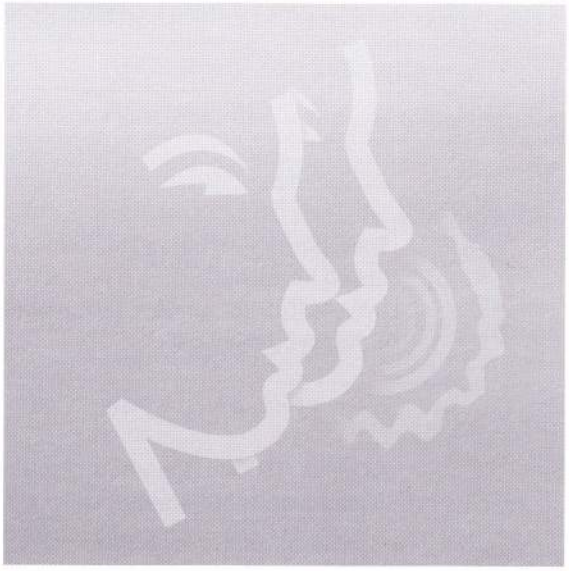
Working with

Children's Voice Disorders



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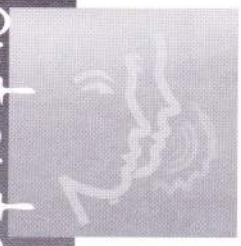
Contents



Tables and Figures

TABLES

FIGURES

Acknowledgements

We would like to acknowledge and thank our colleagues, whose enthusiasm for our initial articles and subsequent workshops on paediatric voice, persuaded us to 'have a go'. We are particularly grateful to Anne Somerville for showing Stephanie Martin our original Resource Pack; to Richard Todd for his patience and skill when all seemed lost (on the disc), and to John Pickles, Consultant Otolaryngologist, for his continuing support and referrals!

In addition, our heartfelt thanks goes to our families for their patience and support through every chapter, writer's block and crisis, real or imagined.

Foreword

At last, we have a basic yet comprehensive and user-friendly text that successfully combines the theory and practice of working with paediatric dysphonia. The authors share a wealth of ideas with us, and their approach makes the book recommended reading for any speech & language therapist working with dysphonia. I believe it will become a core text for students and clinicians, whether they are generalists or specialists in this field.

Hunt and Slater provide clear departmental standards of care; model case histories and clinical evaluation forms, and a voice care leaflet. I have found that many therapists do not gain much experience in working with dysphonic children, either because such children fail to get referred, or because they are treated in specialist centres. Having examples of the paperwork, which is so crucial these days, will save many readers the effort of 'reinventing the wheel'.

The authors raise key issues such as the appropriateness and timing of interventions, and do not allow the reader to fall into the trap of believing that dysphonia can only be due to vocal abuse. In fact, hoarseness can be a result of normal development.

This is an important book because the authors have addressed a significant gap in the market. I believe that therapists will be reassured and reinvigorated by using it; every department should have a copy.

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Introduction

Working with Children's Voice Disorders has been written for speech & language therapists working with children in schools or community clinics, who have no specialist knowledge of voice. It is intended for clinicians who have limited numbers of this client group on their caseload, but who are committed to providing effective therapy to these children. It is also suitable for Speech and Language Therapy students.

The book begins with an overview of the development of the infant and juvenile larynges, highlighting the differences between the immature and mature structures, and the concomitant changes in voice. In designing an appropriate and realistic treatment programme, it is essential to take into account the nature of the voice problem. Therefore, the authors' next focus is on the contributory and maintaining factors of voice problems, setting the dysphonia into context. The authors guide the inexperienced therapist through taking a case history, and the assessment and evaluation of the child's voice, before discussing the principles of management with this potentially challenging client group.

The authors draw on over 10 years experience with children's voice disorders to give practical advice on therapy; the aims of intervention, and how best to achieve them. The later chapters contain practical ideas, therapy exercises, and forms for setting up groups, together with case studies and suggestions on how to evaluate therapy and measure outcomes.

The ideas suggested in this book work equally well in individual or group therapy settings, and it is hoped that they will give therapists the confidence and skills to take on children with voice disorders. This book is, in part, the authors' response to the pleas of colleagues over the years, such as 'I am seeing a six-year-old child with vocal nodules, HELP!'

Chapter 1: Laryngeal and Voice Development in Children

INTRODUCTION

The purpose of this chapter is to give a brief overview of the gross anatomical changes that occur within the larynx from infancy through to puberty, and the concomitant changes in voice. In order to appreciate the range of problems and contributory factors encountered when working with dysphonic children, it is essential to understand that the child's larynx is not a miniature version of the adult larynx. It is not the intention of the authors to go into detail on the function of the normal adult larynx, as this is well documented in other sources (Hirano *et al*, 1983; Mathieson, 2001; Martin & Lockhart, 2000). The focus in this chapter is on the processes of maturation, and how these are evident in the production of the young voice.

ANATOMICAL AND PHYSIOLOGICAL DEVELOPMENT: BIRTH TO PUBERTY

The Infant Larynx

The maturing of the structure of the vocal folds and the growth of the larynx are lengthy processes. As stated above, the child's larynx is not simply a miniature version of an adult larynx, but is an immature structure that is constantly changing.

The infant larynx differs from the adult's in terms of its position within the vocal tract, as well as in its size and shape, and structural maturity of its tissues. In the newborn, the larynx is situated high in the neck, and the pharyngeal cavity is short and lies horizontally, offering little resistance to airflow. This, together with the ability of the epiglottis to make contact with the soft palate, enables the infant to breathe while it feeds. The infant's airway is 'funnel-shaped', in contrast to the more 'tubular' shape of the adult's. This is the result of the growth of the cricoid cartilage, which widens the subglottic area (Figure 1).

No significant differences exist between male and female larynges in infancy, resulting in voices that are similar in both sexes. However, variance in size and weight of infants does influence laryngeal size. For example, pre-term babies may have considerably smaller larynges than full-term babies.

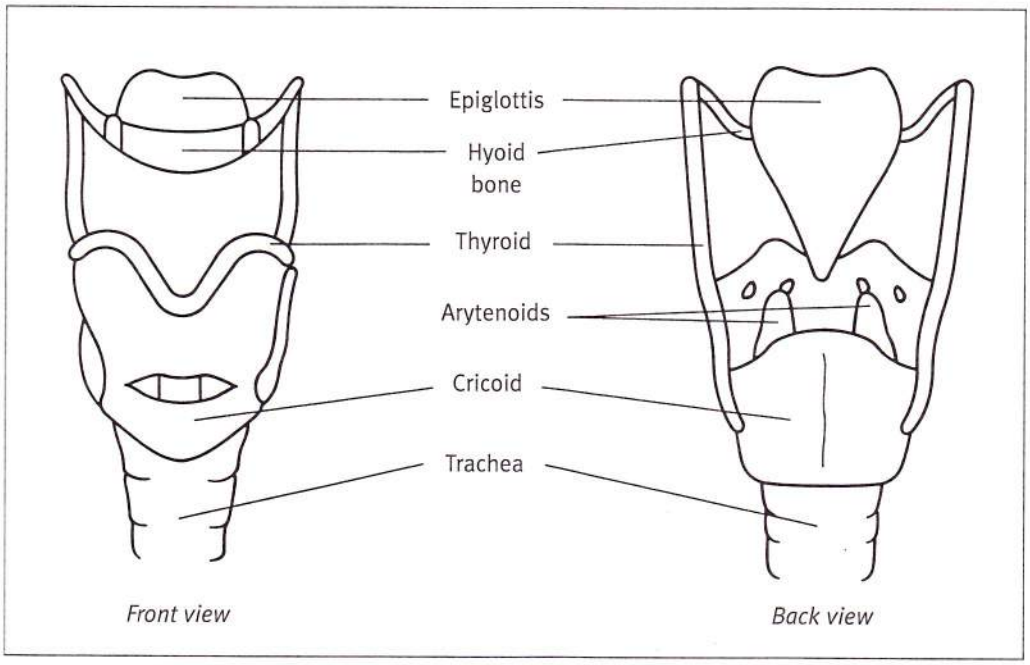
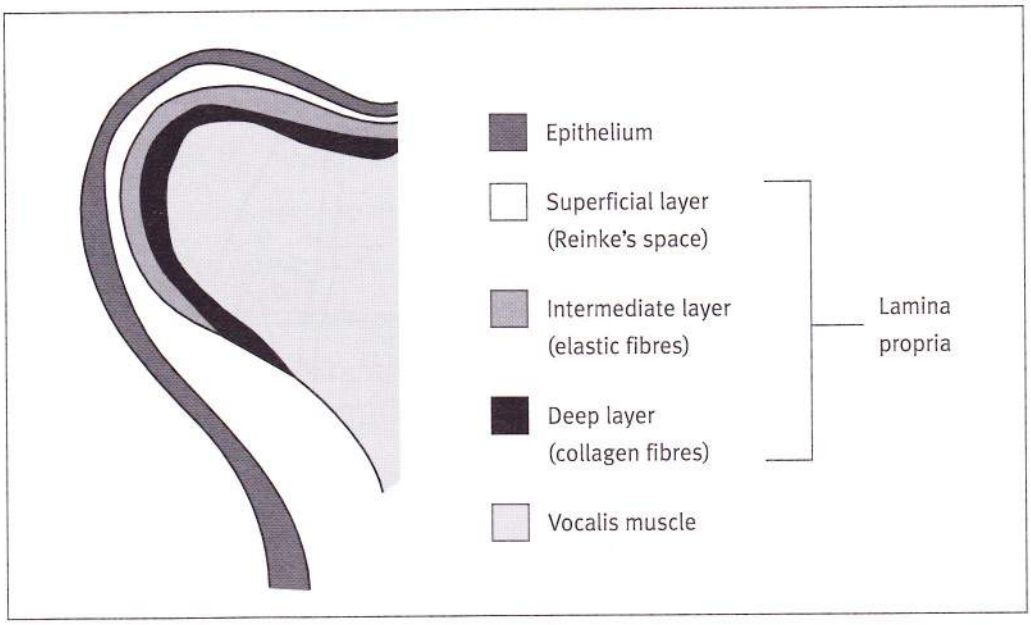


Figure 1
Cartilages of the Larynx

There are various differences between the infant and adult larynx:

- In infancy, the laryngeal cartilages are both soft and pliable, with large amounts of loose and highly vascular connective tissue. Thus the infant larynx is more vulnerable than that of an adult and can easily become oedematous following direct trauma, such as that following intubation.
- The infant thyroid cartilage is broader and shorter than the mature cartilage, and this influences the shape of the larynx, making it more rounded than in later life.
- The infant larynx is also more compact, with the cartilages assuming a large proportion of the structure of the larynx (in particular the arytenoid cartilages). As a result, the vocal folds are relatively short, producing a higher fundamental frequency than the adult larynx. This is discussed in the second part of this chapter.
- The infant vocal folds are morphologically immature. Hirano *et al* (1983) found that the infant vocal folds not only lack mass, but also the physical properties of the mature and sophisticated five-layered vibratory structure evident in adulthood. Until this structure has fully developed, the immature vocal folds are likely to be more vulnerable to vocal abuse (Figure 2).

Figure 2
Five-layered Structure



Little is known about the neurological maturity of the infant larynx, but it has been suggested that this may not be fully developed until three years of age (Von Leden, 1985). Unfortunately, there is also little recent information on the intrinsic muscles of the infant larynx. However, a study by Kahane and Kahn (1984) found that the adductors (lateral cricoarytenoid; thyroarytenoid, and interarytenoid muscles) represented the bulk of the intrinsic muscle mass (Figure 3). It is speculated that functionally this relates to the muscles required to build up the intrathoracic and

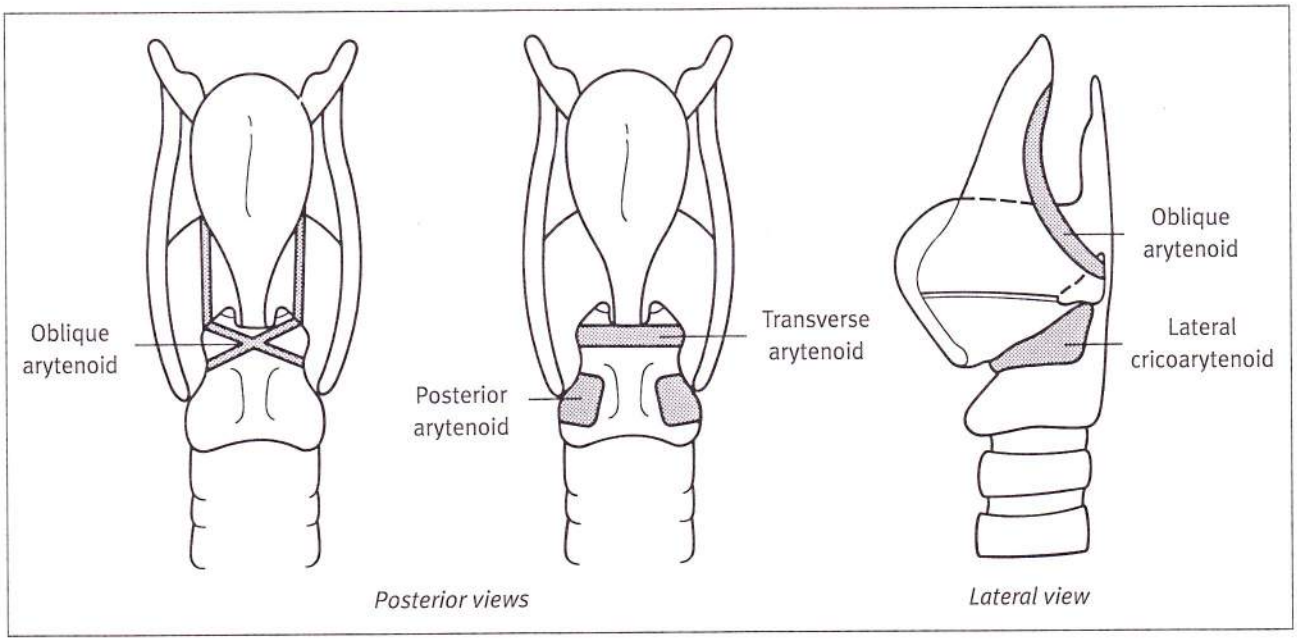


Figure 3 Cross-sections of the Larynx Showing Intrinsic Muscles

intra-abdominal pressures necessary for the development of upper body strength, erect posture, walking, and the elimination of body waste. The cricothyroid muscle is the most massive muscle in the infant larynx, which may be attributable to adjustments needed during infant reflexive vocalisations and vocal play.

The Child Larynx

During childhood the position of the larynx changes. By the age of two years, it has descended from about C3–C4 to about C5. By five years, it has descended to C6. As a result, the pharynx increases in length, and by the age of five years it is no longer possible for the epiglottis to make contact with the soft palate. The shape of the vocal tract becomes more angulated and mature, and by the age of nine years its shape is comparable with that of an adult's, although it is obviously smaller in size.

The growth of the larynx and pharynx are correlated with growth in body height, and in childhood they remain the same for both sexes. Cartilages increase in size and firmness, and vocal folds increase in length. At four years old, the vocal folds – in particular the lamina propria – are poorly developed (Hirano, 1981; 1983). Although the fibrous connective tissues increase in density and structural complexity, these structures do not actually become 'mature' until after puberty. Boys' vocal folds grow at a greater rate than girls', being some 8 per cent larger by the age of nine years.

The Adolescent Larynx

As puberty approaches, the larynx begins to transform quite rapidly, and there is a sudden increase in the rate of growth. The larynx continues to descend in the neck, and by the end of puberty has reached its adult position at about C6–C7. It is during puberty that significant differences begin to emerge between the sexes.

By puberty, the male laryngeal cartilages are significantly larger and heavier than their female counterparts. The thyroid prominence is clearly more pronounced in males than females, and is typically referred to as the 'Adam's Apple'. Maddern *et al* (1991) believe this prominence is due to the change in angle of the thyroid cartilage, but this is disputed by Mathieson (2001).

Although growth of the larynx is associated with puberty in both males and females, antero-posterior growth in the male far exceeds that of the female. From pre-puberty to puberty, the male vocal folds undergo nearly twice as much growth as those of the female. The maturation of the lamina propria and vocal ligament continues in adolescence, and is not completed until after puberty. The change in the structural complexity of the vocal fold mucosa is a significant factor in voice change at puberty, as is the length of the vocal folds.

This maturation may be complete at about the age of 14 years in boys, but in girls it continues on average until about the age of 15–16 years. Pubertal growth of the larynx and of body height are closely related, and are obviously influenced by similar hormonal mechanisms.

The maturational changes that occur before and during puberty – that is, changes in length, width, thickness and biomechanical properties – result in significant changes in the adolescent voice, in particular the male voice. These will be discussed in more detail in the latter part of this chapter.

CHANGES IN VOCAL PARAMETERS AND NORM

When working with paediatric dysphonia, the clinician needs to remain aware of the maturation processes as well as the speed and constant nature of the changes.

The newborn infant arrives in the world with some innate skills, and the potential for developing an enormous range of further skills. One of the innate skills is the ability to respond positively to the human voice, most strongly its mother's.

Among the infant's host of potential skills lies the ability to communicate. It is the need to communicate that initiates the development of this defining human function. Throughout the development of communication, there is an intricate relationship between biological maturation processes, both physiological and neurological, and development prompted by acquisition of new knowledge and skills. Recent research (MacLarnon & Hewitt, 1999) suggests that modern humans and Neanderthals possess a larger thoracic vertebral canal than earlier hominids. This suggests a more highly developed channel, allowing innervation of the intercostal and abdominal muscles used to modify respiration during speech. This

is one example of the evolutionary changes that have gone hand in hand with the development of speech in humans.

Respiratory Changes

The necessity for breathing exercises in adult voice work has been debated, and controversy exists over the role of breathing in voice therapy (Harris *et al*, 2000). Whichever school of thought the therapist follows, it is essential to remember that breathing is the power behind the production of voice. In children, the clinician should be aware that the development of phonic respiration begins at birth with the first cry. The crying baby is not automatically at risk of becoming dysphonic – on the contrary, crying is the first step towards the co-ordination of breathing with speech production.

During normal (vegetative) respiration, the length of inspiration equals that of expiration. The infant's first vocalisations at birth are the beginnings of later voluntary control of vegetative respiration. This ability to change the ratio of length of inspiration to length of expiration is essential for speech. It is this type of respiration that is known as phonic respiration. It has been postulated (Hunt & Slater, 1996) that the use of a dummy or pacifier in infancy that inhibits crying, may therefore restrict the development of phonic respiration.

Another factor affecting the development and refinement of phonic respiration is the change in volume of the rib cage, with a corresponding increase in lung size, during the second and third years of life (Boliek *et al*, 1997). Exercise increases the efficiency of the lungs, and is therefore also relevant to the development of phonic respiration. Much concern is currently centred on the increasingly sedentary lifestyle of children, and the implications this has for general fitness levels, as well as the risks of future heart disease. There are also implications for the development of efficient respiration, as a lack of exercise will reduce the development of the child's vital lung capacity. An adolescent's lung volume should be around four times that of a five-year-old (Mathieson, 2001). However, sedentary visual entertainment such as videos and playstations, and safety considerations due to such factors as increased road traffic and child abductions, have reduced traditional outdoor activities and physical exercise (Cotes, 1979) to the degree that the normal increase in lung volume may be impacted.

Vegetative Sounds

Crying is not the only sound produced by an infant: there are also burps, coughs and 'coos', which produce a response from the mother and other involved adults. These vegetative sounds reward the infant with a vocal response from the adult. The reinforcement of cooing usually takes the form of the adult imitating the infant's vocalisations. This process continues the development of phonic respiration. It is the precursor to the emergence of babble, because the interaction is so pleasurable for the baby that it continues to experiment with sounds.

Pre-verbal Communication

It is generally accepted that a mother knows the meaning of each of her baby's different cries. Research does not support this view (Mathieson 2001). It is also popularly believed that a mother can identify her own baby by its cry. Even before the individuality of the voice has been established, vocalisations are distinct in each infant. Pre-linguistic tonal development can occur from the age of two weeks (Mathieson, 2001). From this point an infant can produce melody, beginning with upward glides, and followed by rising and falling glides. By the time the infant is beginning to babble, at around three months, the wide range of frequencies in the babble increases the attractiveness of the sounds to adults, which in turn promotes positive reinforcement for the infant. The skill of using longer and more varied sound sequences has to be supported by a complementary skill in phonic respiration.

In these early months the infant has no ability to filter the sounds it hears, so all environmental sounds carry equal importance. The modern world is a noisy place to live in, and within the home there is often background noise such as TV, radio, or music, which means that the infant rarely experiences complete quiet. Any vocal input takes place against this level of background noise. The effects of this on language development are well documented (Ward & Birkett, 1992). Adult reinforcement of vegetative sounds, changes in frequency and babble will be 'lost' to the infant in the background noise. This will reduce the infant's output, and have a corresponding impact on the development of phonic respiration, language and speech skills.

Vocal Range

In the process of establishing a child's pitch, the fundamental frequency decreases until about the age of five years. For the first 141 days of life, a baby's cry has a fundamental frequency of 443 Hz for a boy and 414 Hz for a girl (Shephard & Lane, 1968). By the age of five years, the fundamental frequency for both sexes is around 254 Hz (White, 1995). Once established, the range of the voice is constant at about two and a half octaves for both boys and girls, and will remain so until the age of around 16 years. The singing range for boys and girls prior to puberty varies very little, and covers the middle octave.

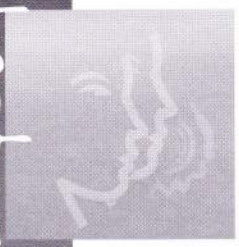
Pitch at Puberty

The pubertal voice, with its accompanying pitch changes in adolescent boys, occurs as the larynx undergoes a period of rapid growth. The effect on the pitch of the young male's voice is a drop of around an octave. The rapidity of growth causes temporary losses of co-ordination of the muscles in the larynx, which are realised as the characteristic pitch breaks of the 'breaking' voice. The adolescent female also experiences changes in pitch associated with the growth of the larynx. However, these changes are not as extensive in girls as in boys, and they take place over a longer period of time. Therefore the 'breaking' voice is usually not as evident in girls, because control over co-ordination of the laryngeal muscles can be more easily maintained. The laryngeal changes are completed by the age of 15–16 years, whereas body growth continues for several more years.

SUMMARY

As stated at the beginning of this chapter, the immature larynx is a structure in a state of constant change. However, the structural and functional changes of the larynx cannot be viewed in isolation when working with the dysphonic child. It is important that these changes are set in context with the concurrent development of language and speech-production skills.

Chapter 2: The Origins of Paediatric Dysphonia



INTRODUCTION

In this chapter the complexity of dysphonia in children begins to emerge. There is a brief overview of the more common laryngeal disorders in children, and the likely involvement of a community speech & language therapist. The organic causes of dysphonia are usually a fairly small part of the overall picture. The majority of this chapter, therefore, is devoted to the wide array of other causal and maintaining factors. These factors may be divided into the following categories:

- Physical and developmental
- Medical
- Psychological and behavioural
- Cultural and environmental.

COMMON LARYNGEAL DISORDERS

Maddern *et al* (1991) describe laryngeal disorders under two categories – anatomical and neurological – and list 24 anatomical causes alone, which are further divided into three sub-groups: nose, oral cavity, pharynx; larynx; and tracheobronchial (Figure 4). It is true that there is a wide range of conditions that impact on voice. However, for the practising clinician, the more complex disorders are rare, and often bring with them a range of medical problems whose resolution is of greater importance for the child and family than any voice problem.

The authors believe that the clinician's skills are best focused where they can achieve maximum benefit to the child, and where the overriding clinical need is the resolution of a voice disorder. This usually encompasses the children presenting with vocal pathology such as nodules, laryngeal webs, polyps, or papilloma.

Incidence of Common Laryngeal Disorders

There is a paucity of recent research regarding the incidence of common laryngeal disorders in children. Miller and Madison (1984) found that 40 per cent of 249 children attending a voice clinic had vocal nodules, and of these 94 per cent were bilateral. Cornut and Troillet-Cornut (1995) support this, and found that 68 per cent of children identified as being dysphonic had nodular lesions. The remainder had

1 *Nose, Oral Cavity, Pharynx*
- Choanal atresia
- Micrognathia
- Pierre Robin syndrome
- Cleft Lip/Palate
- Tonsil and adenoid hypertrophy
- Macroglossia
- Ankyloglossia

2 *Larynx*
- Supraglottic
  - Laryngomalacia
  - Vallecular cyst
- Glottic
  - Atresia, stenosis, cleft
  - Laryngeal web
  - Nodules, polyps, papilloma
- Subglottic
  - Stenosis (acquired or congenital)
  - Hemangioma

3 *Tracheobronchial*
- Stenosis (acquired or congenital)
- Tracheomalacia
- Extrinsic
  - Congenital vascular anomaly
  - Aberrant subclavian artery
  - Aberrant innominate artery
  - Vascular ring
  - Mediastinal adenopathy/tumour
  - Congenital goitre
- Intrinsic
  - Foreign
  - Granuloma

Figure 4
Anatomic Difficulties Associated with Paediatric Dysphonia

polyps, cysts or webs, and only 1.42 per cent had normal vocal cords. Pannbacker (1999) reported that the frequency of occurrence for vocal nodules in clinics is between 15 and 35 per cent, and Stone (1982) found them to exist more frequently in children than in adults.

The authors have run paediatric voice groups since 1991, and these have been attended mainly by children diagnosed as having vocal nodules. The development of assessment and diagnostic tools, such as videostroboscopy, in Joint Voice Clinics, has resulted in more accurate diagnoses. This means therapy can be

targeted at children whose dysphonia can be remediated by therapy alone. The importance of an adequate diagnosis is discussed further in Chapter 3.

The high incidence of nodules has led some authors to question the validity of treatment. This debate will be examined in more detail in Chapter 4. Sander (1989) asked that clinicians be circumspect in treating childhood dysphonias, because he believed that the continual process of growth and maturation resulted in naturally occurring dysphonia. He further suggested that aurally skilled clinicians detect 'problems' that are within the normal range of vocal behaviours. Nonetheless, it is difficult to ignore the dysphonic child, especially one with vocal nodules, and hard to believe that a reliably functioning and good quality voice does not improve the child's ability to function as a social individual. The high incidence of nodules in itself should not suggest a state of 'normality', particularly when physiological changes have taken place.

As with all speech and language problems, the question of gender is also relevant. Miller and Madison (1984) found that out of 241 children having vocal nodules, thickened cords, oedematous cords and other pathologies, 162 were boys: that is, there were twice as many boys as girls.

This is reflected by the authors' experience, and is illustrated in Figure 5.

Research and the authors' experience clearly indicate that boys are more at risk of developing dysphonia than girls. This trend is reflected throughout the spectrum of communication problems, not just with voice. Although recent research seems to suggest a genetic link to speech and language problems, there is no hard evidence to support a similar link in the development of childhood dysphonia.

THE INVOLVEMENT OF OTHER COMMUNICATION PROBLEMS

It has already been stated that voice problems may co-exist with other problems that come within the remit of the speech & language therapist – for example, a cleft lip or palate. In this example, the imbalance of resonance needs to be dealt with in order to decrease the amount of work that the larynx undertakes as it attempts to counteract the resonance problem. The authors would always expect that the primary presenting problem should be addressed first.

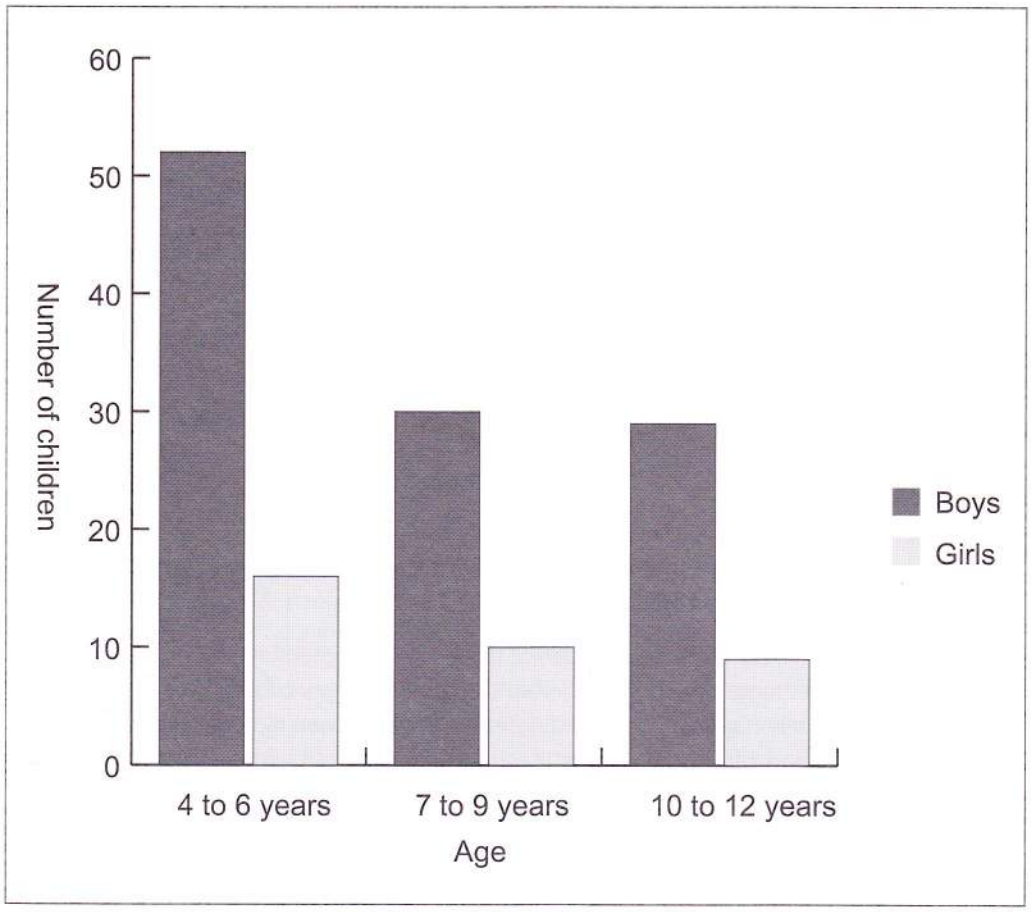


Figure 5
The Incidence of Dysphonia in Children Attending the Authors' Voice Groups (1991–1999)

Any language difficulties, whether they result from delay or disorder of acquisition, or from English being a second language, will cause the child to have difficulty in understanding some of the theories of the Voice Care Programme (covered in later chapters). In addition, the dysfluent child may have underlying problems that are manifesting themselves as either a dysfluency or a voice problem (Case Summaries 1 and 2, pp16–19). These may have to be addressed, or even referred to another agency, prior to successful therapy taking place.

Poor or ineffectual communication and social skills may have implications for the appropriateness of vocal behaviours in different environments or with different communication partners. If these skills are affected as a result of wider difficulties, such as autistic spectrum disorders, then the management of the dysphonia should be an integral part of the overall management of the child.

In conclusion, the clinician must decide which of the child's communication problems is primary, and whether or not the resolution of that problem will also resolve the voice problem.

CASE SUMMARY 1

Name: Th

Age on Referral: 8,00

Initial Contact: Referred by teacher for dysfluency. On assessment, he presented with mild dysfluency characterised by fluent initial sound repetition and occasional blocks. Th also presented with a hoarse voice, and was referred to the Voice Clinic.

Onset of Voice Problem: Th's mother thought that his voice had always sounded 'gruff', and believed it to be normal for Th. His dysfluency had occurred sporadically for about two years.

Case History:

Family: Th was the third of four siblings, and had two brothers aged 11 and 13, and a six-year-old sister. There was no family history of dysfluency, or other speech or language problems.

Medical: Th suffered from hay fever, and took antihistamine tablets in the summer months. At 19 months of age he was admitted to hospital for one night with a high temperature and a swelling on his neck caused by an infection. Th had a persistently blocked nose with excessive discharge, and suffered frequent ear infections. He snored, and his GP had noted enlarged tonsils.

Environment: Th's father smoked in the home.

Behavioural: Th's mother described him as very active, anxious and 'nervy'. He enjoyed karate, which he originally took up to increase his confidence. Th would often fight and argue with his sister and the brother closest to him in age.

Development: Th was born at 34 weeks, but all milestones were within normal limits.

Posture: Th was tall for his age, and tended to round his shoulders and carry his head forward.

Tension: Excessive laryngeal tension.

Breathing: Clavicular.

Voice Evaluation: Moderately hoarse voice. Occasional phonation breaks. High pitch and narrow range.

Voice Clinic: Tonsils large but clean, adenoids moderately large. Nose full of mucous. Large bilateral vocal nodules.