ORIGINAL ARTICLE

Adenoid involvement in velopharyngeal closure in children with cleft palate

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 $\ensuremath{\textbf{OBJECTIVE:}}$ To assess the role of the adenoid pad in velophary ngeal (VP) closure.

DESIGN: A retrospective review of patients with cleft palate (CP) who underwent nasendoscopy and multiview videofluoroscopy during evaluation for VP insufficiency (VPI) from January 2006 to March 2008.

PATIENTS: Thirty-two consecutive patients were identified. None of the patients were lost to follow-up. Five patients were excluded: two for advanced age, two due to mental disabilities and one with a submucous cleft.

INTERVENTION: Video nasendoscopy and multiview videofluoroscopy were performed for evaluation of VPI.

OUTCOME MEASURES: Adenoid size based on nasendoscopy studies, and adenoid involvement in VP closure based on videofluoroscopy were recorded. **RESULTS:** The average patient age was 6.6 years (range three to 13 years). Seventy-eight per cent of patients had small adenoid volumes (less than 50% obstruction of the choanae), and six patients (two unilateral cleft lip and palate patients, one bilateral cleft lip and palate patient, two isolated CP patients and one cleft of secondary palate patient) had large adenoid volumes (50% or greater obstruction of the choanae); the adenoid pads of these patients were almost always (five of six patients) involved in their VP closure patterns. Videofluoroscopy showed that 26% (95% CI 9% to 40%) of patients did not significantly use their adenoid pad in VP closure. Forty-three per cent of those not using their adenoids attempted contact with a Passavant's ridge.

CONCLUSIONS: In general, the adenoid pad should be maintained in CP patients. However, not all CP patients in the present study used their adenoid pad in attempted VP closure. If adenoidectomy is medically indicated, a percentage of these patents might be considered to be at lower risk for the development of postadenoidectomy VPI.

Key Words: Adenoid; Adenoidectomy; Velopharyngeal incompetence; Velopharyngeal insufficiency

In cleft palate (CP) patients, adenoidectomy is almost universally contraindicated. Due to the fear of postadenoidectomy velopharyngeal insufficiency (VPI), the procedure is very rarely performed and, consequently, the benefits of adenoidectomy in this population are less understood.

The indications for adenoidectomy have been expanded in recent decades for patients without CPs. Current indications include chronic adenoid hypertrophy causing craniofacial morphology problems, excessive snoring and sleep apnea, hyponasal speech or possible quality of life issues (eg, poor olfaction). Patients with a history of chronic recurrent sinusitis or chronic purulent rhinitis are also candidates for this procedure, although there is a great deal of controversy with this indication (1). Adenoidectomy has become less and less controversial in patients with chronic otitis media (2). Based on current evidence, adenoidectomy should be considered in children undergoing ventilation tube placement who have symptoms suggestive of chronic nasal obstruction

La participation des adénoïdes à la fermeture vélopharyngée chez des enfants ayant une fente palatine

OBJECTIF: Évaluer le rôle des végétations adénoïdes dans la fermeture vélopharyngée (FV).

MÉTHODOLOGIE : Analyse rétrospective de patients ayant une fente palatine (FP) et ayant subi une nasendoscopie et une vidéofluoroscopie multivue pendant l'évaluation d'une insuffisance de la FV (IVP) entre janvier 2006 et mars 2008.

PATIENTS : Les chercheurs ont repéré 32 patients consécutifs. Aucun n'a été perdu au suivi. Cinq ont été exclus : deux en raison de leur âge avancé, deux en raison d'incapacités mentales et un en raison d'une fente submuqueuse.

INTERVENTION : Les chercheurs ont effectué une vidéonasendoscopie et une vidéofluoroscopie multivue pour évaluer l'IVP.

MESURES D'ISSUE : Les chercheurs ont déterminé la dimension des végétations adénoïdes d'après les études nasendoscopiques et la participation des adénoïdes à la FV d'après la vidéofluoroscopie.

RÉSULTATS : Les patients avaient en moyenne 6,6 ans (plage de trois à 13 ans). Soixante-dix-huit pour cent d'entre eux avaient de petits adénoïdes (obstruction des choanes de moins de 50 %), et six patients (deux fentes labiales et palatines unilatérales, une fente labiale et palatine bilatérale, deux FP isolées et une fente du palais secondaire) en avaient de gros (obstruction des choanes d'au moins 50 %), qui contribuaient presque toujours (cinq patients sur six) au mode de FV. La vidéofluoroscopie a révélé que 26 % (95 % IC 9 % à 40 %) des patients n'utilisaient pas leurs végétations adénoïdes de manière significative pour la FV. Quarante-trois pour cent d'entre eux tentaient un contact avec une crête de Passavant.

CONCLUSIONS : En général, les végétations adénoïdes devraient être conservées chez les patients ayant une FP. Cependant, dans la présente étude, les patients ayant une FP n'utilisaient pas tous leurs végétations adénoïdes pour obtenir une FV. Si l'adénoïdectomie est indiquée sur le plan médical, un pourcentage de ces patients peuvent être perçus comme peu vulnérables à l'apparition d'une IVP après l'intervention.

or adenoid hypertrophy that is confirmed by nasendoscopy or nasopharyngeal radiography. Patients who require subsequent sets of ventilation tubes may also be candidates for adenoidectomy, regardless of adenoid size or symptomatology (3,4).

Calnan (5) was the first to emphasize the risk of hypernasal speech following adenoidectomy in CP patients. This was supported when Subtelny and Koepp-Baker (6) presented their findings regarding pharyngeal anatomy in 1956.

To support the recommendation against adenoidectomy, authors commonly cite data from studies in which VPI persisted after adenoidectomy. The reported rate of persistent hypernasality is one in 1500 in non-CP children following adenoidectomy (7). A previously unknown palatal defect was found to be one of the predisposing factors and was discovered in 30% to 63.5% of these patients (8,9).

In more recent decades, with the advent of multiview videofluoroscopy and nasendoscopy, multiple groups have published

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TABLE 1			
Patient demographics a	nd adenoid	characteristics	(n=27)

Age,			Obstruction of	Involved in
years	Sex	Diagnosis	choanae, %	closure
4	М	BCLP	50-75	+
4	Μ	BCLP (incomplete)	<50	+
5	Μ	BCLP	<50	+
7	Μ	BCLP	<50	+
7	Μ	BCLP	<50	-
10	Μ	BCLP (incomplete)	<50	-
4	F	Isolated CP	<50	+
4	Μ	Isolated CP	<50	-
5	F	Isolated CP	50-75	+
6	Μ	Cleft of 2° palate	<50	+
7	F	Pierre Robin sequence	<50	+
8	Μ	Pierre Robin sequence	50-75	+
9	Μ	Cleft of 2° palate	75–95	-
9	Μ	Pierre Robin sequence	<50	+
11	F	Isolated CP	<50	+
3	F	UCLP	<50	+
3	F	UCLP	<50	+
3	F	UCLP	<50	+
5	Μ	UCLP	<50	_
5	Μ	UCLP	<50	+
6	F	UCLP	50-75	+
6	Μ	Median cleft lip and palate	<50	+
7	F	UCLP	50-75	+
7	М	UCLP	<50	+
9	F	UCLP	<50	+
12	М	UCLP	<50	-
13	М	UCLP	<50	+

Patient age, sex and diagnosis are shown in relation to the percentage of adenoidal obstruction of the choanae and adenoidal involvement in the isolated cleft palate (CP) closure mechanism. + Yes; – No; BCLP Bilateral cleft lip and palate; F Female; M Male; UCLP Unilateral cleft lip and palate

further evidence with regard to the import of the adenoid pad in velopharyngeal (VP) closure (10-14).

At the University of Missouri (Missouri, USA), we are occasionally asked to evaluate the speech and VP mechanisms of CP patients who are being considered for adenoidectomy. In the face of the current consensus view – that adenoidectomy is contraindicated in all CP patients – we assessed the frequency with which the adenoid pad is involved in attempted VP closure among our CP patients. As James Thurber once said, "There is no exception to the rule that every rule has an exception".

METHODS

A retrospective review of patients who underwent nasendoscopy and multiview videofluoroscopy from January 2006 to March 2008 was performed. Preapproval from the University of Missouri Institutional Review Board was obtained. The inclusion criterion for the present study was a history of CP repair. Exclusion criteria were hearing loss, mental disability, previous VPI correction procedure, submucous cleft, syndromic diagnosis and younger than three years of age. None of the patients were lost to follow-up. Of note, all of the patients enrolled had suspected VPI; these patients were the only ones who were routinely evaluated by nasendoscopy and videofluoroscopy at the University of Missouri.

Patient demographics including age, sex, diagnosis and surgical history were recorded at the time of evaluation. Nasendoscopy and multiview videofluoroscopy were performed by the same surgeon (ARM) in conjunction with a single speech and language pathologist (GBR). For all measurements, the patients' best performances were used to determine their ratings. Agreement between the speech and language pathologist and surgeon was 100% for these ratings. Adenoid size (based on nasendoscopy), and presence or absence of veloadenoidal contact (based on lateral videofluoroscopy) were recorded. Adenoid size was described by estimating the percentage of obstruction of the choanae (less than 50%, 50% to 75%, and 75% to 95%) as viewed by nasendoscopy. In situations in which the velum never made contact with the posterior pharyngeal wall or adenoid pad, the contact point was estimated by the vector of velar motion. More specifically, a line was drawn from the genu of the velum at rest through the genu at maximal excursion to the posterior pharyngeal wall or adenoid pad. This point on the posterior pharyngeal wall or adenoid pad was recorded as the place of contact. Subgroup analysis based on diagnosis, unilateral cleft lip and palate, bilateral cleft lip and palate, or isolated CP was performed.

Statistical analysis

Data were subjected to statistical analysis performed at the Department of Biostatistics, University of Missouri. CIs were determined using the distribution of sample proportion. The prevalence of adenoid involvement in VP closure was previously assumed to be 100%. Using a Z test, the certainty of prevalence greater than 0% and greater than 10% was calculated. Subgroup analysis was not attempted due to the small sample size and relatively similar group percentages.

RESULTS

Thirty-two patients who underwent evaluation with nasendoscopy and videofluoroscopy following palatoplasty were identified (Table 1). All had suspected VPI. Five patients were excluded: two for advanced age (16 and 80 years), two due to mental disabilities and one with a submucous cleft. The average age of the patients was 6.6 years, which did not vary significantly between groups (Table 2). The majority of patients were male. The adenoid size appreciated by nasendoscopy did not vary between groups. Eightythree per cent of the patients had small adenoid volumes (less than 50% obstruction of the choanae). Six patients (two unilateral cleft lip and palate patients, one bilateral cleft lip and palate patient, two isolated CP patients and one cleft of secondary palate patient) had large adenoid volumes (50% or greater obstruction of the choanae); the adenoid pads of these patients were almost always (five of six patients) involved in their VP closure pattern. Considering all patients, approximately 26% (95% CI 9% to 40%) did not significantly use the adenoid pad for VP closure, as observed by videofluoroscopy (Table 2). The prevalence of adenoid involvement in VP closure was found to be significantly greater than 0% (P=0.001) and greater than 10% (P=0.03). There was no significant variability among subgroups. Of those not using their adenoids, 43% attempted or made contact with a Passavant's ridge.

Adenoid involvement in VP closure

DISCUSSION

As previously discussed, performing adenoidectomy in CP patients has been almost universally contraindicated since Calnan (5) and Subtelny and Koepp-Baker (6) presented their landmark findings in 1953 and 1956, respectively. The literature and consensus opinion has strengthened these studies thereafter. To consider adenoidectomy for a patient with CP with or without cleft lip, the potential benefits of removing the adenoid pad must be weighed against the risk of VPI development.

The indications for adenoidectomy have been expanded in recent decades for non-CP patients (3,4). Although the benefits are fairly well established for treatment of chronic otitis media with effusion and severe airway obstruction, it continues to be disputed for many others (eg, chronic rhinosinusitis) (1,2). The true benefit of adenoidectomy for treatment of chronic otitis or rhinosinusitis in CP patients is unknown because the procedure is rarely, if ever, performed in this patient population.

Many studies have hypothesized that adenoidectomy would be ineffective at treating or reducing the morbidity of chronic otitis media due to intrinsic eustachian tube dysfunction in CP patients. The evidence of eustachian tube dysfunction is well documented in CP patients, and its implication in middle ear disease is clear (8,13,15). This dysfunction is the reason for the ubiquitous use of tympanostomy tubes in this population at a young age. Not surprisingly, all subjects reviewed in this study had at least one set of pressure equalization tubes placed. Shprintzen (16) states, "Chronic middle ear disease is not a legitimate reason for adenoidectomy in children with clefts, since they are more likely to have persistent otitis media because of Eustachian tube dysfunction". Shprintzen goes on to state that unless hypertrophic adenoids occlude the airway causing health compromise or obstructive sleep apnea, adenoidectomy should not be considered.

It is our belief that in all patients, with and without CPs, chronic middle ear infections have a multifactorial etiology. Certainly, eustachian tube dysfunction is the predominant etiology for the vast majority of CP patients. However, the theory that recurrent middle ear infections are caused by eustachian tube dysfunction alone may be an oversimplification, especially in postpalatoplasty children. This argument potentially could go on indefinitely because the risk of postadenoidectomy VPI is believed to be too high to perform a prospective study.

In the past 30 years, with the advent of multiview videofluoroscopy and nasendoscopy, many studies have been published concerning the importance of the adenoid pad for complete VP closure. The vast majority of these studies (10-12) concluded that the adenoid pad is essential for closure and should be maintained. However, as with all things in medicine, there are always exceptions to the rule: namely, presence of a Passavant's ridge, the very low incidence of VPI development with adenoidal involution and the variable height of adenoidal contact. While considering the physical properties of the VP valve, one should always keep in mind that the correlation between speech and x-ray findings, or with direct or indirect visualization of VP closure, is not 100% (17).

In 1975, Skolnick et al (10) used multiview videofluoroscopy to study 30 postpalatoplasty children, two to 12 years of age, with normal speech. The authors found that all subjects exhibited velar-adenoidal contact. Ten of the children also

	UCLP	BCLP	Isolated CP	All (n=27)			
	(11=12)	(11=0)	(11=3)	(11=27)			
Average age, years (range)	6.9 (3–13)	6.2 (4–10)	6.5 (4–9)	6.6 (3–13)			
Adenoid size, %							
<50% obstruction	83	83	78	78			
50–75% obstruction	17	17	11	11			
75–95% obstruction	0	0	11	4			
Adenoid involved with closure, %	75	67	78	74			
Passavant's ridge. %	9	17	17	13			

The distribution of adenoid size, defined as the percentage of obstruction of the choanae, is shown for each diagnosis subgroup and all patients. Also, adenoidal involvement in the velopharyngeal closure mechanism and presence of a Passavant's ridge is shown. BCLP Bilateral cleft lip and palate; CP Cleft palate; UCLP Unilateral cleft lip and palate

made contact with a Passavant's ridge during speech. Although not discussed by the authors, one could infer that 30% of children with a Passavant's ridge may not have needed the adenoid pad for successful VP closure.

In 1986, Siegel-Sadewitz and Shprintzen (12) reported a longitudinal case series of 20 children without CPs, five with isolated CP (postpalatoplasty) and five with unrepaired submucous CP, all with normal speech. Changes in VP closure patterns were observed in 60% of the normal and 30% of the CP subjects studied with videofluoroscopy. None of the subjects, with or without CPs, developed VPI during the period of adenoidal involution. The authors attributed this result to a compensatory change in angulation of the pharyngeal wall during this time period. The posterior pharyngeal wall was found to become more vertical, decreasing the horizontal distance between the velum and posterior pharyngeal wall.

The decreased distance that the velum is required to travel and the compensatory elongation of the velum – 'velar stretch' – both increase the probability of maintaining normal speech as the child grows (18). Logically, one can infer that the risk of postadenoidectomy VPI decreases in parallel with the growth of the child.

In 1980, Mason and Warren (11) published a longitudinal review of 122 postpalatoplasty patients. Before adenoid involution, they all had speech perceptually judged to be within the normal range. Approximately 30% of these patients developed VPI to such an extent that surgical correction was recommended. To explain and possibly predict this evolution, the authors created a classification system based on the vertical height of velar-adenoidal contact. Type I VP closure was defined as the most superior adenoid contact (convex portion of adenoid), type 3 the most inferior (concave portion of adenoid) and type 2 in the intermediate zone. The authors hypothesized that types 1 and 2 had the greatest risk of VPI development during adenoid involution. Conversely, type 3 contact would be unaffected by adenoid involution because the adenoid's contribution to VP closure was negligible from the beginning. In relating the definitions from this article to ours, type 3 contact would have been labelled as no significant use of the adenoid tissue for closure. Furthermore, we agree with Mason and Warren's (11) hypothesis that these patients would have a lower risk of postadenoidectomy VPI.

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Our multispecialty craniofacial group does not usually perform multiview videofluoroscopy or nasendoscopy on patients without evidence of VPI, thus limiting the variety in our patient population. In our small series of nonsyndromic CP patients who underwent evaluation, 74% showed evidence of adenoid involvement in VP closure by videofluoroscopy. We believe that lateral videofluoroscopy provides the best vantage point to view the velar-adenoidal relationship. Of those who did not use the adenoid pad for closure, 43% attempted or obtained closure with a Passavant's ridge. All of the subjects who did not use their adenoid pad, also had small adenoids (less than 50% obstruction of the choanae). However, hypertrophy of these structures would not have changed VP closure because the vector of velar movement would have still been too inferior.

Our results indicate that the adenoid pad is not involved in VP closure in a certain percentage of CP patients, namely, patients whose velum approaches the posterior pharyngeal wall below the adenoid or those who attempt closure with a Passavant's ridge in that area. Similar to Mason and Warren's (11) conclusions, we hypothesize that adenoidal involution or adenoidectomy would be unlikely to affect speech in these groups. Our study does have intrinsic limitations. The sample size was small and, thus, the true prevalence of velar-adenoidal contact is still unknown. However, our data does show that the prevalence is certainly less then 100%, as was previously believed. Additionally, not all of our patients had velar closing ratios of one (ie, contact of the velum with the posterior pharyngeal wall). We described the contact point in this circumstance based on the vector of motion. One could argue that this motion is not truly linear; however, we believe that

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the approximation is adequate for the purposes of the present study.

If adenoidectomy is considered in a patient with CP, a thorough work-up should be obtained including nasendoscopy and videofluoroscopy. In patients who use the adenoid pad for VP closure, we agree that total adenoidectomy should be avoided whenever possible. Partial adenoidectomy in CP patients, although alluring, should be approached with caution. As discovered by Ren et al (19), posterior pharyngeal wall abnormalities from incomplete adenoidectomies can result in VPI even in children without CPs. Perhaps the best solution would be to tailor the partial adenoidectomy based on the VP closure mechanism. Those with good preoperative velar motion would have the lowest risk for VPI development with an anterior partial adenoidectomy. In contrast, those with marginal velar motion, but good lateral wall movement would fare better with a lateral adenoidectomy. Finally, if complete adenoidectomy is unavoidable in a patient relying significantly on the adenoid pad for closure, a secondary correction procedure can be planned for the impending VPI.

CONCLUSION

As a general rule, the adenoid pad should be maintained in CP patients. However, not all CP patients in the present study used their adenoid pad in attempted VP closure. If adenoidectomy is medically indicated, a percentage of CP patents might be considered at lower risk for the development of postadenoidectomy VPI. However, the true risk of postadenoidectomy VPI in patients with CP continues to be unknown in the absence of a prospective trial.

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