

What Technique Results in the Lowest Rate of Velopharyngeal Insufficiency in Patients With Submucous Cleft Palate? A Systematic Review and Meta-Analysis

Quelle technique favorise le plus faible taux d'insuffisance vélopharyngée chez les patients ayant une fissure palatine sous-muqueuse? Une analyse systématique et une méta-analyse

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Abstract

Objective: To determine which surgical technique offers the lowest rate of velopharyngeal insufficiency (VPI) without the need for further operative intervention, in pediatric patients with nonsyndromic submucous cleft palate (SMCP). **Methods:** This systematic review and meta-analysis included articles reporting on nonsyndromic pediatric patients treated surgically during childhood for SMCP, with data on postoperative speech outcomes and/or recommendations for secondary surgery. Main outcome measures included rates of unfavorable speech outcomes defined as persistent VPI requiring secondary surgery and speech outcome data. **Results:** 15 articles met our inclusion criteria, reporting on 383 children who underwent surgical treatment; 343 patients were included in studies reporting recommendations for secondary surgery. There was 1 randomized comparative trial, 4 comparative studies, and 10 single cohort studies. Eight articles used validated speech assessment tools. Our model showed the proportion of patients recommended for secondary surgery varied between techniques, ranging from 0.0% (CI 0.0, 1000) in pharyngeal flap to 17.8% (CI 8.9, 32.5) in straight line repair techniques, but there was no statistically significant difference between treatments ($P = .33$). Speech improvement ranged from 44.4% to 100%, with 9 studies recommending secondary surgery for some of their patient series. **Conclusions:** Although not of statistical significance, pharyngeal flap yields the lowest rate of reoperation as a primary technique for pediatric patients with nonsyndromic SMCP. Delayed repair age inherent to SMCP may render operations that rely on a functional levator muscle with less favorable outcomes. The absence of standardized surgical techniques, speech outcomes, speech therapy, and assessment make comparative analysis and recommendation difficult. We advocate for standardized speech assessment tools to improve future quantitative assessment of cleft surgery outcomes and a randomized controlled trial to better elucidate the preferred first-line technique.

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Résumé

Objectif: Déterminer les techniques chirurgicales qui offrent le plus bas taux d'insuffisance vélopharyngée (IVP) sans autre intervention opératoire chez les patients pédiatriques présentant une fissure palatine sous-muqueuse (FPSM) non syndromique. **Méthodologie:** La présente analyse systématique et méta-analyse incluait des articles rendant compte de patients pédiatriques non syndromiques ayant reçu un traitement chirurgical pendant l'enfance à cause d'une FPSM, y compris des données sur l'élocution postopératoire ou les recommandations en vue d'une opération secondaire. Les principales mesures de résultats incluaient les taux d'élocution défavorables définis comme une IVP persistante exigeant une opération secondaire et les données sur les résultats de l'élocution. **Résultats:** Au total, 15 articles respectaient les critères d'inclusion et rendaient compte de 383 enfants qui ont subi un traitement chirurgical; 343 patients ont participé à des études qui recommandaient une opération secondaire. Ces articles incluaient une étude comparative randomisée, quatre études comparatives et dix études de cohortes uniques. Huit faisaient appel à des outils d'évaluation de l'élocution validés. Le modèle des auteurs démontrait que la proportion de patients chez qui on recommandait une opération secondaire variait selon les techniques, soit de 0,0 % (IC, 0,0, 100,0) pour la technique de lambeau pharyngien à 17,8 % (IC, 8,9, 32,5) pour la technique de réparation linéaire, mais il n'y avait pas de différence significative entre les traitements ($p=0,33$). L'amélioration de l'élocution oscillait entre 44,4 % et 100 %, neuf études recommandant une opération secondaire pour certains patients de leur série. **Conclusions:** Même si ce résultat n'avait pas de signification statistique, le lambeau pharyngé est associé au taux de réopération le plus faible lorsqu'il est utilisé comme technique primaire chez les patients pédiatriques ayant une FPSM non syndromique. En raison de l'âge tardif de réparation inhérent à la FPSM, les opérations qui reposent sur le muscle élévateur fonctionnel peuvent donner des résultats moins favorables. Il peut être difficile de procéder à une analyse comparative et de formuler des recommandations à cause de l'absence de techniques chirurgicales standardisées, de résultats sur l'élocution, d'orthophonie et d'évaluation. Les auteurs préconisent des outils d'évaluation de l'élocution standardisés pour améliorer la future évaluation quantitative des résultats de l'opération de la fissure palatine et la tenue d'une étude contrôlée randomisée pour mieux déterminer la technique de première ligne à favoriser.

Keywords

submucous cleft palate, pediatric, surgery, outcomes

Introduction

Submucous cleft palate (SMCP) is a congenital condition initially described by Roux in 1825¹ and further characterized by Calnan who specified the triad findings of a midline muscular diastasis (zona pellucida), notch of the posterior border of the bony palate and bifid uvula.² It has an estimated incidence of 0.02% where 2 of the 3 findings are present.³ SMCP diagnosis is easily missed due to its subtle clinical findings, which are often not examined for until the development of, or delay in the development of, speech.⁴ Some children will have earlier detection due to persistent ear infections or difficulty feeding. Diagnosis and subsequent treatment are therefore frequently late relative to the population of children with an overt cleft palate for several reasons.

Surgical techniques for SMCP are many and include palatal reconstructive techniques (Furlow double opposing Z-Plasty (FP), radical intravelar veloplasty (IVV)+/- palatal pushback flaps), pharyngeal wall techniques (sphincter pharyngoplasty (SP), pharyngeal flap (PF)) and combination procedures of the above. The question remains as to which surgical technique offers the optimal outcome, that being resolution of velopharyngeal insufficiency (VPI) without need for further operative intervention.

A Cochrane review in 2008 for the management of submucous cleft was eventually withdrawn in 2016 as being out of date and not meeting current methodological standards.⁵ Gilleard et al published a comprehensive systematic review in

2014 addressing a similar question based on speech outcomes.⁶ Their review found little conclusive evidence for establishing the most efficacious technique due to the mixed etiologies of the included study populations, and lack of objective validated speech assessments for the studies included.⁶ Furthermore, this was not restricted to the pediatric population. To date, there is no clear evidence in the pediatric population to support which technique best addresses SMCP-associated VPI. Given the difficulty in comparing speech outcomes between populations without an established and consistently used speech assessment tool, we have elected to compare the proportions of patients recommended for secondary surgery to address residual VPI as our determinant of surgical success.

Specifically, our goal is to determine the surgical technique that yields the best result for SMCP in the pediatric non-syndromic population as defined by the lowest rate of recommended secondary surgery due to persistent VPI. The analysis will also take into account overall speech improvement rates and complications reported for each surgical technique, where possible.

Methods

The systematic review was registered online with Prospero (ID CRD42020153761). A detailed search strategy was developed and conducted in order to identify relevant articles for review (Appendix 1).

Several databases were searched from inception: Ovid MEDLINE, Embase, CENTRAL, Web of Science Core Collection, CINAHL, and Health Technology database. Clinical trial registries (clinicaltrials.gov, OpenTrials), conference proceedings (PapersFirst, Proceedings), and theses and dissertations (ProQuest Dissertations & Theses Global, Theses Canada Portal, Networked Digital Library of Theses and Dissertations) were searched for additional unpublished studies. These database and gray literature searches were supplemented with forward and backward citation chaining to identify any studies missed by the initial search. Prior to the final analysis, searches were repeated such that newly published studies were included. There were no limitations on publication date or language in the search. Only full publications were included in the final review.

Identified publications underwent a 2-stage screening process against the inclusion and exclusion criteria, first at the title and abstract stage, followed by a full-text review of studies included at first screening. This was completed in duplicate by 2 independent reviewers (SG and LB), and disagreements were resolved with consensus. Inclusion required that (1) studies included pediatric patients treated surgically for nonsyndromic SMCP, and (2) studies included data on postoperative speech outcomes. Case studies and systematic reviews were excluded, as studied in which data for pediatric patients or patients with SMCP only or nonsyndromic patients could not be separated. Non-English publications were translated into English for review.

Following 2-step screening, the 2 independent reviewers extracted data in duplicate from included publications. Data extraction was facilitated by a template that was created in Microsoft Excel Version 16.54 (Redmond, WA). This data extraction template was piloted on an initial 10% of full-text papers and modified as required, following recommendations by the Cochrane Handbook for Systematic Reviews of Interventions.⁷ Extracted data included the following: year of publication, location of study, study design, number of patients with nonsyndromic SMCP, gender of patients, age of patients at diagnosis and at surgery, criteria for diagnosis of SMCP, method of speech assessment, presence of pre- and postoperative speech therapy, surgical technique, recommendation for and number of secondary procedures performed, postoperative speech outcomes, postoperative complications (fistula, OSA, hyponasality), and length of follow-up.

Additionally, the quality and risk of bias of studies meeting inclusion criteria were assessed independently by both reviewers using the McMaster tool.⁸ Disagreements were resolved by consensus between reviewers.

Data Analysis

Collected study data were organized in a table and analyzed descriptively. The table was organized by study, and where applicable, each study population was divided into subcohorts according to type of surgery. Patients from different studies were then pooled into groups based on surgical technique.

Surgical technique was classified according to the principle of the procedure; we grouped all intervelar veloplasty and

palatoplasty techniques together as “straight line repair” (SLR), Z-plasty closure techniques as Furlow palatoplasty (FP), and pharyngeal procedures as pharyngeal flap (PF) or sphincter palatoplasty (SP) separately. Techniques were grouped accordingly to increase the power of pooled results, due to the small volume of studies that met our inclusion criteria. Where combination procedures were described these were grouped as “combination.” Combination procedures and sphincter pharyngoplasty were excluded from the final analysis due to small numbers.

The primary study outcome, proportion of patients recommended for secondary surgery was compared between groups based on surgical technique using a random-effects model. In this analysis, papers without specified recommendations for secondary surgery were excluded, as well as small groups based on surgical technique with a total $n < 20$ deemed too small to provide conclusive evidence, and study subcohorts with $n < 5$ patients being too small to contribute and resulting in potentially poor effect estimates. The proportion of patients with secondary surgery recommendation was calculated with 95% confidence intervals (CIs) and presented in a forest plot.

Improvement in speech was considered as a binary datum, with an improvement in speech achieved or not. The proportions of patients with improvement in the speech were added to the table, and the range was reported. The frequency of complications (postoperative fistula, obstructive sleep apnea (OSA), and hyponasality) was reported in the table and analyzed descriptively. Missing data were reported as not specified (NS) and omitted from the analysis.

Results

Fifteen manuscripts from the period 1954 to 2017 have been included in the final analysis, after a total of 419 studies were screened by 2 independent reviewers (Figure 1). Excluded articles were those that did not include speech outcomes or treated patients in adulthood. Studies that did not report treatment and outcome data separately for patients with syndromic SMCP were also excluded. Where combination techniques were used, these patients were also excluded from the analysis. The 15 studies report on 383 patients with nonsyndromic SMCP that were operated on in childhood, and 343 of these patients had follow-up data with secondary surgery recommendations where relevant.

The 15 manuscripts included one randomized comparative trial, 4 comparative studies (one prospective and 3 retrospective) with 2 to 6 different surgical techniques utilized, and 10 single cohort studies (2 prospectives, 8 retrospective) reporting on one surgical technique each. The quality scores for the included manuscripts varied, with 8 manuscripts scoring less than 8. Three of these papers were published before 1988. A quality score of 8 or less is representative of low-quality data. Characteristics of the patient population and the outcomes specified have been summarized in Tables 1 and 2.

A number of speech assessment techniques were described; of these 73% of the studies (11 of 15) utilized a quantitative

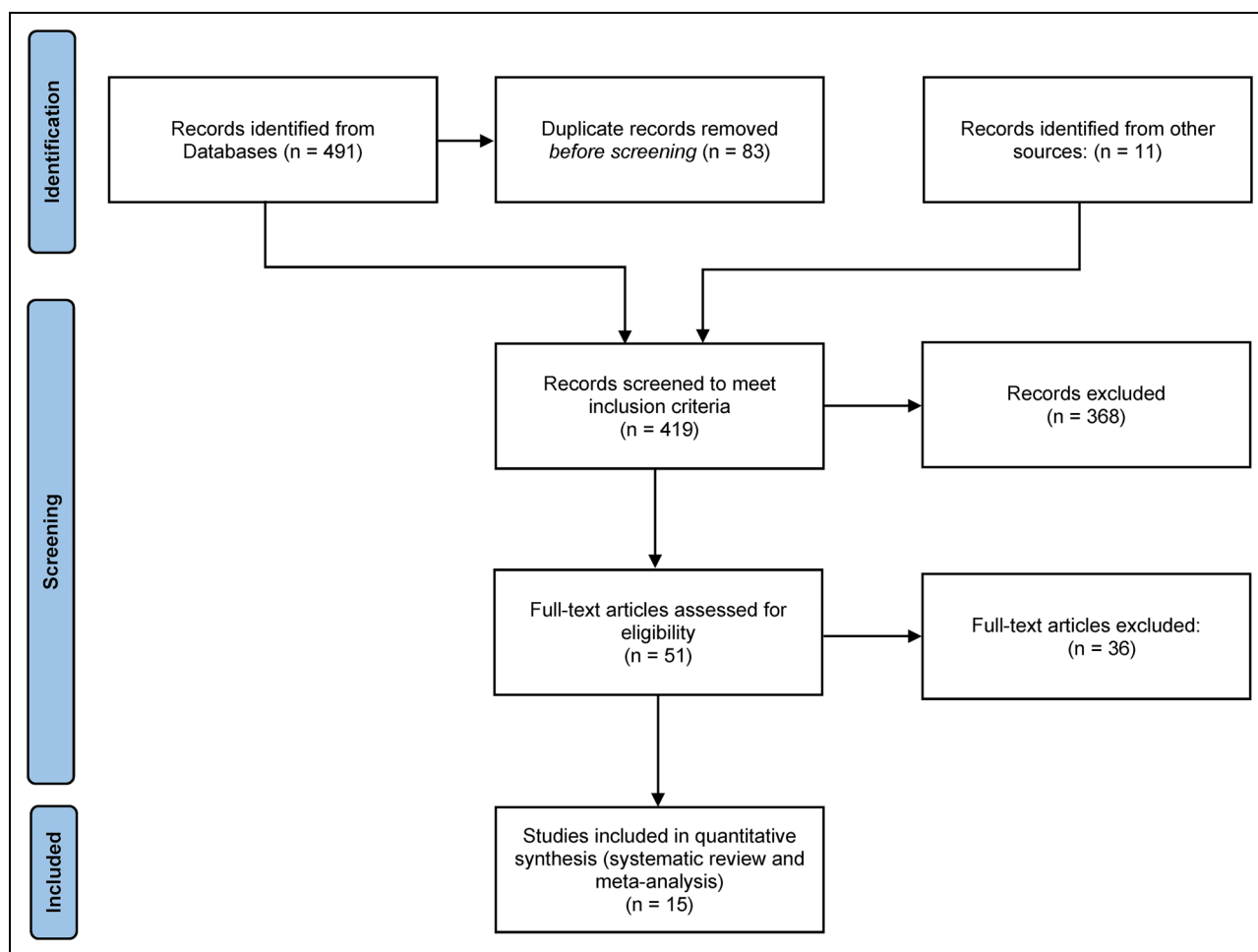


Figure 1. PRISMA flow diagram.

speech assessment technique. The range of quantitative assessment varied from perceptual assessment of resonance and nasal-ance scored on a scale of 1 to 4 with associated descriptors such as 1 “good” and 4 “poor,”⁹ through to validated standardized scores such as the PWSS and GOS-SP.ASS.^{10,11} Perceptual speech assessment scores were used by 33% of the studies (5 of 15).

A random-effects model was used to estimate the proportions of secondary surgery recommendations with 95% CIs and the results are presented in a forest plot (Figure 2). The model showed the highest proportion of secondary surgery recommendation belonged to the SLR group, 17.8% (CI 8.9, 32.5), and the lowest proportion belonged to the PF group, 0.0% (CI 0.0, 100.0). However, there was no statistically significant difference between the surgical techniques in respect to the proportion of patients with recommendation for secondary surgery ($P = .33$). Our model demonstrated low heterogeneity ($I^2 = 11\%$), which was not statistically significant ($P = .33$).

Discussion

This systematic review was designed to further elucidate the question of which surgical technique offers the optimal

outcome for SMCP-related VPI. Of 419 studies, only 15 met our inclusion criteria. A large number of articles were excluded due to our narrow inclusion criteria; 383 patients were identified, between 1954 and 2017, this was further reduced to 343 to account for insufficient follow-up data.

Surgical Technique, Outcomes, and Secondary Surgery

The most frequent surgical technique across this 63-year cohort remains the FP. The other 2 most common techniques are SLR and PF as primary techniques for SMCP. Overall speech improvement ranged from 44.4% to 100%, across 15 studies, with 10 studies recommending secondary surgery. The difference between surgical techniques was not statistically significant, but the reported rates of secondary surgery per surgical technique were notable with 0.0% for PF to 17.8% for SLR. The lack of difference detected may be due to underpowered group analysis. Although the SLR was the most frequently recommended for secondary surgery, PF numbers are small, and primary PF patient selection may be biased toward larger velopharyngeal (VP) gaps. Nonetheless, based on our analysis, PF

Table 1. Characteristics of Included Studies.

Author, year	Study design	Sample size ^a (n)	Participants' age at surgery (m = months, y = years)	Type of surgery	Participants in each surgical group (n)	Length of follow-up	Study quality score ^b
Abdel-Aziz ¹⁸	Single cohort prospective	9	Range 5y-10y	PF	9	1 year	4
Abdel-Aziz et al ²¹	Single cohort prospective	15	Range 4y-9y	FP	15	1 year	9
Afroz et al ¹³	Comparative retrospective	25	Range 2y-11y Range 3y-17y	SLR FP	11 14	6 months 6 months	11
Argenta et al ¹⁹	Single cohort retrospective	19	Range 2y-16y	FP	19	1 year	10
Baek et al ¹⁶	Single cohort retrospective	74	Range 11m-19y	FP	74	Average 14 months (range 3-85 months)	10
Calnan	Single cohort retrospective	16	Range 6y-16y	VWK	16	Not clear	3
Ezzat et al ¹⁵	RCT	20	Mean 5.5y ± 1.3 Mean 5.6y ± 1.3	SLR SLR	10 10	2 years 2 years	8
Moses et al ²⁵	Single cohort retrospective	7	Mean 7.3y	FP	7	Average 3.75 years	7
Ng et al ¹⁴	Single cohort retrospective	17	Mean 7.7y	FP	17	1 year	11
Oji et al ⁹	Single cohort retrospective	13	Range 1y-12y	SLR	13	6 months	6
Park et al ²⁴	Comparative retrospective	50	Mean 4.8y	SLR PF SLR & PF FP	18 21 8 3	Average 5 years Average 5 years Average 5 years Average 5 years	8
Pensler and Bauer ²²	Single cohort retrospective	15	Range 6m-7y	SLR	15	Average 33 (±15) months	4
Roberts and Brown ²⁰	Single cohort retrospective	4	Range 5y-14y	PF & SP	4	1 year	4
Seagle et al ¹⁷	Comparative retrospective	27	Range 1y-14y	FP SLR & PF SP PF SP & FP Adenoidectomy	18 3 2 2 1 1	Not stated (NS) NS NS NS NS NS	10
Ysunza et al ²³	Comparative prospective	72	Median 4.6y	SLR SLR	37 35	3 months 3 months	13

Abbreviations: PF, pharyngeal flap; FP, Furlow palatoplasty; SLR, straight-line repair; VWK, Veau-Wardill-Kilner palatoplasty; SP, sphincter pharyngoplasty.

^aSample size includes only nonsyndromic pediatric patients with follow-up data.

^bDetailed quality score is provided as an appendix.

certainly had the lowest (0%) rate of reoperation due to persistent VPI.

Speech Assessment

Perceptual speech assessment in these included studies was carried out by a highly trained speech therapist and further assisted by the use of scoring systems such as the GOS.SP.ASS and PWSS and Henningsson perceptual speech assessment.¹⁰⁻¹² Adjuncts to these scoring systems include nasometry, nasendoscopy, and videofluoroscopy. The quality of the speech assessment ranged from a subjective assessment to

an in-depth quantitative assessment with nasometry and/or validated qualitative speech assessment scores. However, standardized assessment between cleft centers is not established, and this introduces inherent bias in the quality of the data collected and therefore limits comparisons between techniques across multiple centers.⁶ Gilleard et al recommended previously that SMCP-related VPI should be assessed with pre- and postoperative audio/video speech assessment on a validated standardized scale, pre- and postoperative nasalance scores, and lateral video fluoroscopy with gap size reported. The 4 papers published after this recommendation and included in our systematic review all utilized a standardized quantitative speech

Table 2. Summary of Study Outcomes.

Author, year	Type of surgery	Number of patients in each surgical group	Postoperative speech therapy	Secondary surgery recommendation (n)	Secondary surgery performed (n)	Patients with improved speech n (%)	Patients with OSA (n)	Patients with hyponasality (n)	Patients with fistula (n)
Abdel-Aziz ¹⁸	PF	9	Yes	0	0	7 (77.8)	0	0	NS
Abdel-Aziz et al ²¹	FP	15	Yes	2	1 (1 not done as parents happy)	13 (86.7)	0	0	0
Afrooz et al ¹³	SLR	11	Yes	0	0	11 (100.0)	0	0	0
	FP	14	Yes	1	1	13 (92.0)	0	0	0
Argenta et al ¹⁹	FP	19	NS	5	5	14 (73.7)	NS	NS	NS
Baek et al ¹⁶	FP	74	NS	0	0	64 (86.5)	0	0	0
Calhan	VWK	16	Yes	NS	NS	14 (87.5)	NS	NS	0
Ezzat et al ¹⁵	SLR	10	Yes	NS	NS	10 (100.0)	NS	NS	NS
	SLR	10	Yes	NS	NS	10 (100.0)	NS	NS	NS
Moses et al ²⁵	FP	7	Yes	1	1	6 (85.7)	NS	NS	NS
Ng et al ¹⁴	FP	17	Yes	1	1	16 (94.1)	0	NS	0
Oji et al ⁹	SLR	13	Yes	6	6	6 (46.2)	NS	NS	NS
Park et al ²⁴	SLR	18	Yes ^a	7	6 (1 refused surgery)	8 (44.4)	NS	NS	NS
	PF	21		0	0	19 (90.5)	0	0	NS
	SLR & PF	8		0	0	7 (87.5)	0	0	NS
	FP	3		0	0	2 (66.7)	NS	NS	NS
Pensler and Bauer ²²	SLR	15	NS	2	NS	13 (86.7)	NS	NS	NS
Roberts and Brown ²⁰	PF & SP	4	NS	NS	NS	4 (100.0)	NS	NS	NS
Seagle et al ¹⁷	FP	18	Yes ^b	3	3	15 (83.3)	NS	0	1
	SLR & PF	3		0	0	3 (100.0)	NS	0	0
	SP	2		1	0 (patient relocated)	1 (50.0)	NS	1	0
	PF	2		0	0	2 (100.0)	NS	0	0
	SP & FP	1		0	0	1 (100.0)	NS	0	0
	Adenoidectomy	1		0	0	1 (100.0)	NS	0	0
Ysunza et al ²³	SLR	37	Yes	5	NS	32 (86.5)	NS	NS	NS
	SLR	35	Yes	4	NS	31 (88.6)	NS	NS	NS

Abbreviations: PF, pharyngeal flap; FP, Furlow palatoplasty; SLR, straight-line repair; VWK, Veau-Wardill-Kilner palatoplasty; SP, sphincter pharyngoplasty.

^aOnly for patients with persisting hypernasality and glottal substitutions after 6 months.

^b23 of the 27 patients received speech therapy post-operatively, including the failed patients.

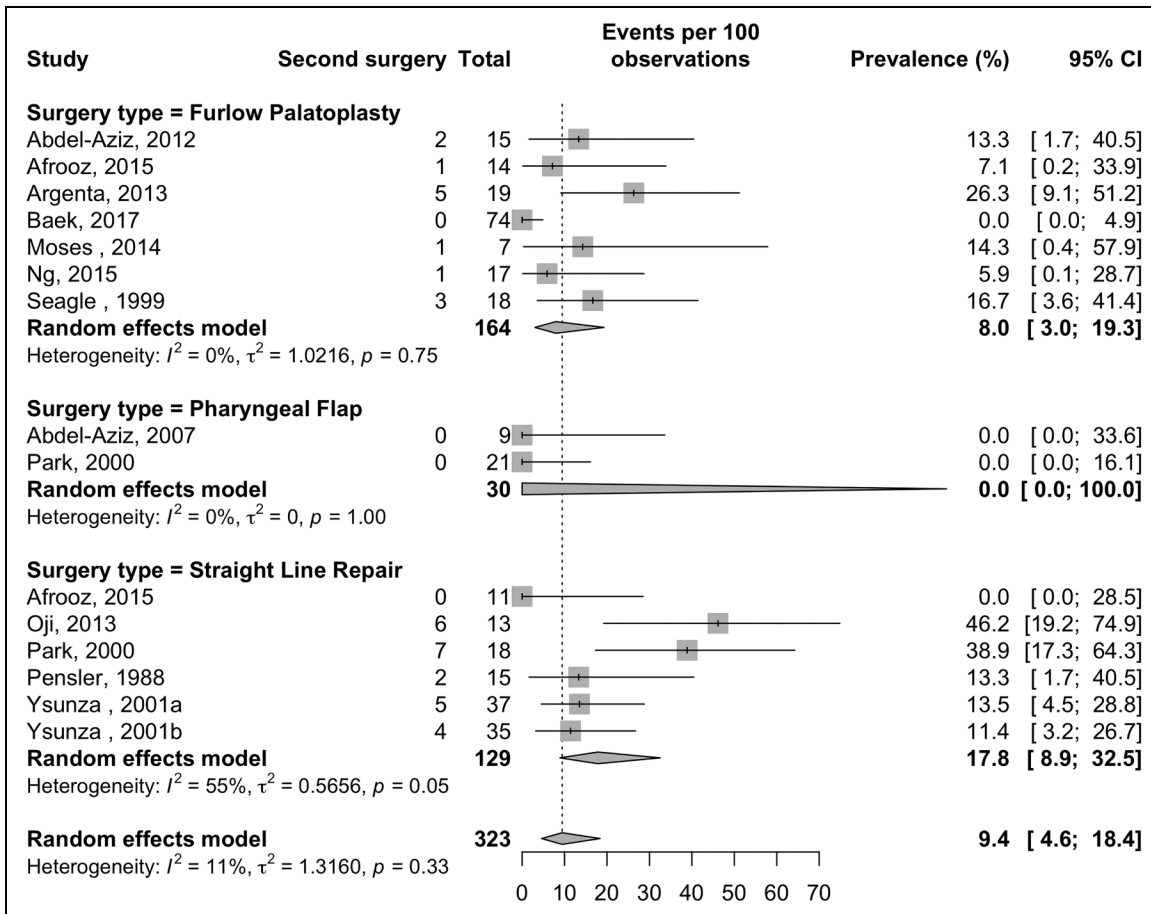


Figure 2. Forest plot: A random effects model of proportions of patients requiring secondary surgery, grouped by surgical technique.

assessment score (PWSS¹³; GOS-SP.ASS¹⁴; PWSS¹⁵; and Henningsson and hypernasality scores¹⁶). Ultimately, outcomes will more easily be critically contrasted if cleft palate teams use a standardized and universally accepted speech evaluation tool.

Complications

Complications across the 16 papers were variably reported but overall low. Obstructive sleep apnea was not stated in the majority of papers (60%), of those reporting, there were no cases identified. Similarly, only one case of hyponasality was reported (SP group).¹⁷ Fistula rates were also largely not stated (60%); only one case was identified (FP group).¹⁷ As such, it is difficult to make any recommendations based on these data. Nonetheless, complications of the chosen technique need to be part of the decision calculus regarding which technique to select.

Indications for Specific Techniques

The studies included in our review variably reported on their indications for the technique chosen. A number provided no justification.^{2,9,13,18-20} Some authors changed from using a PF

due to concerning rates of OSA.^{21,22} Some authors utilized videofluoroscopy or nasendoscopy to justify their chosen surgical technique.^{17,23,24} Others established the role for FP or had criteria for when FP was performed that included gap size.^{14,16,25}

Gap size. Surgical technique choice may be directed by gap size.^{17,26} Some papers limit the use of FP to gaps less than 8 mm¹⁷; however, of 15 studies, only 4 studies discuss gap size. Park et al selected PF where palatopharyngeal disproportion (a relatively short palate or a deep pharynx) were observed on cephalography or nasendoscopy, without measurements specifically provided.²⁴ Baek performed FP on patients that met 2 or more of their inclusion criteria including intermediate gap size defined as 50% to 80% closure of the closing gap on nasendoscopy.¹⁶ Postoperative outcomes did not delineate between the gap sizes.¹⁶ Ysunza et al did not find any significant difference between the 2 groups.²³ Ezzat et al reported on gap size pre- and postoperatively comparing radical IVV with radical IVV and palatoplasty¹⁵; they found no difference between groups with gaps up to 10 mm addressed with these techniques.¹⁵ Of these techniques, 20% had mild hypernasality with a maximum postoperative gap of 5 mm. Of this group of 2 there was no comment on requirement for secondary surgery.

Seagle et al reported that gaps less than 8 mm treated with FP were more successful than those greater than 8 mm.¹⁷ This group measured gap size in all patients and compared the outcomes across FP, PF, combined palatal pushback with PF, and finally SP. Of the 3 patients who had a failed FP, these were successfully treated with a combined palatal pushback with PF.¹⁷ Unfortunately, the gap size was not determined across the other 13 papers; this measurement would assist objective decision-making for technique choice and may assist to predict which patients are best managed initially with a PF.

Age of repair. All children were repaired in childhood (up to 17 years of age). We were unable to identify a correlation of repair age with technique or with the outcome as these data were not reported in sufficient detail across the series included. Nonetheless, although we aimed to provide analysis on timing and technique, our data do suggest that a plain vanilla SLR or FP which both rely on functional levator muscles may well not be achieving outcomes similar to those children operated with overt cleft palate. What is clear is that these patients do not have their repair until a diagnosis is made, which further relies on a compliant patient to participate in a perceptual speech assessment. Ultimately, this late diagnosis and surgery well into the second or third year of life likely result in poorer outcomes for operations that rely on the levator's function. Although only 2 studies reported on PF, a 0% reoperation rate for persistent VPI is impressive.

Limitations

The limitations of this paper relate to the low quality of the studies which has resulted in an underpowered subgroup analysis. There were no randomized controlled trials but one randomized comparative study, while most studies were retrospective cohort studies. The speech assessment tools were heterogeneous, overall limiting quality meta-analysis of speech outcomes, and lacking in comprehensive use of standardized objective assessment. This further reiterates the work of Gilleard et al and Boyce et al.^{6,27}

Conclusions

The goal of successful SMCP surgery is normal speech, ideally achieved at a single, uncomplicated operation. This systematic review and meta-analysis have demonstrated that the PF has the best outcome for first-line treatment of SMCP; however, this did not reach statistical significance, likely a function of the limited number of studies and case numbers meeting inclusion criteria. Delayed repair age inherent to SMCP may render operations that rely on a functional levator muscle with less favorable outcomes. Gap size, which is often used in the post-palatoplasty VPI population to guide treatment, would seem a logical objective measurement useful to guide surgical technique for SMCP, although the delayed timing of surgery in these patients may not hold this assumption true. The

absence of standardized surgical techniques, speech outcomes, speech therapy, and assessment makes comparative analysis and recommendation difficult. We advocate for a standardized speech assessment tool to improve future quantitative assessment of SMCP surgery outcomes and a randomized or other controlled, standardized trial to better elucidate the preferred first-line technique, with speech outcomes and complication profiles key metrics.




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Supplemental material

Supplemental material for this article is available online.

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