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# Investigations in paediatric obstructive sleep apnoea. Do we need them?

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**Abstract**

Ninety percent of normal children with obstructive sleep apnoea (OSA) improve, or are cured, with adenotonsillectomy. However, 10% of apparently normal children show no improvement following this operation and it has a very poor outcome in Down's syndrome, where only about one in six children improve. Adenotonsillectomy is also rarely curative in children with cerebral palsy or craniofacial syndromes. In these children, investigations of the site and severity of their obstruction is necessary.

Taking a detailed history and asking the parents to fill in a questionnaire for data collection will identify most children with OSA. Pulse oxymetry has some limitations but is a good screening tool. It does not provide enough information for the management of children with complex upper airway obstruction who are likely to have ongoing problems with OSA throughout their childhood despite intervention. For these children, formal sleep studies are needed. Full polysomnography is the gold standard investigation to ascertain the severity of OSA.

To ascertain the site of upper airway obstruction during sleep, sleep nasendoscopy has been found to be an excellent tool. This is performed under a light general anaesthetic in main theatres and is demonstrated using video footage in the presentation. This is a new classification to document the site of airway obstruction in paediatric OSA. A micro-layryngobronchoscopy is also required in any child who has daytime noisy breathing, a previous history of cardiac malformation or Down's syndrome, in whom a more distal site of airway obstruction may be present.


*Keywords:* Stridor; Snoring; Obstructive sleep apnoea; Endoscopy; Airway obstruction; Bronchoscopy; Adenotonsillectomy; Down's Syndrome; Craniofacial abnormalities

## 1. Review

Adenotonsillectomy is the treatment of choice for normal children suffering with obstructive sleep apnoea (OSA). The results of surgery are an improvement in nocturnal

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hypoxia, daytime sleepiness and growth rate [1]. Polysomnography performed before and after adenotonsillectomy in normal children has demonstrated a universal improvement in their apnoea /hypopnoea index (AHI) and an abolition of OSA in about 90% of cases [2]. However, this means that 10% of apparently normal children continue to have OSA after adenotonsillectomy [3]. The results of adenotonsillectomy in children with Down's syndrome, cerebral palsy and craniofacial abnormalities are not so encouraging.

Polysomnography is the ''gold standard'' investigation for quantifying sleep disordered breathing. Although polysomnography is invaluable and essential in documenting the severity of sleep disordered breathing it provides no information concerning the site of upper airway obstruction.

Methods used to try and identify the site of upper airway obstruction in children with OSA include pharyngeal pressure catheters [4], cinefluoroscopy [5], computed tomography [6] and intraoperative measurements of the oropharyngeal dimensions [7]. Direct visualisation of the upper airway using a flexible fibre optic endoscope in children with obstructive awake apnoea (OAA) has proved to be very accurate in diagnosing the site of airway obstruction [8]. It has also become the first of line investigation in the management of children with stridor [9]. The disadvantage with awake flexible endoscopy is that it provides little information regarding the site of upper airway collapse that occurs when the child is asleep.

Sleep endoscopy using a flexible endoscope (sleep nasendoscopy) was first described by Croft and Pringle and is routinely used to assess the site of snoring and airway obstruction in adults [10]. Sleep nasendoscopy was first performed in children in 1991 on 15 children with documented OSA. A variation on the technique sleep nasendoscopy using a face mask has also been described and the results show that it was very accurate in determining the site of upper airway obstruction in children [11]. Unfortunately, its value in the management of children with obstructive breathing has not gained wide recognition despite its obvious benefits. The technique of sleep nasendoscopy and a new simple to use classification to document the sleep endoscopy findings is presented in this paper [10].

## 2. How I do it: sleep nasendoscopy

Sleep nasendoscopy should be performed on children using the following method. The children are anaesthetised on the operating table with full cardiopulmonary monitoring by a consultant paediatric anaesthetist via a facial mask with a mixture of halothane and oxygen. A Guedel's airway is inserted and jaw thrust provided in order to maintain a patent airway. Once the child is deeply anaesthetised but still breathing spontaneously, topical nasal decongestant is instilled into the nose. The flexible nasendoscope (Olympus ENF-P3) is introduced into the right nostril and a camera attached to enable the procedure to be recorded and to be viewed on a television monitor (Fig. 1). The nasendoscope is then advanced to the postnasal space until a satisfactory view of the velopharyngeal sphincter is obtained. At this stage the anaesthetist removes the Guedel's airway and releases the jaw thrust. This results in the child developing upper airway obstruction and oxygen desaturation. The site of airway obstruction is

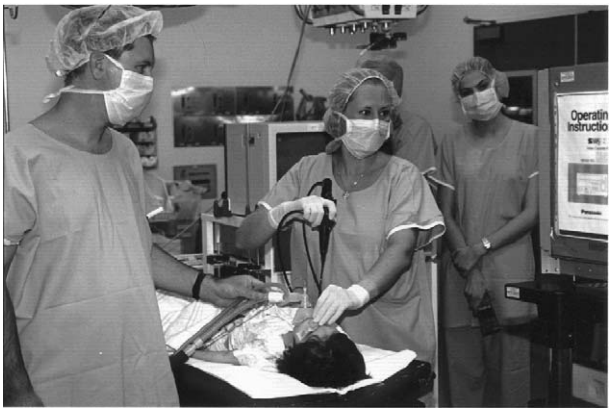

Fig. 1. A photograph of diagnostic sleep nasendoscopy being performed in theatre. The anaesthetist is providing blow over oxygen but the airway is undisturbed as the child breathes spontaneously.

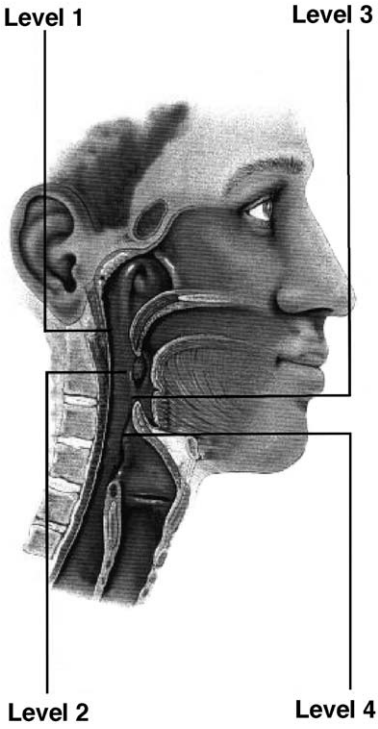


Fig. 2. A classification system for documenting the results of sleep nasendoscopy. The photographs show the endoscopic view of the obstruction at each level from 1 to 4.

readily visualised by using the nasendoscope. The sleep nasendoscopy assessment should include the effect of jaw thrust and of bagging through anaesthetic mask (CPAP) on the obstructed airway. Once the surgeon is happy that the site of upper airway obstruction had been identified, the Gadel's airway is reinserted and the airway secured. A full laryngobronchoscopy examination should then be performed using rigid Hopkins rod telescopes and a Benjamen–Lindholm laryngoscope held by suspension with a Reicker–Kleinsasser laryngoscope holder [12]. This enables sites of airway obstruction distal to the glottis to be identified.

The sites of airway obstruction found on sleep nasendoscopy can be divided anatomically into the following four levels to provide a classification system (Fig. 2):

- Level 1 or velopharyngeal/adenoidal obstruction.
- Level 2 or tonsillar/lateral pharyngeal wall obstruction.
- Level 3 or tongue base obstruction.
- Level 4 or supraglottic obstruction.

## 3. Discussion

### *3.1. Sleep nasendoscopy*

Using the technique of sleep nasendoscopy described in this paper, it is possible to ascertain the level of upper airway obstruction in children with OSA or OAA. It allows a dynamic picture of the upper airway to be obtained during all phases of respiration. The major criticism of the technique will be that anaesthetically induced sleep is not the same as natural sleep and therefore sleep nasendoscopy may give spurious results. In defence of this criticism, it has been the author's experience that in the children with OAA who underwent flexible nasendoscopy whilst awake the findings were identical to those found when the procedure was performed under general anaesthetic. This indicates that the gaseous anaesthetic (halothane and oxygen mixture) used for the sleep nasendoscopy does not significantly alter the dynamics of the upper airway when compared with the awake child in cases of severe obstructive breathing. Furthermore, correction of the airway obstruction targeted at the site of obstruction, found sleep nasendoscopy, has provided excellent success rates.

The technique and success of sleep nasendoscopy requires considerable skill and patience to achieve because of the narrow window of depth of anaesthesia needed to demonstrate the site of upper airway obstruction in the individual child. The child must be sufficiently sedated at the beginning of the procedure to tolerate the introduction of the flexible nasendoscope through the nose yet must be breathing spontaneously without central apnoeas. Inhalation anaesthesia provides us with a rapidly reversible anaesthetic during which the most appropriate time to perform the procedure can be found. Once the nasendoscope is introduced through the nose into the nasopharynx, the inhalation anaesthetic is ceased. As the anaesthesia is lightened the child starts to snore and develop signs of upper airway obstruction. It is during this stage that the site of airway obstruction can be ascertained with the nasendoscope. More severely obstructed children

developed signs of airway obstruction sooner in the procedure (whilst they are still deeply anaesthetised) compared to those children with less severe upper airway obstruction.

It is a very gradual reversal of anaesthesia that is essential for sleep nasendoscopy to be successful and explains the spurious results obtained in a recent publication on sleep nasendoscopy in adults for the investigation of snoring [13]. The oxygen desaturations achieved during sleep nasendoscopy are directly comparable to those obtained during the pre-intervention sleep studies, thus confirming the same degree of obstruction during the procedure as during natural sleep. It appears that sleep nasendoscopy, if performed in the way described in this paper, can provide the surgeon with an objective measure of both the severity of airway obstruction in the individual child and also reliably demonstrate the site of the obstruction to which treatment can be targeted.

### *3.2. Distal airway pathology: rigid laryngobronchoscopy*

In this paper, we have advocated that a formal rigid laryngobronchoscopy should be performed in the assessment of syndromic children with complex obstructive breathing. It is important to exclude the presence of pathology distal to the glottis that may be exacerbating the upper airway symptoms. Such pathology may include subglottic stenosis, tracheomalacia, innominate artery compression, bronchomalacia or vascular rings. Synchronous airway lesions have been identified in up to 27% of infants with stridor and airway obstruction diagnosed as laryngomalacia [14].

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