alar cartilage and alar rim on the cleft side, the differences between intermediate and definitive cleft rhinoplasties approached significance ( $P = 0.058$ ). This trend showed increased utilization of columellar strut (17% versus 11% for intermediate rhinoplasty), alar rim/batten (18% versus 13%), and tip onlay grafts (17% versus 12%) in definitive cleft rhinoplasty. In both definitive and intermediate rhinoplasties, the most common technique to address a short columella in bilateral cleft lip was the bilateral alar cinch suture (31% and 33% for intermediate rhinoplasty). Similarly, the columellar strut graft was more often used for columellar lengthening in definitive cleft rhinoplasty (78% versus 40% for intermediate rhinoplasty,  $P < 0.001$ ) (Table 2).

When asked about definitive rhinoplasty, a majority of surgeons (65%) use autologous grafts in greater than three-quarters of their procedures. Overall, the use of autologous cartilage was more common in definitive rhinoplasty ( $P < 0.001$ ), with only 17% of respondents utilizing autologous cartilage in greater than three-quarters of their intermediate rhinoplasties (Table 3). A chi-squared analysis showed that for tip augmentation during intermediate cleft rhinoplasty, auricular and septal cartilage were the most common autologous sources ( $P = 0.001$ ). Autologous septum was the most common source for tip

**Table 3. Percentage of Cases Utilizing Autologous Cartilage**

Percentage of Cases Utilizing Autologous Cartilage	Intermediate, n = 52	Definitive, n = 55	Chi-squared Analysis
1–25	31	5	$X^2 (2) = 39.07$ $P < 0.001$
26–50	9	5	
51–75	3	9	
76–100	9	36	

augmentation, columellar support, and dorsal support in definitive cleft rhinoplasty ( $P = 0.001$ ) when compared with autologous rib or chonchal cartilage (Table 4). Absorbable plates and cadaveric cartilage were more commonly used in intermediate rhinoplasty.

### DISCUSSION

The current variability of practice patterns in SCR performed by pediatric surgeons on ACPA-approved cleft teams was demonstrated in this survey. Intermediate rhinoplasty timing varies from surgeon to surgeon, and different benefits can be attributed to both early and late intervention.<sup>1</sup> The benefit of completing an intermediate rhinoplasty between ages 4 and 6 years allows patients to obtain preliminary reconstruction before the psychological peer pressure inherent with starting school.<sup>7,13</sup> Additionally, for patients who require lip revision, this

**Table 4. Sources for Augmentation in Secondary Cleft Rhinoplasty**

Rhinoplasty	Purpose	Absorbable Plate	Cadaveric Cartilage	Autologous Ear	Autologous Septum	Autologous Rib	P*
Intermediate, n = 52	Tip augmentation	4	12	17	19	2	0.001
	Columellar support	10	15	7	21	8	0.006
	Dorsal support	2	14	9	19	9	0.067
Definitive, n = 55	Tip augmentation	1	4	14	42	11	<0.001
	Columellar support	1	8	6	41	14	<0.001
	Dorsal support	1	5	9	34	24	0.001

\*P &lt; 0.05

procedure can be accomplished concurrently. At this age, the goal of optimizing nasal tip symmetry will help facilitate peer acceptance and ideally contribute to making the final correction easier.<sup>13</sup> Specifically, working on the depressed lower lateral cartilage on the affected side with minimal dissection of the cartilage framework on the unaffected side may improve continued nasal growth that does not further worsen the cleft deformity.

The benefit of intermediate rhinoplasty at ages 8–12 is that patients have achieved orthodontic alignment and, if necessary, completed alveolar bone grafting. This improved skeletal base arguably allows for more lasting corrections.<sup>14</sup> In our data, we saw that the mean age at which intermediate rhinoplasty was considered was  $5.83 \pm 2.66$  years, showing that early intervention was preferred by the surveyed surgeons.

Definitive rhinoplasty traditionally occurs once maxillary growth, nasal growth, and necessary procedures to ensure patients have a stable and adequate skeletal base are all satisfactorily completed. By this age, the majority of patients who presented with a cleft lip extending through the alveolus will have undergone alveolar bone grafting, and many will also have undergone LeFort I maxillary advancement.<sup>9</sup> Due to sex-based differences in craniofacial growth, this age is normally 14–16 years in females and 16–18 years in males.<sup>15</sup> The average age at which definitive cleft rhinoplasty was considered in the present survey was consistent with the literature at  $15.86 \pm 1.73$  years.

Septoplasty during cleft rhinoplasty allows for improvement of both aesthetic outcomes and nasal airway passages.<sup>16</sup> Septal resection and septal repositioning are known to help alleviate severe nasal airway obstruction.<sup>7</sup> However, extensive submucous resection of the septal cartilage precludes patients from future septal cartilage grafts and may prevent further nasal growth. Therefore, septoplasty is traditionally reserved for definitive cleft rhinoplasty unless patients have an obvious functional indication for earlier intervention.<sup>1,13,15</sup> Only 10% of patients were reported to undergo septoplasty during intermediate cleft rhinoplasty, whereas 98% of patients were reported to undergo septoplasty during definitive cleft rhinoplasty. The most common reason for septoplasty in both definitive and intermediate rhinoplasties was nasal airway obstruction.

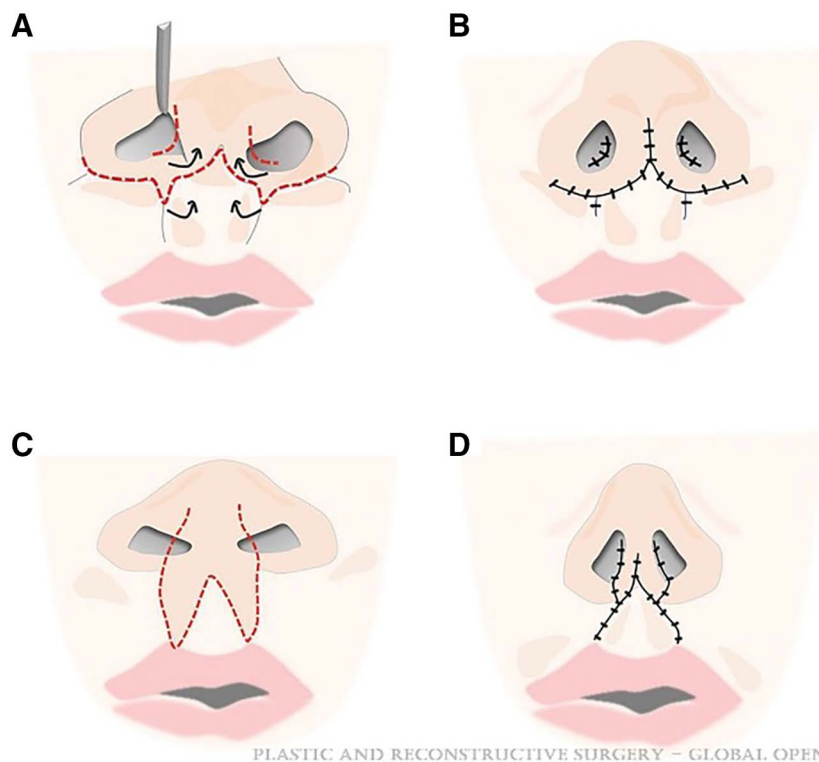
In general, definitive cleft rhinoplasty involves more aggressive osteotomies and cartilage grafting since there is less concern regarding the effect on nasal and midfacial growth.<sup>1</sup> This includes manipulation of the lower lateral cartilage, columellar struts, tip grafting, and dorsal augmentation. The exact approach to definitive rhinoplasty is variable, but goals involve achieving appropriate

symmetry and definition. Intermediate rhinoplasty, on the other hand, requires a more conservative approach to ensure the patient has sufficient available options at the time of definitive repair. There was a significant association between surgical approach and type of rhinoplasty, with an open approach being used more often in definitive cleft rhinoplasty. The external or open approach allows surgeons maximal visualization and provides exposure necessary for placement and fixation of cartilage grafts.<sup>1,17,18</sup>

In our data, the technique utilized to elevate the depressed alar cartilage and rim on the cleft side varied between intermediate and definitive cleft rhinoplasties. The most commonly used technique in both intermediate and definitive cleft rhinoplasties was tip-defining intradomal sutures, with 80% of respondents utilizing this technique during intermediate rhinoplasty and 93% during definitive repair. Chondromucosal V-Y advancement was utilized for correction of the depressed alar cartilage more often in intermediate rhinoplasty when compared with definitive rhinoplasty. This technique contributes to achieving symmetry of the cleft-side nostril.<sup>19</sup> On the other hand, grafts including columellar struts, alar rim/batten grafts, and tip onlay grafts were more common during definitive rhinoplasty. This has been described in previous literature and is due to more complex deformities secondary to scar burden from previous operations and stiffer cartilage from age-related changes.<sup>20</sup>

When addressing the bilateral cleft nasal deformity, there were no differences in the technique used to address a short columella between intermediate and definitive cleft rhinoplasties. Nearly all respondents (93%) utilized the Mulliken technique of bilateral cinch of the alar cartilages to narrow the alar dome.<sup>8</sup> The Cronin technique utilizing V-Y advancement flaps from the nasal floor and alae was the next most popular. This technique involves using bipedicle flaps with external perialar incisions and an internal incision in the membranous septum (Fig. 2A, B).<sup>21,22</sup> This was followed by the bilateral reverse technique using combined U-incisions and a V-Y plasty<sup>23</sup> and bilateral forked flaps (Fig. 2C, D).<sup>22,24</sup> Columella elongation has shown to significantly improve nasal width and projection as well as columella length and width in bilateral cleft lip and palate patients.<sup>22,25</sup> All elongation techniques have demonstrated limitations when compared with normal controls, but these limitations seem to decrease after alveolar bone grafting.<sup>22</sup> The Cronin technique may provide better restoration of nasal width, while bilateral forked flaps have demonstrated better nasal tip projection.<sup>22</sup>

The columellar strut graft helps correct asymmetry of the medial crura while providing a foundation for



**Fig. 2.** Surgical procedure of Cronin and bilateral fork flap techniques. A, Incisions for Cronin technique with arrows indicating rotation toward the nasal tip. B, After closure of the Cronin technique. C, Bilateral fork flap incisions. D, Closure of bilateral fork flaps. Adapted from the work of Broll et al.<sup>22</sup>

tip corrections and a buttress for the lower lateral cartilages.<sup>26–29</sup> This is more often utilized in patients with bilateral deformity due to the inherent instability of their nasal structure.<sup>28</sup> In our data, the columellar strut graft was utilized more often during definitive cleft rhinoplasty, which is consistent with previous literature of cartilage grafting in cleft rhinoplasty.<sup>20</sup>

Cleft surgeons have a variety of options when considering sources for structural augmentation during rhinoplasty. Donor sites for autologous cartilage include rib, ear, and nose, each of which have their benefits and drawbacks. Harvesting costal cartilage can cause morbidities, such as warping, scarring, pain, and pneumothorax.<sup>30</sup> Although costal cartilage requires soaking, shaping, and carving to achieve desired form, its abundance and strength may also provide plastic surgeons a greater range of structural options. Auricular and nasal cartilage have minimal risk factors associated with harvesting, and previous studies have demonstrated their functionality.<sup>31–34</sup> Previous studies have demonstrated that these donor sites are the most popular since they provide stable correction with a low-risk profile.<sup>20</sup> In the survey results, auricular and septal cartilage were used more than rib cartilage for tip augmentation during intermediate rhinoplasty. In definitive cleft rhinoplasty, autologous septum was the most common preference, with autologous ear and costal cartilage grafts being used less frequently. The use of all three donor sites for tip augmentation is well described in the literature.<sup>13,35,36</sup> Some suggest that costal cartilage allows for lower resorption and, therefore, greater structural

support for tip augmentation, although this is yet to be documented in a prospective fashion.<sup>35,37–39</sup> Septal grafts continue to provide a wide range of reconstructive options and can often sufficiently correct inadequate projection on the cleft side.<sup>13,40</sup> The accessibility of this donor cartilage due to concurrent septoplasty during definitive cleft rhinoplasty likely explains its higher rate of utilization. Common reasons for harvesting costal or auricular cartilage during definitive rhinoplasty are due to the increased structural integrity of costal cartilage or the lack of viable septal cartilage due to previous procedures.

Similarly, there was an uneven distribution in the autologous sources for columellar support in both intermediate and definitive rhinoplasties. Once again, autologous septum was used more often than auricular and costal cartilage in patients requiring additional columellar support. Adding columellar support aids surgeons in constructing a strong nasal framework for cleft nasal reconstruction. A columellar strut graft allows adjacent structures to retain support, which is especially important for the lower lateral cartilage in cleft patients.<sup>41,42</sup> Septal cartilage grafts have been shown to effectively provide dimensional changes in crural length, which is often vital in cleft rhinoplasty.<sup>43,44</sup> Auricular and costal cartilage are used for patients who no longer have septal cartilage,<sup>45</sup> and suturing techniques to structurally reinforce auricular grafts in these situations have been developed.<sup>46</sup>

When considering the autologous source for dorsal support during intermediate rhinoplasty, the distribution was relatively even. However, more surgeons still reported

using autologous septum than other sources. In definitive rhinoplasty, the distribution was significantly uneven, with more surgeons reporting use of autologous septum and autologous rib rather than auricular cartilage. All autologous sources have been described in the literature, with the benefits of septal cartilage being its availability and adequate structural support.<sup>47</sup> Autologous costal cartilage is frequently used due to its abundance, which is helpful for patients with a severely deficient dorsum.<sup>48,49</sup> This is also helpful when simultaneous reconstruction of the dorsum and tip is required, as seen in definitive cleft rhinoplasty.<sup>47,50</sup>

Although autologous sources are often preferred, synthetic materials allow surgeons to overcome limitations such as quantity and morbidity at the donor site.<sup>51</sup> When asked about nonautologous augmentation, the most commonly reported use of absorbable plates was for columellar support during intermediate rhinoplasty. Absorbable plates are effective alternatives during rhinoplasty and provide surgeons the liberty to easily customize grafts to a patient's specific needs.<sup>52</sup> Cadaveric cartilage was frequently used in intermediate cleft rhinoplasty for tip augmentation, columellar support, and dorsal support. These grafts are effective and safe during cleft rhinoplasty.<sup>53</sup> Notably, the rate of absorbable plate and cadaveric cartilage use dropped when surgeons were asked about definitive cleft rhinoplasty. However, those surgeons who used nonautologous materials in definitive cleft rhinoplasty were more likely to use cadaveric cartilage than absorbable plates (Table 4). The utility of using nonautologous materials during intermediate cleft rhinoplasty stems from the requirement for definitive cleft rhinoplasty after skeletal maturation.<sup>54</sup> Successfully avoiding cartilage harvest during early nasal reconstructions gives surgeons the opportunity to retain autologous options for future definitive repair.<sup>53,55</sup> The senior author of this study prefers the Stryker Delta Resorbable system and utilizes 0.8-mm-thick plates since they have a longer resorption time than other resorbable composites and retain 50% of their initial strength after 6 months. This provides ample time for scar maturation to support the new nasal position before complete plate resorption.

Overall, this study provided insight into SCR practice patterns among surgeons on ACPA-accredited cleft teams, but it is not without limitations. To begin, the sample size was limited by our response rate. Although we received responses from over a fifth of all ACPA teams, we were not able to obtain responses from all surgeons on these teams. Future studies with larger sample sizes may allow researchers to reveal associations and trends that were not captured by this cohort. Furthermore, the nature of this survey required participants to retroactively assess their own practice patterns, leading to the obvious risk of recall bias. Future studies assessing aesthetic outcomes with three-dimensional photographs and patient-reported functional outcomes would help devise concrete recommendations.

## CONCLUSIONS

The present study highlights the major trends in practice patterns of surgeons from ACPA-approved teams performing SCR. The majority of surgeons favor performing

intermediate cleft rhinoplasty during school age and definitive cleft rhinoplasty after the mid-teen years. When comparing intermediate with definitive cleft rhinoplasty, we found significant increase in the use of open techniques, autologous cartilage use for augmentation of the nasal tip, dorsal nasal support, and columellar support. Nonautologous materials consisting of absorbable plates and cadaveric cartilage were far more commonly utilized in intermediate rhinoplasty than in definitive rhinoplasty. We also found considerable variability among surgeons, which highlights the lack of consensus on when and how these procedures should be performed. These findings emphasize the need for further outcomes data for specific timing, techniques, and materials to help inform best practice in SCR.

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