The Otolaryngologist’s Approach to the Down Syndrome Patient

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Down syndrome is the most common congenital chromosome anomaly, occurring 1/100 births.¹

Studies in developed countries document sizable gains in child survival, from 25 years in 1983² to an estimated life expectancy of 50–60 years today.³

- Increased life expectancy largely due to advancements in ability to repair congenital heart defects.

In past 25–30 years there has been a movement to integrate people with developmental disabilities into the community via group homes rather than institutions.
Attention has been focused on health factors that affect the quality of the patient’s life, and affect their ability to reach full potential.

A survey of parents attending a Down syndrome association conference showed that 50% of Down syndrome children saw an Otolaryngologist regularly.⁴

Bottom Line: There are more people with Down syndrome in our communities, and almost all of them will require medical care.

Many of these patients have issues with the ears, nose and throat and will need to see an Otolaryngologist.
What is the relevance?

- Down syndrome patients have several morphologic abnormalities that predispose them to problems with the ear, nose and throat.
  - midface hypoplasia with malformation of the Eustachian tube\(^5\) → increased number of ear infections and hearing loss
  - shortened palate\(^6\)
  - relative macroglossia
  - narrowing of the oropharynx and nasopharynx\(^7\)
  - generalized hypotonia → increases the frequency and severity of obstructive sleep apnea\(^8\)
  - Alterations in the paranasal sinuses
  - abnormalities of serum immunoglobulins\(^9\)
  - ciliary dyskinesia\(^{10}\) → high incidence of chronic sinusitis
It is likely that the practicing Otolaryngologist will encounter many Down syndrome children, and appropriate treatment can have a significant impact on the quality of life of these patients.

Many of the conditions of the Down syndrome child can be treated by the general otolaryngologist, or the general pediatric otolaryngologist.
Prenatal

- Absent or hypoplastic nasal bones
- First trimester:
  - Present or Not
- Second trimester:
  - nasal bone length
  - hypoplastic = shorter than 2.5 mm\(^{11}\)
Lack of Nasal Bones on Prenatal Ultrasound
Significance

- Very important to have sonographers who are formally trained to perform such evaluation.
  - Differences 16.7% reported absent nasal bones in sonographers without training or quality assurance, to 70% prevalence in studies where sonographers were appropriately trained.  

- Increases ability to detect Down syndrome
  - It has been shown that using sonographic markers of prenasal thickness, nasal bone length, and nuchal skin fold, increased the detection of Down syndrome in the second trimester by 19–23% compared to serum markers alone.  

- Isolated finding of absent nasal bones likely does NOT indicate Down syndrome
  - In one study, 6/6 100% of fetuses with the isolated finding of absent nasal bones had normal karyotypes, however. 6/8 (75%) of the patients who had absent nasal bones in addition to other abnormal ultrasound findings, did have Down syndrome.
Stenotic Ear Canals

Increased incidence of secretory otitis media
  → Chronic ear disease
  → Secondary hearing loss

Ossicular abnormalities

Inner ear dysplasia
  → Hearing loss
In early life, it has been estimated that 40–50% of newborns with Down syndrome have stenotic ear canals.\textsuperscript{15}

- Predispose the Down syndrome patient to cerumen impaction
- Further, it has been observed that patients with stenotic ear canals had a markedly increased incidence of associated middle ear effusions.\textsuperscript{16}

- Cerumen impaction combined with the stenotic canal make it difficult to adequately examine the ear, and monitor for effusion.
Recommendation: Down syndrome children should establish care with an Otolaryngologist early in life, as the patient will frequently require microscopic exams and cerumen disimpaction of the canals under microscopy.\textsuperscript{17}

It is also recommended that those with canal stenosis continue to follow up every 3 months with the Otolaryngologist for evaluation of the middle ear space, to ensure that there is no cerumen impaction, and to monitor for middle ear fluid and infection.\textsuperscript{17}
Experience reported by Cincinnati Children’s Hospital is that the majority of children with stenotic canals grow with age, and by years 2 or 3 this canal is no longer a obstacle to accurate examination.  

Each patient should be followed regularly by the Otolaryngologist until it is clear that the patient is of appropriate age and size so that s/he is at low risk of serous otitis media and can be easily examined.
There is a high prevalence of serous otitis media in Down syndrome children.\textsuperscript{19,20}

There are several etiologic factors that explain this increased incidence of ear disease.
- Decreased immunity
- Midface hypoplasia
- Eustachian tube dysfunction
  - General hypotonia
  - Cartilage abnormalities
Children with Down syndrome have an increased number of upper respiratory infections

- Reduction of both T and B lymphocyte function\textsuperscript{23, 24}
- Impaired body response to specific pathogens
- Defective neutrophil chemotaxis\textsuperscript{25}
Midface hypoplasia affects the nasopharynx and the eustachian tube openings. Bony confines of the nasopharynx are smaller in Down syndrome children.²⁶

- Normal sized soft tissue of the nasopharynx can only occupy this space at the expense of the airway.
- This decrease in post nasal space may cause even small to medium sized adenoids to give rise to Eustachian tube dysfunction.
Eustachian Tube Dysfunction

- It has also been demonstrated that the eustachian tube in these patients are extremely small, and collapsed in several portions. ²⁷
  - Cartilage cell density in Down syndrome individuals was decreased at all ages, predisposing the canal to collapse. ²⁸
  - Generalized hypotonia of these patients can lead to decreased function of the tensor veli palatini muscle of the palate, which is responsible for opening the Eustachian tube.²⁹
Hearing Loss

is more frequent in children with Down syndrome than in healthy children.
In studies which have conducted audio screening on randomly selected children with Down syndrome, results have shown that 50–90% of Down syndrome children have a hearing impairment.\(^\text{30, 31,32}\)

In one study where 90% of children were found to have at least a mild–moderate hearing loss, only a small percentage of parents (15.2%) reported a positive history of hearing loss.\(^\text{34}\)
Hearing impairment may be masked in patients with intellectual impairment, as speech delays, and lack of response to verbal cues may be attributed to mental retardation.\textsuperscript{35}

Detection of this loss is critical, as it is agreed that the detrimental effects of hearing loss on language development are believed to be greater for those children with learning disabilities compared to children without mental retardation.\textsuperscript{36}
It is recommended that all children with Down syndrome go for routine audiologic screening. AAP recs:

- Audiologic testing at birth (ABR/OAE)
- then every 6 months up to age 3 years (play audiometry–debated)
- with annual testing after 3 years of age, or when ear specific pure tone audiometry may be obtained.\textsuperscript{37,38}
The benefits of pressure equalization tubes in Down syndrome patients has been debated over the past decade.

While proven very effective in the general population to decrease the duration of middle ear effusion in the Down syndrome patient, results have been varied.

Many studies published state that they are not effective, however, one can find fault in methodology of each study.

- Mean age of $5.4^{39}$ and $8.2^{40}$ when placing first set of tubes
- Tubes not replaced after extrusion$^{39}$
**Recommendation: PE Tubes**

- Cincinnati Children’s Hospital:\(^{41}\)
  - Enrolled before the age of 2 years
  - Followed by an Otolaryngologist every 3–6 months, depending on the degree of canal stenosis present.
  - All children were treated for chronic ear infections and middle ear effusions by placement of PE tubes
  - Replacement tubes as needed.
  - At the end of the study two years later, 93% of the patients had normal hearing.

- **Recommendation:** If surgical management is results must be closely monitored, and the surgeon must be aggressive with re-intervention.
**Increased Risks**

- Otolaryngologist must counsel the parents of the patient of the possible increased risks in these patients:
  - cholesteatoma
  - persistent perforation
  - atelectatic tympanic membranes
  - persistent otorrhea

- Parents should also know:
  - PE tubes may be placed earlier in the child’s life
  - expect that the child may need multiple set of tubes throughout childhood, even into adulthood

- Parents should be counseled that reinsertion of tubes is a continuation of treatment, rather than failure of the original attempt.
- Parents should be counseled on the importance of follow up with the audiologist and the Otolaryngologist, and the need for aggressive re-intervention.
In addition to middle ear effusions, a component of conductive loss may be caused by abnormalities of the mastoid, or abnormality of the ossicular chain.

- Of 107 DS patients only 60% of CHL could be explained by middle ear effusions or tympanic membrane perforations.  

**Mastoid**

- Neuroimaging of 59 patients with Down syndrome and found nonaeration or underaeration of mastoids in the majority (74%) of cases.  
- Lateral cervical spine films study showed 63% of the mastoids examined on with sclerosis and poor aeration.  

Whether this increase in density is caused by a mastoid infection that occurred during maximum growth years, or a congenital component is yet to be determined.
Middle Ear Abnormalities

- Study of post mortem temporal bones\textsuperscript{43}
- Ossicular abnormalities attributed to chronic disease:
  - Erosion of the long process of the incus
  - Erosion manubrium of the malleus
  - Erosion superstructure of the stapes

- Interestingly, they also had some findings that were attributed to congenital deformities:
  - Malformation of the stapes
  - Dehiscence of the facial nerve.

- These findings should be considered in children who have a persistent conductive hearing loss despite maximal management of middle ear effusion.
Ear Surgery

- Down syndrome patient predisposes them to cholesteotoma and erosion of the ossicular chain. ⁴⁵

- Ossicular chain reconstruction techniques did significantly improve hearing in this population.

- Parents should be counseled that resolution of disease may require several operations.
  - Largest to date study; 64% of ears were managed with a single surgery, and 89% of ears were controlled with two surgeries or less. ⁴⁶

- Similarly, parents should also be counseled that canal wall preservation techniques may not be appropriate for this population.
  - 70%–89% of patients required a canal wall down procedure in a study of 9 patients. ⁴⁵,⁴⁶
Down syndrome children also have higher rates of mixed hearing loss and sensorineural hearing loss compared to other children, estimated to be 4–9%.47,48

Chronic middle ear disease vs. true neural loss?

The true incidence of sensorineural hearing loss in Down syndrome children will be determined as future studies evaluate hearing in children who have been aided by early and aggressive care of their middle ear disease.
Inner Ear Anomalies

Uniformly small inner ear structures compared to controls\textsuperscript{47}

- hypoplastic cochlea,
- critically smaller cochlear nerve canal
- narrowed internal auditory canal
- hypoplastic lateral semicircular canal with small bony island
- hypoplastic vestibules.
Hearing Solutions

- **BAHA:**
  - 18/81 BAHA centers in UK performing surgery on Down syndrome patients.
  - 43 patients, all but one wore the BAHA on a daily basis\(^49\).
  - Survey showed 27/28 were very pleased or pleased with the results\(^50\).
  - Glasgow Children’s Benefit Inventory (emotion, physical health, learning and vitality) showed a significant benefit in all categories in Down syndrome children.
  - Higher rate of complications 20–50%, all soft tissue problems.
    - attributed to the fact that patients with learning difficulties have a tendency to interfere with the area, leading to disturbances of the dressing, sutures and possible graft failure.
    - A solution to this was proposed, where following BAHA abutment a perforated thermoplastic cage is sewn over the surgical
Cochlear Implants

Four patients with Down syndrome had received cochlear implants in the UK and Ireland. All congenital deafness. All four of the patients had middle ear disease preoperatively, with two patients requiring PE tubes. None of the cases had any complications associated with otitis media. None had intraoperative difficulties due to anatomy.

The outcomes of these four implanted patients have been modest gains in auditory performance. The eldest child, who has had the implant the longest, showing the most improvement.

As more patients with Down syndrome become candidates for cochlear implants, patients and families must be counseled about expectations. Abnormalities in the temporal bone of a child with Down syndrome that may increase the risk of complications. Outcomes may not be as good as children without additional disabilities, as learning and communication difficulties may prolong the rehabilitation.
Sound field amplification – Pilot Study
- Participant’s speech perception significantly improved when the FM sound field amplification was being used.
- The sound field amplifier is recommended over a traditional hearing aid in this population, as the sound field amplifier selectively amplifies the teacher’s voice, which improves the signal-to-noise ratio.
Obstructive Sleep Apnea and Sleep Disordered Breathing

- Obstructive sleep apnea syndrome (OSAS)
  - 0.7% to 2.0% of the general pediatric population\textsuperscript{53,54}
  - prevalence in pediatric Down syndrome patients has been estimated at 77–80\textsuperscript{55,56}

- Children with Down syndrome have many predisposing factors of OSAS.\textsuperscript{55,56,57}
  - midfacial and mandibular hypoplasia
  - Relative macroglossia
  - Glossoptosis (downward displacement or retraction of tongue)
  - abnormally small upper airway with superficially positioned tonsils and relative tonsillar and adenoidal encroachment
  - increased secretions
  - increased incidence of lower respiratory tract anomalies
  - obesity
  - generalized hypotonia
    - \(\rightarrow\) resultant collapse of the airway during inspiration.
Midface and Mandibular Hypoplasia

Relative macroglossia
In Down syndrome patients with relatively narrowed nasal airway, even normal adenoid growth can encroach the airway.
The effect of obesity on OSAS in DS patients is debated.

- 2 studies looked at BMI and OSAS
  1) The BMI z-score, was higher in the OSA group (2.9) compared to the non OSA group (1.4). However, there were some children with very high BMI z scores* who did not have OSA and some non obese children with severe sleep apnea.
  2) Another study where 91% of patients were not obese, yet 97% had OSA.

- Based on these results, OSAS is likely a multi-factorial disease with several contributing factors in these patients.
- Still, BMI is a modifiable risk factor, and the results of the above studies suggest that weight reduction may show some benefit in the management of OSA in Down syndrome children.

*The BMI z-score, also called BMI standard deviation score, are measures of relative weight adjusted for child age and sex
Children with OSAS have:

- a worsened trend in word reading speed\textsuperscript{62}
- visual attention
- verbal fluency
- neurodevelopmental problems
  - daytime somnolence
  - behavioral disturbances
  - school failure
  - developmental delay.
- pulmonary hypertension\textsuperscript{61}
- cor pulmonale
- congestive heart failure\textsuperscript{63}
  - Chronic
  - intermittent hypoxemia
  - respiratory acidosis
  - Although we know of no published studies specifically examining these effects of neurodevelopment and learning on children with Down syndrome, it is logical to expect that this population, who is already predisposed to learning delay and difficulty in school, would be significantly impaired by the effects of sleep apnea. Similarly, children with Down syndrome are predisposed to congenital cardiac anomalies, and are more likely to have pulmonary hypertension than are non syndromic children with the same cardiac anomalies. Again, this may be exacerbated or worsened by OSAS.
How do we know a Down Syndrome child has sleep apnea?

- He needs a sleep study!
Because of the unreliability of parental reporting, the high prevalence of OSAS in this population, and the negative effects of sleep apnea, it is recommended that all children with Down syndrome between the ages of 3 and 4 years, go for objective testing using full overnight polysomnography for a baseline study.\(^5\)

- 24/35 (69%) parents reported no sleep problems → 13/24 (54%) of these did indeed have obstructive sleep apnea on PSG.\(^5\)

- 18/30 (60%) of the children with negative histories also had abnormal polysomnography
New Recommendation:

Before entertaining tonsil and adenoid surgery in the Down syndrome population, it is now recommended that a pre-operative polysomnography is obtained.\textsuperscript{59}
Of those 16 patients, all 16 (100%) had abnormal overnight polysomnograms, but the nap study was less sensitive in detecting OSAS, with only 12 (75%) of these patients having abnormal nap studies.

The degrees of hypoventilation and desaturations were significantly higher in the overnight studies, and thus the nap studies under estimated abnormalities.58
Tonsillectomy and Adenoidectomy

- Decreased efficacy in curing sleep apnea in Down syndrome patients
  - 30–50% still require CPAP, further surgery, or tracheostomy at a later date.63

- When Down syndrome patients and age and BMI matched controls compared64
  - In the Down syndrome group, the AHI showed improvement after surgery, but was not as significant as the improvement in the control group.
  - The REM–AHI and lowest SaO2 did not show significant change in the Down syndrome children
May still be recommended if the parents are given appropriate information about expectations and can give informed consent.
  ◦ parental expectations is not for complete cure, but for improvement in symptoms.
  ◦ may decrease the need for CPAP or oxygen, lower the setting.
  ◦ It is known that CPAP compliance is low in normal adults$^{65}$, and it is even more difficult for children with a developmental disability, who do not understand the disease or the treatment, to be fully compliant.

Therefore, a likelihood of reducing dependence on CPAP, and/or a 25–50% chance of being weaned completely from a nighttime breathing apparatus, may make the surgery a good option for many Down syndrome patients.
Increased Risks

- Increased incidence of VPI and hyper nasal speech
  - 1:2000–1:3000 rate of complication seen in the general population
  - One survey found 2/74 Down syndrome patients developed transient velopharyngeal insufficiency, and 2/74 other patients hypernasal speech
  - were found to have both structural and functional causes of hypernasality
  - Structural: high arched, and short soft palate
  - Functional: hypotonia, slowed motor learning, and oral-motor developmental delay

- Increased post operative complications in Down syndrome children compared to controls
  - including increased hospital stay
  - fivefold increase in respiratory complications requiring intervention
  - increased duration until adequate PO intake

- Recommendation: It is therefore recommended that all Down syndrome patients be admitted to the hospital after adenotonsillectomy for observation.
No evidence to support more aggressive surgery initially

- Down syndrome patients who underwent T&A plus lateral pharyngoplasty as initial therapy for OSAS.
  - They found no significant difference between the groups
  - 48% in the T&A only group to have persistently abnormal AHI post operatively
  - 63% in the T&A plus lateral pharyngoplasty group to have abnormal AHI after surgery.\textsuperscript{71}
Some good evidence for genioglossus advancement for OSA refractory to T&A⁷²
Cine MRI was originally used by neurosurgeons to evaluate CSF flow in real time.

Placed supine on the table, sleep is induced by sleep deprivation, spontaneous sleep or sedation, most accurate when snoring.

The cine MRI obtains multiple sagittal and axial images in real time, creating a dynamic, three dimensional video of the airway collapse.

This view can appreciate multiple levels of collapse, and it has also been noted that adenoid enlargement and nasopharyngeal obstruction are more prominent on cine MRI.
Sinusitis and Rhinitis

- One study of Down syndrome patients found that 17.6% of Down syndrome children were reported to have a continual runny nose.\textsuperscript{39}

The narrowing of their nasopharynx adenoid tissue to obstruct the airway

Several studies have shown abnormalities in the immunoglobulin (Ig) levels in Down syndrome\textsuperscript{23}
Sinusitis and Rhinitis

- Treatment similar to the general population (hope you were listening to Dr. Rose)
  - nasal irrigation
  - nasal steroids
  - Antihistamines
  - decongestants
  - antibiotics as needed

- In patients whose sinusitis and rhinitis are not aided by medical management surgical intervention may be warranted.

- Flexible nasopharyngoscopy should be preformed to look for adenoid hypertrophy, which may be obstructing the choanae. This should be done even if the patient has already had an adenoidectomy, as regrowth of adenoid tissue is more common in the Down syndrome patient compared to the general population.84
Rapid Maxillary Expansion

- Orthodontic procedure used to correct a narrow transverse maxillary diameter.
- The two maxillary bones are separated at the mid-palatal structure using an intraoral screw mechanism. This leads to a widening of the perimeter of the arch.
- Although the major effect is noticed clinically in the area of dentition, the transverse enlargement of the apical bone also affects nasal width.
Usually, these changes result in altered nasal airway flow, with consequently improved nasal ventilation.

In this study 13 patients with Down syndrome used the intraoral maxillary expansion device and 10 patients with Down syndrome did not.

The results showed a significant increase in the total nasal volume, which persisted five months after removal of the device.

The study further reported a significantly improved incidence of acute otitis media, Adenoiditis and tonsillitis, Snoring, mouth breathing, Restlessness, word articulation, tongue protrusion, and facial aesthetics.
Airway Anomalies

- **Laryngomalacia**
  - Down syndrome patients have generalized hypotonia, leading to flaccidity of the supraglottis, anatomical changes in the epiglottis, arytenoids, and aryepiglottic folds and a high prevalence of GERD.\(^{75}\)

- **Multiple sites of obstruction were seen in 38% of cases.**\(^{76}\)
  - Tracheomalacia was found in 23/39 (59%), laryngomalacia in 28%
  - macroglossia (26%)
  - subglottic stenosis (23%)
  - congenital tracheal stenosis (5%)
It is important that these cases be managed by a tertiary care center that is familiar with treating the Down syndrome patient and is practiced at comprehensive airway evaluations and a systemic approach to surgery in the Down syndrome child.

Even at centers with high volume of Down syndrome patients, parents should be counseled pre-operatively about the possibility of residual symptoms in children with severe obstruction.
Subglottic Stenosis

- Believed to be more prevalent in the Down syndrome population
  - 4% of LTRs were DS vs 0.1%–0.15% prevalence\textsuperscript{78}
- Congenital narrowing of the subglottis as well acquired deformities.
- Same risk factor for SGS: \textit{trauma to the subglottis}\textsuperscript{79}
  - DS child has a higher rate of major surgery (i.e. cardiac anomalies) (and intubation)
  - Severe respiratory infections requiring intubation
  - Usually occurs at a young age, which predisposes them to subglottic injury and subsequently, subglottic stenosis.
A key factor in preventing subglottic injury, is choosing an appropriate sized endotracheal tube, as age-appropriate endotracheal tubes are too large for the Down syndrome patient. 80,81

- A prospective study evaluated 74 children, 42 with Down syndrome, 32 healthy controls, none of whom had wheezing, stridor, or previous intubation before surgery.
- The Down syndrome children required an ETT 2–3 sizes smaller than age matched controls.
- Further, MRI showed that tracheal diameter was smaller in Down syndrome compared to controls, demonstrating that the overall smaller airway size is not limited to the subglottis, but includes a smaller trachea.

**Recommendation:** The recommendations based on this prospective study are that endotracheal tubes at least two sizes smaller should be initially used for intubation in children with Down syndrome.98 To ensure proper sized tube placement, it is critical to confirm the fit of the tube after it is placed by checking for an audible air leak at an inspiratory pressure between 10–30 cm H₂O.81
Although AAI is one of the most well known and feared problems associated with Down syndrome, reports of complications associated with AAI are few, and current guidelines and recommendations of airway management and positioning during surgery for the patients are vague.

- Incidence of AAI seen on radiography is 14–20% \(^{82, 83}\)
- Incidence of symptomatic AAI is much less with only a few case reports throughout the literature.
  - 404 patients with Down syndrome that found 14.6% to have radiographic evidence of AAI, only 1.5% of the patients had symptoms. \(^{83}\)
Atlanto axial instability, also called atlantoaxial subluxation, is the result of increased mobility at the articulation of the first and second cervical vertebrae. A review reports that craniocervical instability, most commonly atlantoaxial instability is the result of generalized ligamentous laxity, involving any of the three ligaments of the C1C2 joint.
The radiographic definition of AAI is made by measuring the distance between the anterior surface of the dens to the posterior surface of the tubercle of C1. An anterior atlantodental interval of greater than 4.5 indicates abnormal instability.

Asymptomatic AAI is that which is diagnosed by radiography, but the patient has no neurologic symptoms.

The patient who is symptomatic may experience easy fatiguability, abnormal gait and difficulty walking, neck pain, limited neck mobility, torticollis, clumsiness, lack of coordination, sensory deficits, spasticity, hyperreflexia, clonus, incontinence, and extensor-plantar reflex.
The issue of atlanto axial instability came into wide recognition after the Special Olympics introduced a requirement in 1983 that all individuals with Down syndrome have a lateral neck radiograph before participating, and that those with evidence of instability be banned from certain activities. This was further supported by a statement by the American Academy of Pediatrics in 1984. 84

Radiographs of the neck to be unreliable at identifying atlantoaxial subluxation.

A review of case reports of individuals who have experienced catastrophic injury to the spinal cord by the AAP determined that trauma rarely causes the initial symptoms or progression of symptoms, and that nearly all the individuals who have experienced catastrophic injury to the spinal cord have had weeks to years of preceding, less severe, neurologic abnormalities. 83–88
In a 1995 statement, the AAP retired their previous statement, and revised their recommendations to state that evaluation and physical exam by a physician who has cared for the patient longitudinally, is a greater priority than obtaining radiographs when determining a Down syndrome patient’s eligibility for participation in sports.

It is now recommended that the pediatrician perform a careful history and physical examination with attention to myelopathic signs and symptoms at every well-child visit, or when symptoms possibly attributable to spinal cord impingement are reported.³⁸
Because the poor ability of radiographs to detect clinical neurological compromise, it is imperative that every patient have a thorough neurologic exam preoperatively, preferably by a physician who knows the patient well.

While gentle rotation of the head for ear surgery is likely safe, it is still recommended that the patient’s head be supported throughout the procedure, and that extremes of neck positioning be avoided.

When performing tonsillectomy, the patient should remain in a relatively neutral position.
Conclusion

- **Ear**
  - Routine exam by audiologist and Otolaryngologist
  - Aggressive intervention and re-intervention for OME

- **Throat**
  - All DS patients should get sleep study around age 3
  - T&A still first line for OSA

- **Airway**
  - Use ETT 2 sizes smaller, check for air leak

- **Spine**
  - All patients should have pre-op neurologic exam
  - Support the head at all time
Although these children have disease that is more complex and difficult to treat than the non-syndromic pediatric patient, the general Otolaryngologist can have a profound impact on the Down syndrome patient.

Proper management of ear, nose, and throat disorders by the Otolaryngologist can support the Down syndrome child’s physical, emotional, and educational development.
Works Cited


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