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Friedman tongue position: Age distribution and relationship to sleep-disordered breathing

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ABSTRACT

Purpose: Friedman tongue position (FTP) may play an important role in the evaluation of children with sleep-related breathing disorders (SRBD), but there are no previous data on FTP distribution by age. The objective of the current study was to determine the distribution of FTP by age and examine the relationship between FTP and snoring in children.
Methods: Prospective cross-sectional study of 199 children (mean age, 6.8 years; 59% male) had tongue position assessed by FTP as part of their clinical examination of the oral cavity during routine ENT visits at a tertiary care children's hospital. The FTP and snoring frequency of participants was examined across the entire age range as well as by comparing those older (middle childhood and above) and younger than 5 years of age.
Results: Tongue position did not correlate with age or snoring frequency. The proportion of children with FTP III/IV was not significantly different in children younger than five years of age compared to older than five. Habitual snoring was not associated with having a higher FTP. Among children who snored <3 times per week, those who had previously undergone tonsillectomy did have higher FTP compared to those who had not ($p = 0.007$). BMI-%-for-age was significantly correlated with FTP ($p = 0.003$). The percent of children having FTP class III/IV differed significantly between ethnicities (22% of whites, 26% of others, 45% of hispanics, 53% of African–Americans; $p = 0.011$). Inter-rater reliability among pediatric otolaryngologist was excellent (kappa = 0.93, $p < 0.001$).
Conclusions: There does not appear to be an association between FTP with age or snoring frequency in children. The excellent inter-rater reliability for FTP among pediatric ENT providers suggests the null findings are not due to rater bias. These findings may serve as an important reference for those studying the role of tongue position in pediatric SRBD and complement previous studies examining FTP among children with known OSA or snoring.

1. Introduction

Obstructive sleep apnea (OSA) is a common disorder, affecting 1–5% in children, with significant associated morbidity [1]. OSA represents the severe end of the sleep-related breathing disorders (SRBDs). SRBDs are s spectrum of disease, which ranges from primary snoring to partial obstructive hypoventilation to OSA [2]. The primary etiology for pediatric SRBDs is adenotonsillar hypertrophy. Between the ages of two and seven, the tonsils undergo a growth phase, and this age period also coincides with a period of rapid neurocognitive development. As a consequence, the morbidity of SRBDs may include deleterious effects on intelligence, attention, school performance, behavior, mood, cardiovascular function, and growth [1,2].

The first-line treatment of choice for children with pediatric SRBD remains adenotonsillectomy (T&A) [1]. Recent studies investigating the efficacy of T&A for OSA have garnered much interest. Estimates of the ability of T&A to normalize polysomnogram (PSG) findings are variable, with a recent randomized controlled trial demonstrating normalization (AHI < 2 and OAI < 1) of PSG findings in 79% of participants [3]. Adenotonsillectomy has less success for resolution of OSA in black children, obese children, and children with more severe baseline OSA [3].

For adult patients, a staging system for OSA has been developed for the purpose of predicting success of surgical treatment which

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relies on the tongue position, tonsil size and body mass index [4]. Determination of tongue position is important since it may predict hypopharyngeal obstruction [4,5]. The Friedman tongue position (FTP) has good inter-examiner agreement [5] and has been shown to correlate with OSA severity in adults [6]. In adult patients with OSA, low FTP portends greater surgical success with uvulopalatopharyngoplasty [7,8].

Similarly in children, tongue position has been shown to be associated with residual OSA following T&A [9–11]. Conflicting results have been found regarding the relationship between tongue position and OSA severity [4,12,13]. To our knowledge no study has evaluated the distribution of tongue position in children by age, and only one prior study has examined FTP in a sample that included non-snoring children [13]. Therefore, the objective of the current investigation was to determine the distribution of the FTP by age, as well as to examine the relationship between FTP and snoring in a sample of children referred to ENT clinic at a tertiary care children's hospital. We hypothesized that children with higher FTP would have more SDB symptoms.

2. Methods

2.1. Patient enrollment

Institutional review board approval was obtained. Prospective enrollment of patients presenting to the Department of Pediatric Otolaryngology for outpatient clinic visit was undertaken. Participants were eligible for inclusion if they were between the ages 1–13 years old in order to select for preadolescent children. Children were excluded if they had craniofacial abnormalities, known genetic abnormalities, and/or cerebral palsy. We did not exclude children with a previous diagnosis of SRBD or T&A because we were interested in the association of FTP with their current symptoms as well. Patients were approached in clinic and verbal consent was obtained by the research coordinator. No interventions or procedures were carried out. During the standard clinic examination of the oral cavity the otolaryngologist used the Friedman tongue position classification to evaluate tongue position. For each participant, basic demographic characteristics, history of snoring frequency, FTP (I, IIa, IIb, III, and IV), tonsil size (scale 0–4+), turbinate size (normal, mild, moderate and markedly enlarged), palate arch (normal, high-arched), and clinical action taken (no suspicion of SRBD, nasal steroids with reevaluation, possible SRBD and referral for PSG, possible SRBD with reevaluation, and probable SRBD with surgery recommended) were recorded. For tonsils and turbinates, if right and left sides differed in size the larger of the two was recorded. Palate was classified as either normal or high-arched based on oropharyngeal examination, with representative photographs provided for reference. In terms of weight class, overweight was defined as BMI at or above the 85th percentile, and obese was defined as BMI at or above the 95th percentile [14].

2.2. Friedman tongue position classification

The FTP was assessed as previously described [5], and represents the relative anatomical position of the tongue and tonsils, uvula, soft palate, and hard palate. Patients were asked to open their mouth without tongue protrusion, and the FTP grade is as follows: FTP I is defined as visualization of the entire uvula and tonsils, FTP IIa is when the uvula but only partial tonsils are visualized, FTP IIb is when the most of the soft palate and base of uvula but not the tonsils are visualized, FTP III is when the soft palate is partially visualized, and FTP IV is when only the hard palate can be visualized. Turbinates were also assessed. The following grading scale was used to assess turbinate size: I was defined as normal, II mildly enlarged, III moderately enlarged with the turbinate either touching the septum or blocking the inferior meatus, and a turbinate grade of IV was defined as markedly enlarged with the turbinate touching the septum and blocking the inferior meatus.

2.3. Inter-rater reliability

In order to assess the ability of pediatric ENT providers to apply FTP reliably, 26 video clips were shown to seven different attending pediatric otolaryngologists. These 26 video clips with equal representation of FTP 1–4 were taken from a previous study evaluating inter-rater reliability of FTP among adult patients [5]. Each examiner viewed the video clips and assigned each one a specific FTP. Inter-rater reliability among pediatric otolaryngologist was excellent (kappa = 0.93, $p < 0.001$).

2.4. Statistical analysis

Possible associations between ordinal variables were tested with Spearman's rank correlation, categorical variables with Pearson's chi-squared test, one categorical and one ordinal variable with Mann–Whitney U test, and one multinomial and one ordinal variable with the Kruskal–Wallis H test. Given that there were more than two raters, inter-rater reliability was assessed via Fleiss's Kappa. Statistical significance was defined at $p < 0.05$. Power analysis of a chi-square test with our sample size of 199 subjects, $p = 0.05$, and one degree of freedom to detect small, moderate, or large effect sizes would be 0.29, 0.98, and 0.99. Therefore, our study size provides good power to detect moderate/large effects, but is somewhat limited in detecting small effects.

3. Results

3.1. Participant characteristics

The sample consisted of 199 children, and participant characteristics are detailed in Table 1. The sample was approximately half male and ranged from 2 to 13 years of age. About two-third of participants were white. The majority of participants were non-obese. Children were referred to ENT for a large number of reasons, but the two most common were snoring and large tonsils. In addition, 15% of children had previously had an adenotonsillectomy and 10% an adenoidectomy alone.

3.2. Airway characteristics

Tonsil size varied with 18% of children having 0+ tonsils, 27% 1+, 23% 2+, 23% 3+, and 10% 4+. Turbinate size was as follows: 12% normal, 59% mildly enlarged, 23% moderately enlarged, and 7% markedly enlarged. Sixteen percent of children had FTP I, 28% IIa, 27% IIb, 28% III, and 1% IV. Fifty percent of participants had a high-arched palate. FTP was not associated with having a high-arched palate ($\chi^2 = 0.96$, $N = 199$, $p = 0.326$). BMI-%-for-age was significantly correlated with FTP (rho = 0.19, $p = 0.003$), and children with a BMI-%-for-age above the 85th percentile had significantly higher FTP ($U = 2509$, $z = 2.1$, $p = 0.031$). The difference in FTP in children with BMI-%-for-age above the 95th percentile did not reach significance ($\chi^2 = 1.85$, $N = 178$, $p = 0.173$). Children of black and hispanic ethnicities were more likely to have at least an FTP of III compared to white children ($\chi^2 = 11.2$, $N = 199$, $p = 0.011$); likewise, children of black and hispanic ethnicities had higher FTP ($H = 13$, df = 3, $p = 0.003$). Tongue position was not associated with sex ($U = 4532$, $z = 0.6$, $p = 0.53$) or prematurity ($U = 2174$, $z = 0.8$, $p = 0.373$). Selected characteristics in relation to FTP are listed in Table 2.