



Tongue base suspension in children with cerebral palsy and obstructive sleep apnea[☆]

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ABSTRACT

Objective: Children with cerebral palsy (CP) are commonly affected by obstructive sleep apnea (OSA). This study examines the efficacy of combined surgical techniques for OSA including tongue base suspension (TBS), using perioperative polysomnograms (PSG) in pediatric patients with CP.

Study design: Case series with outcome analysis.

Setting: University based tertiary care children's hospital.

Methods: A 7-year retrospective chart review of children with CP who underwent surgical management for OSA. Surgical procedures, postoperative complications, and perioperative PSG data were examined. Only patients with both preoperative and postoperative PSG results were included in the study. Based upon procedures performed patients fell into 2 equal groups for analysis.

Results: Fourteen children were identified. Seven patients (mean age = 6.0 years) underwent combined adenotonsillectomy (T&A), uvulopalatopharyngoplasty (UPPP), and tongue base suspension (TBS). Another 7 patients (mean age = 6.3 years) underwent T&A and UPPP alone. Those who received TBS had a mean preoperative AHI of 27.2 compared to 6.8 in the group that did not have TBS. The AHI decreased by a mean of 16.5 in the TBS group and 5.0 in the non-TBS group. The mean oxygen saturation nadir improved in both the TBS (74.0–84.0) and non-TBS (64.8–84.6) groups. The arousal index also improved in the TBS (33.1–20.7) and non-TBS (11.0–5.8) groups. No surgical complications occurred.

Conclusion: This study suggests that concomitant surgical approaches for OSA in children with CP are effective. Moderate to severe OSA in this population may safely benefit from the added technique of tongue base suspension.

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1. Introduction

Obstructive sleep apnea (OSA) in children is defined as a disorder of breathing during sleep characterized by prolonged partial airway obstruction and/or intermittent complete airway obstruction that disrupts normal ventilation. OSA is frequently associated with snoring, restless sleep, excessive daytime somnolence or other neurobehavioral problems [1]. The prevalence of OSA among children ranges from 0.7% to 10.3%. The well documented negative impact of prolonged untreated sleep apnea includes growth suppression, neurocognitive delay, and cardiopulmonary compromise [1,2]. Children with cerebral palsy (CP) are

at increased risk for developing OSA due to the decreased neuromuscular tone of their upper airway [3]. The cardiopulmonary risks from OSA for CP children are exacerbated by the severity of their OSA, history of chronic aspiration, and an already compromised pulmonary reserve. Effective management of OSA in CP children is therefore important for their overall health and survival.

Surgical treatment of OSA in patients with CP has a positive impact on the quality of life for these patients and their families [4]. Adenotonsillectomy (T&A) alone is proposed as a first line surgical option for CP patients with OSA [4,5]. However, evidence suggests that the successful treatment of OSA for one individual does not always translate into equal benefit for another. The benefit from surgery for sleep apnea is often dependent upon an individual's anatomy and physiology. As a result, T&A alone may not completely treat OSA and additional surgery may need to be considered [6,7]. Experience at our institution suggests that this is consistently true for children with CP.

The utility and application of the tongue base suspension (TBS) procedure for OSA has been described and examined in the

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adult literature [8–14]. Interestingly, few studies have focused on the use of TBS in children let alone in the CP population [15]. In fact, the surgical management of OSA in the CP population is rarely discussed. The present study is designed to examine the role of TBS versus other surgical measures for OSA in patients with CP. We aimed to determine the benefit of this technique, its safety, and when it is most appropriately utilized.

2. Methods

Approval for the present study was obtained from the Institutional Review Board of the University of Arkansas for Medical Sciences (Little Rock, AR). A retrospective chart review (June, 2001 to January, 2009) was performed to identify all children (ages 0–18 years) treated for OSA at Arkansas Children's Hospital with CP who had a full night preoperative polysomnogram (PSG) with an apnea/hypopnea index (AHI) equal to or greater than 1 as well as a complete full night postoperative PSG. Only patients who proceeded to surgical management for OSA by author (CB) were included in this study to help control for consistency in operative decision-making and technique. Only advanced surgical approaches to OSA were examined. If surgery consisted of a T&A and did not include additional surgery such as uvulopalatopharyngoplasty (UPPP) then they were excluded from this study. Additionally, patients that proceeded directly to tracheostomy were excluded from this study.

The remaining subjects were then divided into two groups: those that received TBS using the AIRvance™ TS System (a.k.a. Repose® System; Medtronic ENT, Jacksonville, FL, USA) and those who underwent surgical management of OSA without TBS. Adjunctive procedures not directly related to OSA were performed in some patients (i.e. ear tubes, salivary gland excision and/or ligation, etc.). Procedures selected for each patient were based upon patient anatomy, surgeon preference, and severity of OSA. In general, patients with little evidence of obstruction in the nasal cavity, nasopharynx and oropharynx but with evidence of glossoptosis and tongue base obstruction were good candidates for TBS. Also, patients with higher AHI values were seen as higher risk patients needing more aggressive surgical intervention and were more likely to have TBS performed. Most patients included in this study underwent simultaneous T&A (with electrocautery) and UPPP as previously described without variation in technique [16].

A database was created that included patient demographics, presenting history, physical exam findings, full-night preoperative and postoperative PSG results, surgical approach, age at time of surgery, length of follow up, intra-operative complications and the use of CPAP. Length of hospital stay and postoperative complications were also recorded.

2.1. Surgical technique for TBS

The TBS technique for children with CP is similar to that previously described for adults [9]. In brief, patients are transorally intubated and a bite block is placed. An incision is made between the papillae of Wharton's ducts and the periosteum is then elevated to provide at least 1 cm of bony exposure at the genial tubercle. Of note, an alternative approach to the genial tubercle is to perform a submental incision. The circumvallate papillae are then identified and a mark is placed 1 cm to either side of the midline tongue to prevent injury to the lingual artery. The AIRvance™ TS or Repose® System (Medtronic ENT, Jacksonville, FL, USA) is used which includes an electric screwdriver (the "Inserter") with a loaded combined polypropylene suture and self-tapping titanium screw, a suture passer, and a tongue retractor. The suture secured to the implanted screw is passed through the base of the tongue on one side, passed to the other side submucosally and then brought back anteriorly to be tied while palpating for a dimple in the central base of tongue indicating retraction of the tongue base (the tongue is usually brought forward 3–7 mm). The knot is then buried and the mucosal incision is then closed.

2.2. Statistical analysis

Patients were compared using student's paired *t*-test. Preoperative and postoperative PSG results were used for comparison. Lowest oxygen saturation level, AHI, and arousal index (AI) were averaged for each of the two groups prior to comparison.

3. Results

Two hundred and ninety two patients were identified that were treated at Arkansas Children's Hospital during the study period who had both a diagnosis of CP and OSA. A total of fourteen patients were identified from among these patients who underwent advanced surgical management for OSA by author CB and had complete preoperative and postoperative PSG data. Seven patients simultaneously underwent TBS along with T&A and UPPP for moderate to severe OSA (TBS Group). The other seven patients were treated for OSA with a simultaneous T&A and UPPP but did not undergo the TBS procedure (non-TBS Group).

The average age of patients in the TBS group was 6.0 years (range of 2–16 years; 5 male and 2 female). The average age of patients in the non-TBS group was 6.3 years (range of 1–16 years; 4 male and 3 female). There was no significant difference between the two groups with regard to age ($p = 0.45$) or sex ($p = 0.30$). The mean length of follow up for the TBS group was 43.3 months, compared to 60.7 months for the non-TBS group (see Tables 1 and 2).

In the non-TBS group, one subject underwent bilateral submandibular gland excision with bilateral parotid duct ligation.

Table 1
TBS group data.

TBS group													
Pt	Age (yrs)	Sex	Follow up (mos)	Pre AHI	Post AHI	AHI Δ	Pre low Oxs	Post low Oxs	Low Oxs Δ	Pre AI	Post AI	AI Δ	LOS
1	2	M	26.0	47.6	3.8	43.8	59.0	91.0	32.0	27.5	10.0	17.5	3.0
2	2	F	29.0	4.3	1.3	3.0	83.0	92.0	9.0	13.2	7.7	5.5	9.0
3	4	F	15.0	3.1	0.0	3.1	71.0	80.0	9.0	6.2	1.1	5.1	13.0
4	5	M	74.0	24.8	19.4	5.4	92.0	84.0	-8.0	52.4	29.0	23.4	8.0
5	5	M	13.0	1.8	0.1	1.7	93.0	93.0	0.0	10.7	9.9	0.8	9.0
6	8	M	57.0	44.0	4.3	39.7	37.0	63.0	26.0	44.7	2.7	42.0	14.0
7	16	M	89.0	65.0	46.0	19.0	83.0	85.0	2.0	76.9	84.5	-7.6	9.0
Mean	6.0		43.3	27.2	10.7	16.5	74.0	84.0	10.0	33.1	20.7	12.4	9.3

TBS: tongue base suspension group; Pt: patient; yrs: years; mos: months; AHI: apnea hypopnea index; Δ: change; Oxs: blood oxygen saturation; AI: arousal index; LOS: length of stay.

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