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Welcome to Volume 11 Issue 1 of Journal of ENT Masterclass® 2018

I very much welcome all our readers to the 11th edition of the Journal of ENT Masterclass®. In the previous 10 editions, we published more than 200 articles that were provided as a free-of-charge printed journal and were later accessible online. Financial constraints meant that there was always a finite number of issues that could be distributed, and online access was ultimately more readily available to readers. As the world of published research continues to evolve, it appears that online access is gradually taking over from printed material. This 11th edition is, therefore, going to be immediately available as a free online journal with no further printed issues. This will also give the publishers flexibility in editing, adding more material and, in the near future, incorporating videos within the articles.

For this edition of the Journal of ENT Masterclass, we are pleased to have a selection of comprehensive articles written by national and international authors. As always, the breadth of specialty is covered, and new subjects such as laryngeal clefts, management of keloid, paediatric balance disorders and robotic surgery are included. We are very grateful to all authors and must say that we are always in debt to our editors who tirelessly continue their selfless work for the journal.

On other fronts, the ENT Masterclass courses continue to be as popular as ever, with long waiting lists for attendance. The travelling Masterclass has reached the far corners of the Earth, with the 2019 planned journeys to Bahrain, Pakistan, South Africa, China, Germany, Romania, Switzerland and Uzbekistan.

I hope you will enjoy reading this 11th edition, and we will always welcome your comments and suggestions.

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Charing Cross and Royal Brompton Hospitals, London.
Children have a right to be protected from maltreatment as responsibility, trust or power1. Child maltreatment is the abuse and neglect that occurs to individuals under 18 years of age. It includes all types of accidental injuries are included as a comparison of case series. Some studies that were mainly concerned with physical abuse (father 35% and mother 40%) or physical abuse (father 35% and mother 40%).

Key words
Child maltreatment, child welfare, otolaryngology, non-accidental injury

Introduction
Child maltreatment is the abuse and neglect that occurs to individuals under 18 years of age. It includes all types of physical, sexual, and emotional abuse, neglect, negligence, and commercial or other exploitation, which results in actual or potential harm to a child’s health, survival, development or dignity in the context of a relationship of responsibility, trust or power2.

Children have a right to be protected from maltreatment as stated in the United Nations’ Convention on the Rights of the Child3 and most countries have passed legislation in order to protect children. To this end, the United Kingdom government has enacted the Children Act 1989, which enshrines in law the concept that child welfare is paramount, and further, sets out how Children’s Social Care will protect children. There has been subsequent legislation and a number of revisions of the statutory guidance Working Together to Safeguard Children, which includes the definitions of various forms of child maltreatment4. The General Medical Council (GMC) published Protecting Children and Young People in 20125 which states: “Good medical practice places a duty on all doctors to protect and promote the health and well-being of children and young people. This means all doctors must act on any concerns they have about the safety or welfare of a child or young person.”

Child maltreatment is common. In 2017, over 51,000 children in England (over 4 per 1,000) were identified as needing protection from abuse (i.e. placed on a Child Protection Plan following an initial child protection conference)6. However, self reporting suggests the problem is much greater7.

The 2015-16 Crime Survey for England and Wales ran, for the first time, a module of questions asking adults whether they were abused as a child7. The survey showed that 9% of adults aged 16 to 59 had experienced psychological abuse, 7% physical abuse, 7% sexual assault and 8% neglect. They were abused as a child8. The survey reported that perpetrators were most likely to be a family member (father 35% and mother 40%) or physical abuse (father 35% and mother 29%)8.

The impact of these insults, both emotional and physical, can be difficult to quantify but can undoubtedly persist into adult life with potential effects on physical and, importantly, mental health. Victims can continue to suffer as the result of direct biological injury and often develop high-risk anti-social behaviours, inappropriate coping mechanisms and poor parenting emotions and skills9.

As a speciality with a large paediatric population, Otolaryngologists play a critical role in ensuring children within their care are safeguarded from abuse and neglect. An awareness of how child maltreatment can present in the ears, nose and throat is therefore imperative. Furthermore, an insight into characteristic features of non-accidental injury (NAI) in other anatomical locations is equally important, as these may be observed on general or extended examination.

Aims & Methods
This clinical review article was written to highlight the important points for the practising ENT clinician. A literature review was performed to ascertain the current experience of child maltreatment under the care of Otolaryngologists. Further articles were selected for inclusion following review of reference lists of full text studies. This article does not attempt to be an exhaustive review of the literature but highlights the most significant issues.

As clinical trials cannot be conducted in this field, studies tended to be non-controlled observational case reports or case series. Some studies that were mainly concerned with accidental injuries are included as a comparison of accidental versus non-accidental injury. It should be noted that the majority of larger case studies were published before 2000 although it is beyond the scope of this review to interrogate this further.

General Principles of Child Maltreatment
In 2018 the National Institute of Clinical Excellence (NICE) updated its clinical guideline When to suspect child maltreatment providing general guidance on when to consider or suspect child maltreatment. This guidance states that child maltreatment should be suspected if there is bruising caused by a medical condition, and if the explanation for the bruising does not marry with the clinical presentation. Examples within this guideline include:

• bruises in a child who is not independently mobile (i.e. an infant or a child who is disabled).
• multiple bruises or bruises in clusters.
• bruises of a similar shape and size.
• bruises on any non-bony part of the body or face including the eyes, ears and buttocks.
• bruises on the neck that look like attempted strangulation.
• bruises on the ankles and wrists that look like ligature marks.

NAI in the Head and Neck
A number of studies, including Dunstan et al (2002)10 and Kemp et al (2015)11 have shown that the head & neck is the commonest site for abusive bruising in children. Both studies reported the left side of the head and neck to be more commonly bruised in abuse than the right – presumably as most perpetrators are right-handed.

Leavitt et al (1992)12 reviewed 85 children admitted to the hospital with physical abuse, again from an Otolaryngology perspective. 31 (36%) had evidence of abuse to the head & neck, and 21 of these involved the ear.

Children are more likely to be bruised on their head, neck and chest than on other areas of their body. Children with abusive pharyngeal injuries tended to be <1 year old and have co-existent injuries (ranging from bruising to rib fractures)13. As with most reviews of fabricated and induced illness in children, there are a variety of presentations often in children with complex medical histories. The symptoms and signs were difficult to attribute to a known medical condition and resistant to subsequent treatment. Mucosal pharyngeal injury is uncommon but if present, is thought to be the result of child maltreatment in up to 80% of cases14. Palatal petechiae or lacerations should raise concern regarding potential oral sexual penetration15.
Excessive dental caries within the correct context can be a sign of neglect44

NAI in Otology

Steele and Brennan (2002) reported a prospective survey of 111 children presenting with presumed accidental external or internal ear injuries to a paediatric Accident & Emergency department18. The mechanism of injury was variable but the most common injury was laceration of the pinna (56%). Most cases presented within six hours of injury (84%). No child presented with bilateral injuries and only one of their patients was under the age of 1 year. This contrasts with the types of ear injuries reported in association with child maltreatment.


Spontaneous haemorrhage from the ear may occur after acute otitis media, but is normally associated with parotid discharge. Recurrent bleeding from the ear should be considered as a manifestation of abuse when no satisfactory parental explanation is forthcoming and results of coagulation studies are normal. Laceration of the ear is a rare injury and scalp laceration from a metal object is an unusual occurrence. The finding of an unexplained torn labial frenulum in children who have been abused, the authors concluded that epistaxis does not constitute a diagnosis of abuse compared to the general population19. Most Child Health departments in the UK now use the abbreviation WBN – Was Not brought, rather than DNA – Did Not Attend, as the former reminds staff of the increased vulnerability of children and the need for NHS Trusts to have child specific WNB guidelines15.

Conclusion

The GMC have defined the duty of all doctors with relation to child maltreatment. The following features should trigger further enquiry:

1. Young children and disabled children are at increased risk of abuse and must be assessed with a higher index of suspicion
2. Unexplained injuries or those with an implausible, inconsistent or inadequate history
3. Clinical signs which are suggestive of inflicted injury or neglect
4. Risk factors present amongst care-givers, particularly domestic violence, alcohol and/or drug misuse or mental health conditions

Otolaryngologists should be aware of ENT presentations associated with increased risk of causative maltreatment and should retain an understanding of their institution’s Child Protection Policies. Children who are currently at risk, or vulnerable, should be managed with specialist paediatric colleagues within a multi-agency team.

References

Immunodeficiency in children is rare. Most recurrent infections in young children are not due to primary immunodeficiency syndromes, although physiological immunodeficiency of infancy is common, often lasts well into childhood and sometimes requires the use of prophylactic antibiotics if surgical intervention is not indicated. The clinical features of immunodeficiency syndromes are outlined, together with a structure for the investigation and further management in conjunction with paediatric medical subspecialists.

**J ENT Masterclass 2018; 11 (1): 9 - 14.**

**Key words**
Primary immunodeficiency, Secondary immunodeficiency, Classification, Investigations

**Introduction**
Immunodeficiency disorders in children are individually rare, but as a group comprise a significant group of patients. Children with primary immunodeficiency may present to ear, nose and throat specialists in the first instance due to recurrent or severe infections.

This review will outline the different types of immunodeficiencies found in children, how these may present to otorhinolaryngologists, and provide some guidance regarding which children need referral for further investigation.

**Types of Immunodeficiency**
Immunodeficiency in children can be classified into primary immunodeficiency, where the disorder is congenital, genetic or inherited; or secondary and acquired after birth. Primary immunodeficiency can be further classified according to the nature of the disorder and which part of the immune system is affected (e.g. innate, humoral (antibody) or cellular immunity, table 1). In recent years, next generation sequencing techniques have transformed the diagnosis and understanding of primary immunodeficiency disorders2. In the UK, the prevalence of primary immunodeficiency (PID) in children is thought to be between 3 -4/100,0002.

Secondary or acquired immunodeficiencies are classified according to their cause, the most important of which globally is HIV/AIDS. Approximately 1100 children and teenagers are living with HIV in the UK and around 5000 globally is HIV/AIDS. Approximately 1100 children and teenagers are living with HIV in the UK and around 5000 in North America2. Other secondary immunodeficiencies include iatrogenic immunosuppression such as cancer chemotherapy or biological agent use in rheumatology or gastroenterology in the developed world and malnutrition in developing world settings.

There is an additional larger group of children who present with recurrent infections, such as otitis media or recurrent respiratory infections in early childhood without a defined immunodeficiency syndrome whose symptoms often resolve during childhood labelled as physiological immunodeficiency or simply “maturational immunodeficiency”.

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distinguish children who require further investigation from those experiencing infections within the normal limits of childhood.

**General considerations**

Although immunodeficiency is rare, specific features of a clinical history raise clinical suspicion and should lead to investigation. The criteria for definite referral to a paediatric immunology and infection specialist for detailed immunological investigations are shown in table 2. These factors have a relatively low sensitivity and specificity. However, in the context of a child presenting with “worse than normal infections”, these provide a useful context in which to consider the individual child.

**Recurrent infections**

The majority of children presenting to ear, nose and throat (ENT) specialists with recurrent infections will be “normal” children without underlying immunodeficiency, with a proportion having symptoms due to atopy and allergy. A small number will turn out to have immunodeficiency. This is particularly the case where the infections are primarily viral in origin. It is normal for children to suffer 4 – 11 respiratory infections a year depending on age, especially if they attend daycare or nursery, or have older siblings.

In infants presenting with recurrent sinobacterial infection this will most commonly be due to physiological transient hypogammaglobulinaemia of infancy - a prolonged physiological nadir of IgG. This occurs between 3-6 months and normally resolves by one year of age, but can persist with recurrent otitis media and respiratory tract infections during this time. It can also be due to prematurity, as infants born early miss the transfer of maternal IgG during the final trimester.

Other defects of humeral immunity which are known to present with recurrent ENT infections include the rare condition X-linked agammaglobulinaemia (XLA) and the even rarer autosomal recessive agammaglobulinaemia (ARA) (table 1). Children with antibody deficiency often present during the first 2 years of life with recurrent sinopulmonary infections due to encapsulated bacteria such as Haemophilus influenzae or Streptococcus pneumoniae, and those with XLA are also notable for the absence of lymphoid tissue on examination. Combined variable immune deficiency (CVID) is a heterogeneous group of disorders of B cell antibody production, usually presenting with recurrent sinopulmonary infections, most often in late childhood to adolescence or early adulthood. Conditions of primary antibody deficiency have also been reported to present with recurrent chronic rhinosinusitis.

Phagocytic disorders can also present with recurrent infections, in particular with catalase-positive organisms such as Staphylococcus aureus, Serratia marcescens and Nocardia. Chronic granulomatous disease (CGD) is a disorder in the production of NAPDH oxidase, involved in oxidative killing by phagocytes. It may present with rapidly progressive deep soft tissue infections of the outer ear and mastoid, and may include other oral or facial infections.

HIV is the most common immunodeficiency in children worldwide. Recurrent ENT infections are present in about 40% of patients. Persistent, bilateral lymphadenopathy (usually of the posterior triangle) is also often seen in HIV in children, as is recurrent otitis media and oral candidiasis. Parotid gland enlargement is typically an early manifestation in HIV. Oral oropharyngeal candidiasis is a particular hallmark of later stage HIV/AIDS in children.

Unusually persistent infections which require multiple courses of antibiotics, or the need for prolonged periods of intravenous antibiotics should also prompt consideration of an underlying immunodeficiency.

**Severe infections**

More severe primary immunodeficiencies may present early in infancy with potentially life-threatening infections, including of the ENT system. In these cases, patients will often have many systems involved which should help prompt for further investigation into an underlying disorder. Severe combined immunodeficiency (SCID) phenotypes are rare, but early diagnosis improves outcome. They tend to present early in life, within the first month 3-6 months and systemic signs include failure to thrive, chronic diarrhoea and candidiasis.
Opportunistic or unusual infections
Infections with unusual organisms should always prompt further investigation. Although uncommon presentations of common diseases are more common than an uncommon disease, investigation should start early as the underlying condition could be life threatening.

Organisms which should attract special attention include Pseudomonas aeruginosa, which is often a hallmark of genetic respiratory conditions such as cystic fibrosis or primary ciliary dyskinesia which have defects of innate immune barriers. Candidiasis of the mucous membranes of the upper respiratory tract should prompt consideration of HIV, or less commonly chronic mucocutaneous candidiasis. Other organisms which may infect the upper respiratory tract which should prompt consideration of HIV or other T lymphocyte deficiencies include Pneumocystis jirovecii and Mycobacterium tuberculosis. Fungal infections with Aspergillus spp or Candida spp may also be presenting features of a defect of phagocyte function (e.g CGD). Recurrent otitis media and sinusitis with encapsulated bacteria such as Neisseria meningitidis may be the presenting feature of a complement deficiency.

Investigation of suspected immunodeficiency
Once suspicion has been raised about the possibility of an underlying immunodeficiency, a stratified approach to investigation can be put in place. There are some simple first steps which can be taken by anyone suspecting an immunodeficiency in a child such as a full blood count and differential, basic immunoglobulins (IgG, M and A) and sweat test for cystic fibrosis, prior to referral to specialists in children’s immunology and infectious diseases, or respiratory medicine (depending on the clinical presentation). Referral should be made urgently, or if the degree of suspicion is high or there are immediate concerns about the severity of the presentation.

An approach to screening for immunodeficiencies is shown in Table 3. Clinicians should be aware that some low cell counts can be normal under certain circumstances. For example, a transient neutropenia or lymphopenia in isolation can be normal in children following a viral illness. An incidental neutropenia does not need to be repeated if there are no underlying concerns about immunodeficiency. Persistent lymphopenia in a child under 2 years old should prompt screening for SCID.

Management of children with immunodeficiency
In the Ear, Nose and Throat clinic, special considerations should be made when managing patients with underlying immunodeficiency, and management will usually be in conjunction with paediatric immunology and infectious diseases, or respiratory medicine, specialists.

Treatment of underlying disorder
In some immune disorders it is possible to treat the underlying pathology, either by specific immune therapies such as substrate replacement or targeted molecular therapies, or by treating the cause of secondary immunodeficiency.

Humoral deficiencies such as XLA or CVID are managed with immunoglobulin replacement therapy, most commonly now given to children via weekly or biweekly subcutaneous routes, or by intravenous infusions. This therapy is effective in reducing the incidence of acute sino-pulmonary infections in these children, but does not stop them completely.

Highly active antiretroviral therapy (HAART) has transformed HIV from a severe life-threatening illness into a chronic condition. Children with HIV who are successfully treated can expect to have few complications of the disease in childhood and adolescence unless there are drug adherence issues.

Children with CGD receive prophylactic antibiotics and antifungals, although bone marrow transplant is now an effective and potentially curative treatment. Early bone marrow transplant is also the current treatment option for SCID although gene therapy trials are currently also in progress for some forms of the disease.

Preventative therapy
Prophylactic antibiotics are commonly prescribed for children with physiological immunodeficiency of infancy and childhood although there is little formal evidence for their use or of the potential risks of generating antimicrobial resistance. Prophylactic antibiotics are well-established in the formal treatment of children and adults with primary immunodeficiencies. However, there is considerable variation globally of treatment regimens, reflecting the lack of formal evidence available. Use of a single agent (aminosycin or cotrimoxazole) is recommended to treat recurrent infections based on evidence in immunocompetent children.

The macrodolce antibiotic azithromycin is also commonly used as the dosing regimen allows children to only have antibiotics once a day for three consecutive days of the week. Cotrimoxazole can be an effective choice for preventing recurrent upper and lower respiratory infections in conditions including CIGD and HIV. Clinicians should make sure appropriate samples are taken from any sample (such as ear discharge) for microscopy and culture if possible, prior to initiation of any prophylactic regime, or if breakthrough infections occur.

Immunisations play a vital role in preventative therapy for many patients with immunodeficiency, however in certain conditions the efficacy may be limited. In general, annual influenza immunisation is recommended and should be prescribed according to current national guidelines. Additional doses of meningococcal or conjugate pneumococcal vaccines may be recommended, and depending on the underlying disorder, age of the child and laboratory testing some or all live vaccines may be contraindicated. Additional vaccines, or advice regarding the national schedule vaccines will usually be provided by a paediatric immunology and infectious disease specialist.

Treatment of infections
Very little specific literature exists on the treatment of infections affecting the ear, nose and throat in children with immune dysfunction. Various factors need to be taken into consideration, including:

• The patients undergoing immunodeficiency – particularly if starting empirical treatment and patient known to be susceptible to particular organisms (e.g Neisseria meningitidis in complement deficiency)
• Chronicity of infection and possible presence of biofilms – surgical management may be considered at an earlier stage
• Organisms involved and their sensitivities – older patients may well have been exposed to multiple courses of antibiotics, or long-term prophylactic antibiotics, and so may be more likely to harbour multi-resistant organisms

General principles of management in high risk children include:

• Infections should be treated much more aggressively and earlier than would be considered in the general population
• There should be a lower threshold for high dose and intravenous therapy in the initial phases of treatment, and longer duration of treatment may be necessary
• Aggressive surgical management may be needed in certain circumstances, for example tympanostomy tubes for chronic otitis media in complement deficiency, early bilateral myringotomies in recurrent otitis media in HIV, and early incision and drainage of collections in CIGD.

Conclusion
Although immune dysfunction is uncommon in children, it is important for otorhinolaryngologists to be aware of its manifestations as children may well present initially with recurrent or severe infections of the upper airways. Whilst most children will not have an underlying immunodeficiency, some basic investigations and consideration of discussion with a paediatric immunologist may be warranted as early diagnosis can improve outcomes for children with confirmed primary
immunodeficiency disorders. Further evidence is needed to guide the prevention and management of infections, especially in children without proven primary immunodeficiency who suffer from recurrent upper and/or lower respiratory tract infections.

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The diagnosis of a laryngeal cleft is made under direct visualisation during a microlaryngoscopy and bronchoscopy (MLB). Laryngeal clefts are not uncommonly missed during inspection of the airway and so it is important to palpate the posterior cricoid and interarytenoid area using a laryngeal probe or right angled hook. This is especially true of the submucous type cleft, which may easily be missed on inspection. A videofluoroscopy (VF) is performed to assess whether the defect in the interarytenoid area causes aspiration and penetration into the larynx. Initial management of patients diagnosed with a type I laryngeal cleft would be a trial of conservative therapy with the involvement of a speech and language therapist. This includes prescribing a proton pump inhibitor to minimise gastro-oesophageal reflux, the use of thickened feeds and a variety of feeding positions (upright or head turned) and slow feeding with multiple breaks to minimise aspiration. In some high-risk cases feeding may be stopped orally and the use of an enteral tube is commenced.

Figure 1: The Benjamin and Inglis classification system for laryngotracheal clefts. This depicts the four types of laryngotracheal clefts: Type 1 refers to a defect in the interarytenoid musculature, extending to the level of the vocal cords but not through the cricoid; type 2 extend partially through the cricoid cartilage; type 3 extend through the cricoid cartilage into the posterior trachea; type 4 extend into the thoracic trachea up to and sometimes including the carina.

Figure 2: An endoscopic view of a type 1 laryngeal cleft showing the defect extending to the level of the vocal cords.

Figure 3: An endoscopic view of a repaired type 1 laryngeal cleft; sutures visible on pharyngeal and laryngeal surfaces.

Children who fail conservative measures or those with severe symptoms (stridor with respiratory compromise or recurrent chest infections requiring enteral tube feeding) will need surgery with the aim of repairing the cleft and in doing so treating symptoms and helping establish normal feeding patterns.

In the UK and worldwide the method of repair for type I laryngeal clefts is endoscopic. A microlaryngoscopy and bronchoscopy is performed with the child in a supine position with the neck extended, utilising a shoulder roll and head ring. This is initially undertaken using an anaesthetic laryngoscope and a zero degree Hopkins rod (endoscope). Direct visualisation and inspection of the entire airway is performed to assess the laryngeal cleft and rule out other co-existent airway pathology. Subsequently the larynx is then better visualised for surgery by inserting an appropriately sized Lindholm laryngoscope and placing the child in suspension. Vocal cord retractors are used to optimize the view of the cleft and allow more accurate assessment of its extent. Local anaesthetic is infiltrated into the mucosal margins of the cleft, which are then demuced using cold steel microsurgical instruments. Absorbable interrupted sutures (5/0) are then placed on the laryngeal and pharyngeal sides of the posterior larynx to form a two-layered closure (Figure 3). The aryepiglottic folds are routinely divided at the end of the procedure. Successful single-layered closure using a mattress suture has also been described. Post-operatively the normal preoperative feeding regimen is recommenced along with high dose antireflux therapy. A post-operative videofluoroscopy is performed at 4-6 weeks. An MLB may also be performed to directly visualise the repair depending on post-operative symptoms and the VF results.

Type II Laryngeal clefts

Type II laryngeal clefts extend inferiorly, partially but not completely through the posterior cricoid lamina. Similarly to type I laryngeal clefts, they present with a combination of airway compromise, voice disturbance and swallow dysfunction. The diagnosis can be confused with asthma due to common symptoms of a chronic cough and wheeze. Diagnosis is based on a high index of suspicion especially if the child has other known associated disease or one of the syndromes reported earlier. A referral to the speech and language therapists and subsequent videofluoroscopy will provide information on the severity of aspiration and also allow for the introduction of conservative measures such as dietary modification, thickened feeds and management of gastro-oesophageal reflux to commence. However type II laryngeal clefts almost always will require surgical intervention.

Children with severe and recurrent aspiration pneumonias, worsening pulmonary function or airway symptoms need early surgical repair. This is carried out endoscopically in a similar fashion to that performed for type I laryngeal clefts unless coexisting pathology such as subglottic stenosis favours an open approach.

The outcomes of endoscopically repaired type I clefts have been reported as showing an 80% improvement in postoperative swallow and cough and while type II clefts are less commonly reported, there are reviews indicating an 70% improvement in the same symptoms with minimal comorbidity. Syndromic patients and those requiring early surgical repair tend to have a poorer outcome and residual respiratory symptoms can be related to a number of factors.

It is important to remember that each patient diagnosed with a type I or II laryngeal cleft is unique and the severity of underlying pulmonary dysfunction from recurrent aspiration, microaspiration, concurrent neurological comorbidity and gastro-oesophageal reflux is often unknown. As such each child is managed on a case-by-case basis, assessing and optimising any co-existent medical issues with the multidisciplinary team.

Type III and IV Laryngeal clefts

Type III and Type IV laryngeal clefts are anatomically, functionally and prognostically a more challenging group of patients and their management should be undertaken in a tertiary paediatric airway centre with experience in managing children with laryngeal clefts.
Anatomically a type IIa laryngeal cleft extends through the cricoid but not into the extrathoracic trachea while a type IIb passes into the extrathoracic trachea (figure 4, 5). Type IV laryngeal clefts, which are exceedingly rare, extend into the intrathoracic trachea (figure 6). As one would expect the morbidity and mortality of intrathoracic clefts is much higher when compared with extrathoracic clefts and a multidisciplinary approach is essential. A type IV cleft which extends as far as the carina has an extremely high mortality rate with almost all being unable to be addressed surgically.

While it may be possible to repair a short type IIa laryngeal cleft endoscopically, generally surgery for type III and type IV laryngeal clefts is performed via an open approach using an extended laryngofissure to access the cleft. A cervical approach is now considered appropriate in the majority of cases though combined cervical and thoracic approaches have been described for type IV cases. The method of delivery of anesthesia can vary according to the surgeon and paediatric unit. Both cardiosurgical bypass and extracorporeal membrane oxygenation have been described for type IV repairs while for type III a low index of suspicion and a more thorough airway examination is leading to increased diagnosis. Enhanced surgical and anaesthetic techniques also will result in improved survival rates for those with more complex type III and IV clefts. A multidisciplinary team approach to management and liaison or transfer to a unit with considerable airway experience as required is recommended.

Conclusion
Paediatric laryngeal clefts present with an extremely interesting range of pathology from a mild, self-limiting type I cleft or an incidental deep interarytenoid groove to a life threatening carinal cleft. As our understanding increases, particularly of type I cases, there is a higher index of suspicion and a more thorough airway examination is leading to increased diagnosis. Enhanced surgical and anaesthetic techniques also will result in improved survival rates for those with more complex type III and IV clefts.

Acknowledgement
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References
Clinical law: Treating children

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Abstract
From the English legal perspective, a child is someone who has not yet reached 18 years of age. Legal synonyms include 'minor' and 'infant'. The latter is instructive, since it is derived from the Latin noun: Infans, meaning unable to talk. This reflects the legal rules which prevent children from speaking for themselves in court, although this impediment has been at least partly addressed over the last two decades. Nevertheless, it begs a fundamental question, as to whether children can provide their own consent, or whether they depend upon parents to provide it for them.

Key words
Consent, law, children

Nomenclature
It is conventional to describe 16 & 17 year olds as young adults. This reflects the legal rules, which prevent children from speaking for themselves in court, although this impediment has been at least partly addressed over the last two decades. Nevertheless, it begs a fundamental question, as to whether children can provide their own consent, or whether they depend upon parents to provide it for them.

Children lacking competence
This is the simplest group. Although presumed to lack competence, some will be able to demonstrate their capability to make valid treatment decisions as children, and capacity in young people. People under 18 years can thus be considered in three broad groups.

Children in need of guardianship
Depending on their maturity and the intervention that is proposed, children from a young age may be able to provide independent consent. A four year old may be able to consent to a blood pressure measurement; a six year old to a venepuncture; a 12 year old to the removal of an early stage appendicitis. No-one is suggesting that the parents should be excluded from this process; such exclusion would be quite wrong. It is for the family as a whole to decide what part the child’s potential competence should play in the consenting process. But the involvement of children in this process will strengthen the therapeutic relationship, and is to be encouraged.

A child’s previous experience is of great importance. It is submitted that following the very recent diagnosis of leukaemia, a 15 year old, who has been healthy up to this point, will be so horrified by the dissolution of his comfortable and well organised life as to be rendered incoherent, entirely incapable of consenting for the necessary tunnelled central venous catheter (CVV). Contrast this child with a 10 year old on the same ward; suffering relapsed leukaemia. He has already undergone three line insertions and removals. He knows (effectively) everything there is to know about CVV placement, complications and disadvantages. Now facing his fourth insertion, he will very likely be competent to provide independent consent.

Therefore, it is important objectively to determine whether a child of 15 years or younger is competent to provide independent consent for the proposed intervention.

For this assessment, the Gillick test is used; derived from a landmark case where it was established that a child competent to provide consent should be allowed to do so, independently of her parents. The test requires that the child has sufficient understanding and intelligence to enable him to understand fully what is involved in a proposed intervention. Thus, if a child can understand:
• The risks and side effects
• The alternatives to the procedure, and is able to:
  • To retain the information long enough
  • To weigh the information
  • To arrive at a decision
  • And to be free from undue pressure

Gillick provides a high threshold for consent, consistent with public policy. It would be highly undesirable to allow incompetent children to provide consent for interventions which they could not fully understand. The fact that a child has to ‘prove’ their competence places a barrier to children that is never experienced by adults, whose capacity is presumed. One can only speculate how many adults would ‘pass’ the test in Gillick.

The competent child does not enjoy an equal right to refuse treatment. Only those cases in which the refusal of life-saving treatments in these children is at issue have reached the court. But given this opportunity, courts have resolutely denied the (otherwise) competent minor the right to choose death. A 15 year old girl refusing her consent for a life-saving heart transplant had her refusal overridden by the court. M’s reason was that she ‘would rather die than have the transplant and have someone else’s heart…. I would feel different with someone else’s heart…. that’s a good enough reason not to have a heart transplant, even if it saved my life…’

The court authorised the operation, as being in her best interests.

In another case, a 14 year old girl with serious scalding required a blood transfusion. She was Jehovah’s Witness, and refused the treatment. The court found that even if she had been Gillick competent, her grave condition would have led the court to authorise the transfusion. As it was, the girl was unaware of the manner of death from anaemia, and was basing her views on of those of her congregation, rather than on her own experiences. For these reasons, she was judged incompetent to make this decision for herself.
It must be remembered that the vast majority of competent children who refuse treatment are refusing relatively trivial procedures. You would be entitled to rely upon their parent’s consent if necessary, but it is a matter for clinical judgement whether the procedure could be deferred, to allow the child further time to consider, and be reconciled with what is likely to be an inevitable outcome. The problem of refusal in competent children is dealt with in the same way as for the 16 & 17 year age group, below.

Young People

People of 16 & 17 years of age are presumed to have the capacity to provide consent for surgical, medical and dental treatment. This was made possible by a law enacted in 19698, which recognised that the decisions that teenagers were taking, irrespective of the law, contrasted sharply with the age of majority (21 years) at the time. The new law reduced the age of majority to 18 years, and introduced the presumption of capacity for 16 & 17 years olds. In 2007, a wide-ranging statute11 addressing mentally incapacitated adults (counter-intuitively named the Mental Capacity Act) was introduced, including many provisions applicable to young people.

The existing framework does not extend to a statutory right for a young person to provide consent for research independent of her parents, or interventions that do not potentially provide direct health benefit to the individual concerned. However, if capacitious along ‘Gillick’ lines, a young person may arguably be able to provide consent for these activities.

Young people are nonetheless able to provide consent for treatment in absence of their parents. However, the parental right to provide consent for treatment lasts until the end of childhood. This has the effect of providing a ‘safety net’, allowing a 16/17 year old the opportunity of consent for herself, or deferring to her parents, if she seeks fit. Once the child reaches adulthood on her 18th birthday, her parents’ rights disappears. For the rest of her life, she alone can provide consent, either in person; or in some circumstances, by a proxy method.

If parents and a child of this age disagree, it is wise to exercise caution

If a young person wishes to exercise his right to consent, and his parents oppose the decision, then you would be entitled to rely on this consent. However, it would be important to understand the basis for their disagreement. For instance, if you suspected that the patient lacked capacity, you should challenge the presumption. This can simply be done by establishing whether he understands the relevant information; can retain the information, believe it, weigh it up…and communicate his decision. If he can, then he has capacity. But it is still wise to tease out where the problem lies, since this is a most unusual situation, and it would be in the young person’s best interests to resolve the issue before surgery, if that is feasible.

The problem, reversed, is of a young person who refuses treatment, but who is accompanied by a parent who provides consent. Valid parental consent will make the procedure ‘legal’, but as with the situation of consent withdrawal, you will have to make a clinical judgement as to whether proceeding with the treatment against the young person’s wishes is both practicable, and in her best interests.

The parental right in reality diminishes during the period of the 16th and 17th year, and this is reflected in the doctrine of the scope or zone of parental responsibility, a phrase originally deriving from (and still largely residing within) adolescent psychiatry, particularly with respect to parental consent to the child’s compulsory detention. Since 200712, doctors have been advised not to rely on parental consent for the voluntary admission and treatment of a young person for mental illness, if their offspring is refusing the voluntary admission. The alternative of compulsory admission under the Act is sometimes preferred.

Conclusion

In summary, returning to the world of surgery, it is recommended that an elective procedure should be abandoned until the dispute is resolved. If emergency treatment is required, but could be administered in a different way which was still consistent with the refusing patient’s best interests, the alternative should be explored. If her life or limb is threatened, and there is no choice but to provide a definitive operation, then reluctantly, you may feel the need to restrain the patient and proceed. A planned semi-elective tracheostomy in a patient whose supraglottic airway state is deteriorating into an emergency in front of you could be an example of this situation. It should be noted that in reality, the amount of resistance that a child of any age puts up is usually inversely proportional to their malaise and discomfort. In the gravely ill, refusal is rare.

There are those who are gravely ill, but needing urgent rather than emergency treatment. If a 16/17 year old in this category refuses treatment for the preservation of her life, such as the transfusion of blood15, or feeding 16 (in anorexia), courts invariably choose to override the child’s autonomy, and provide an order which allows lawful provision of the treatment against the child’s wishes. This either upholds the parental wishes for treatment, or overrides parental refusal. These cases are rare, but the timescale within which the decision needs to be made allows sufficient time for the court to be contacted, providing the surgeon with the necessary authority.

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Paediatric gastroesophageal reflux disease

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Abstract
Gastroesophageal reflux (GOR) is common in infants and children. Distinguishing Gastroesophageal reflux disease (GORD) from GOR is challenging due to the frequency and range of symptoms, the range of impact on family functioning, and the communication issues, especially in young children. Lack of a single, easily doable, sensitive and specific diagnostic test, makes the diagnosis harder. Gastroesophageal reflux and GORD may contribute to other conditions managed in the paediatric population. By Ear, Nose and Throat (ENT) surgeons. This review discusses the presentation, investigation and management of paediatric GOR and GORD.


Key words
gastroesophageal, reflux, paediatric, children

Definitions
The National Institute for Health and Care Excellence (NICE) defines Gastroesophageal reflux (GOR) and Gastroesophageal reflux disease (GORD) as follows1-4:

• GOR is passage of gastric contents into the oesophagus. It is a common physiological event that can happen at all ages (but is more frequent in infants) and is often asymptomatic.

• GORD is GOR that causes symptoms (for example, discomfort or pain) severe enough to merit medical treatment or that has associated complications (such as oesophagitis or pulmonary aspiration). Pathologic reflux or GORD is easier to diagnose in children presenting with any of the red flag symptoms (table 1) including symptoms such as haematemesis or growth failure. In the absence of these symptoms GORD may also be diagnosed by reported significant 'discomfort' or 'pain'. These symptoms are subjective and affected by communication issues in paediatric patients and the degree of parental concern. It should be borne in mind that at least one third of otherwise healthy babies cry for more than three hours a day.

Epidemiology
GOR is common in infants. There is high prevalence of overt regurgitation in infants less than 3 months of age and the incidence is reported to be as high as 50%6-8. This improves in the first year of life such that at one year less than 5% of infants have symptomatic GOR1. Pharmacological treatments such as proton pump inhibitors (PPI) or Ranitidine confer little benefit.

GOR/GORD in the older child and adolescent is more of an ‘adult type’, different from reflux in infancy. A nationwide French questionnaire study showed that compared to infants, adolescents are more likely to need pharmacological treatments for symptoms of reflux1. This study also showed that reflux was common in children, with GOR present in 10.3% and GORD in 6.2% of children respectively. In another cross-sectional study from Spain, GORD was more commonly found in older female adolescents and children with neurological diagnoses6.

Overall, the exact prevalence and incidence for GORD remains unknown due to difficulty in defining and differing presentation/natural history in different paediatric age groups.

Gastroesophageal Reflux disease
Although there is no prescriptive classification, the authors tend to see infants and children with reflux, broadly divided into these three groups:

Group I. Gastroesophageal Reflux symptoms in young infants
As stated in the epidemiology, this is common and has a good outcome. Infants double their length in the first year of life, with significant motor development (lying to standing position), which further affects the presentation and evolution of reflux making it a somewhat different condition to gastroesophageal reflux in the older child.

Group II. Gastroesophageal Reflux in the older children (teenagers and adolescents)
This type of reflux is similar to the ‘adult type’ of GOR and GORD. In older children, reflux that persists or is troublesome is much more likely to be clinically significant, especially when there is a history of nighttime waking. Other suggestive symptoms include tasting acid, upper chest burning pain, feeling of food getting stuck and discomfort with swallowing. This is more likely to persist
unless medical treatments are used. Barrett’s oesophagitis or oesophageal strictures are reported complications of untreated oesophagitis in children.


Certain paediatric populations have a much higher prevalence of GORD, these include:

- Children with neuro-disability (approximately 50%)
- Pre-mature babies
- Babies with coexistent respiratory or cardiac issues
- Children with disruption of the normal oesophageal neuroanatomy (for example, children with repaired oesophageal atresia/congenital diaphragmatic hernia)
- Children with genetic conditions such as Russell Silver10 and Noonan’s syndrome where pathophysiology is multifactorial and may be related to underlying foregut dysmotility.

It’s worth mentioning that quite often, this group of children receive polypharmacy by clinicians keen to control symptoms (some prescriptions are for 10-15 medicines used 2-3 times a day amounting to 45-50 doses daily of different medications); the authors (NAA, MT) have often seen GORD secondary to side effects of these treatments. The correct strategy in such cases is ‘clinical tailoring’ rather than prescribing more treatments (anti-reflux).

Aetiology of GORD

GOR is a common physiological condition in infants that does not require treatment. Some babies are fed more in a parental attempt to control distress, which creates a further cycle of upset, and can exacerbate regurgitation. Overfeeding diagnosed on a ‘detailed history’ should be addressed prior to attempting medical treatments. An experienced health visitor can play a significantly positive role in the management of GOR in infants and we strongly advise a health visitor referral for assessment, advice and support in such cases.

Sometimes GORD may be secondary to allergy or infection as discussed below.

Cow’s milk protein allergy (CMPA/CMP)

CMPA can present in infants with symptoms of GOR11. However, making such a diagnosis can be challenging in an infant and CMPA is overdiagnosed. In an observational study of 2,342 infants, 6.1% of parents of infants reported an adverse reaction to exposure to cow’s milk, but on oral testing only 2.7% were actually allergic12. Blood testing and skin prick tests (SPTs) have a lower predictive value in infants, compared to children, and some children may have a non-IgE mediated CMPA that responds to a 2 week cow’s milk protein (CMP) free diet.

Again, to make a diagnosis an accurate detailed history of the patient is essential and CMPA should be considered in the following:

- Presence of family history of allergic disease is suggestive but not diagnostic
- Symptoms affecting multiple organs may be suggestive of allergy, for example, eczema, blood in stools, diarrhoea. This is particularly relevant if infants have not responded to initial ‘reflux treatments’
- Worsening symptoms with increased doses of CMP eg. switching from breast to bottle feeding or changing from formula to cow’s milk.

The clinician should have a clear aim and plan before initiating a trial of CMP-free diet for 2 weeks, or when requesting tests such as blood tests and SPTs for allergies, which should be carefully interpreted in the actual clinical context of the child.

Helicobacter Pylori

Not every child with reflux requires testing for Helicobacter. Helicobacter pylori testing should be considered in areas of high prevalence13 and in children with symptoms of dyspepsia:

- Refractory reflux symptom pain
- Those with an unrelated iron deficiency anaemia particularly when dietary iron intake is adequate
- Helicobacter is assessed by stool serology (98% sensitive and specific), blood (94-95% sensitive and specific), or on urease breath test. When suspected, family members should also be screened.

Sequela of GORD

GORD is associated with a number of complications and is a clinical diagnosis. Investigations needed in conjunction with a paediatric gastroenterologist or a paediatrician with interest in paediatric gastroenterology.

Combined oesophageal multichannel intraluminal impedance and pH monitoring

The pH study was formerly the gold standard but has now been replaced by combined oesophageal multichannel intraluminal impedance and pH monitoring (MII-pH). The pH probe helps to determine the degree of acid reflux with the impedance allowing detection of the frequency and height of reflux episodes. The British Society of Paediatric Gastroenterology, Hepatology and Nutrition (BSPGHAN)14 has recently published guidance on its use with indications given in Table 2.

Gastroscopy with multi-level oesophageal biopsies

Gastroscopy15 helps to identify oesophagitis in children (indications in Table 3) and should preferably be undertaken by a paediatric gastroenterologist. Authors recommend doing 3 level oesophageal biopsies, to look for presence or absence of gradient of inflammation in the oesophagus. Typically, in GOR a higher number of inflammatory cells are seen in the lower oesophageal biopsy compared to the upper biopsy, whereas no gradient may be seen in eosinophilic oesophagitis. Eosinophilic oesophagitis may be secondary to allergy and mucosal IgG positivity has recently been reported in association with allergy related eosinophilic oesophagitis15-17. Further, multiple level biopsies in addition to the above alongside the correct identification of gastroesophageal junction are required when screening for Barrett’s oesophagus.

Barium meal

A barium meal is a very useful tool to detect foregut anatomy and diagnose conditions especially malrotation. It is important to assess the position of the Duodenaljunal flexure when looking for malrotation.

Table 2: Indications for combined pH and impedance investigations14

<table>
<thead>
<tr>
<th>Recurrent aspiration pneumonia</th>
<th>Unexplained apneas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unexplained non-epileptic seizure-like events</td>
<td>Unexplained upper airway inflammation</td>
</tr>
<tr>
<td>Dental erosion associated with neurodysplasia</td>
<td>Frequent otitis media</td>
</tr>
<tr>
<td>A possible need for fundoplication</td>
<td>A suspected diagnosis of Sander’s syndrome</td>
</tr>
</tbody>
</table>

Table 3: Indications for performing an endoscopy in GORD2

| Haematemesis not caused by swallowed blood (assessment to take place on the same day if clinically indicated) |
| Malena (black, foul-smelling stool; assessment to take place on the same day if clinically indicated) |
| Dysphagia (assessment to take place on the same day if clinically indicated) |
| No improvement in regurgitation after one year of age |
| Persistent, faltering growth associated with overt regurgitation |
| Unexplained distress in children and young people with communication difficulties |
| Retching, epigastric or upper abdominal pain that needs ongoing medical therapy or is refractory to medical therapy |
| Feeding aversion and a history of regurgitation |
| Unexplained iron-deficiency anaemia |

A suspected diagnosis of Sander’s syndrome.
Clinicians have historically often used a barium meal to diagnose reflux in children; this is inappropriate. A child may not reflux at the time of the barium meal test but reflux at other times of the day. Conversely, a child who does not like the taste of barium may vomit it and unless performed by an experienced paediatric radiologist may be diagnosed as severe GORD.

Fluoroscopy under Speech and Language therapist guidance
This test is performed by a paediatric radiologist in conjunction with a Speech and Language therapist and is considered where aspiration is suspected. Pooling of contrast in the valleculae, pyriform sinuses and pharyngeal recesses may point towards a swallowing abnormality. Aspiration is diagnosed when the dye tracks down into the larynx and tracheobronchial tree. Videofluoroscopy (VF) would typically be considered in a child where the cause of aspiration is unclear and often takes place in a multidisciplinary (MDT) setting with pre-planned GI investigations.

Gastric emptying or Milk scan
The test is based on the principle of administration of a feed consisting of a milk-based meal containing a radotracer (Technetium-99m) hence the name ‘milk scan’. The test is used to estimate, reflux and possible aspiration. Importantly there are no validated normal gastric emptying values in children and often T ½ emptying times are extrapolated from adult research studies. Late images may help to diagnose late activity in the lungs suggestive of aspiration.

Bronchoscopy and Laryngoscopy
Bronchoscopy and Laryngoscopy may help to identify LRD, however it is important to understand that this is based on direct visualisation of the mucosa. Usually there are no tissue biopsies taken with these procedures as one does with gastroscopy. Whereas histology results can be standardised, it is well known that visual reports are subject to inter-observer variation. The ‘reported’ findings therefore need to be interpreted with caution.

Radionuclide Salivagram Single Photon Emission Computed Tomography (SPECT/CT)
Radionuclide salivagram SPECT/CT may help to diagnose aspiration of small amounts of saliva particularly in cases of recurrent chest infections.

Treatment
A recent survey of 1,475 paediatric specialist’s beliefs about symptoms, diagnosis and treatment of GORD in premature infants showed a general disagreement on nearly all aspects of the management2. The difficulty lies in the diagnosis, being essentially clinically based. Variations are likely to occur in relation to personal interpretation and physician experience.

Medical treatments2,7
The NICE guidelines recommend a 4-week trial of PPI or H2 receptor antagonists. This applies to infants and young children and those with neurodisability who may not be able to report symptoms and have one or more of the following:

- Unexplained feeding difficulties (e.g. resisting feeds, gagging or choking)
- Distressed behaviour
- Failing growth

Alginates and sucralfate are used for the treatment of heartburn on an as required basis. These treatments are not without side effects, for example Gaviscon Infant Powder a popular formulation has sodium content of 0.92 mmol per dose and an infant taking 5-6 feeds would receive 5.5-6.5 mmols of Sodium per day, which may partly account for constipation observed in infants. Intraluminal impedance and the scanning utilities in children fail to highlight a significant difference in reflux after Gaviscon use when compared to Placebo3.

In children and young people with persistent heartburn, retrosternal or epigastric pain and endoscopically proven oesophagitis, there is good evidence that a PPI is efficacious. Ranitidine is the commonly used first agent that reduces basal and mealtime acid production and pepsin secretion. PPIs such as omeprazole, lansoprazole, esomeprazole, pantoprazole, rabeprazole etc constitute a group of drugs that reversibly inactivate H+/K+-ATPase - the parietal cell membrane transporter. This action increases the pH of gastric contents and decreases the total volume of gastric secretion, thus facilitating emptying. Liquid meal preparation is expensive and this unlicensed ‘special formulation’ doesn’t taste great (due to bicarbonate), but should be considered in children with gastrostomy and jejunostomy tubes.

Despite the commonly held belief that PPIs and ranitidine are safe treatments, these medications have side effects, as seen in 23% of children treated with H+ blockers and 34% of children treated with PPIs. These include headaches, diarrhoea, nausea and constipation29. The authors (NAA, MT) have also encountered some rarer side effects including allergic rashes, alopecia and lethargy in their practices. More recently population based studies in adults report oesophoritis and gastric cancer30. At this point, there is no evidence of those side effects in children.

Prescription of these medications always requires careful consideration.

The Medicines and Healthcare Products Regulatory Agency (MHRA) warning regarding Domperidone
Domperidone is a dopamine-receptor blocker that acts not only peripherally but also centrally, blocking chemoreceptor trigger zone (CTZ) receptors. There is moderate evidence of absence of efficacy for domperidone for treatment of GORD and despite this until recent times, domperidone has been commonly used in clinical practice as part of empirical medical therapy for GORD. In 2015 the MHRA raised concerns regarding prolongation of the QT interval (QTc) with the risk of cardiac side effects. Case reports have also described extrapyramidal side effects with Domperidone use31-32.

Lack of response to treatment, other feeding modalities and surgery
Lack of response or initial response with subsequent recurrence of symptoms warrants a referral to paediatric gastroenterology for further investigations. Jejunal feeding, endoscopic gastroaplastication33-34 and fundoplication are considered in severe persistent GORD and are beyond the scope of this article.

Conclusion
GORD and GORD are clinically based diagnoses and therefore a clinical approach to the patient is required for diagnosis. The outcome in infants is excellent and is different from GORD seen in the teenager. Early treatment should be considered in the vulnerable high-risk group with rationalisation of polypharmacy where possible. Trial treatments may be performed as PPI guidance and if there is any doubt with regards to the diagnosis a referral should be made to the paediatrician. Investigations for GORD should be decided in conjunction with a paediatric gastroenterologist or a specialist paediatrician who has an interest in paediatric gastroenterology.

References
Assessment and management of pediatric dysphonia

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Abstract
Introduction: Voice disorders affecting the pediatric population are common and complex. Treating clinicians must understand the anatomical changes occurring in the growing larynx, as well as the adjunct psychosocial ramifications related to these disorders. Clinicians must tailor practices commonly used on adult patients and adopt a specialized algorithm for managing these challenging and impactful conditions in children.

Methods: Review of the literature and discussion of clinical recommendations for assessment and management of common pediatric voice disorders.

Results: Specific challenges to as well as recommendations for evaluation and treatment of common phonotraumatic disorders in children are discussed.

Conclusion: Management of pediatric voice disorders differs from that in the adult counterpart and is optimized through specialized knowledge of pediatric anatomy and experience treating dysphonic conditions in children.

Key words
Pediatric dysphonia, pediatric voice disorders, phonotrauma, vocal fold nodules

Introduction
Disorders of the pediatric voice are widespread, with prevalence rates cited as high as 38% in the pediatric population1 impacting 1 million children in the United States alone.2 Etiologies of pediatric voice disorders are multifarious, and include congenital, inflammatory, infectious, and phonotraumatic causes. Vocal fold nodules are a common entity, accounting for approximately 5 to 40% of cases of pediatric dysphonia and are generally seen in children with excessive voice use or behaviors like crying and yelling, which may lead to vocal trauma.3 Other etiologies of pediatric dysphonia include laryngopharyngeal reflux, eosinophilic esophagitis, vocal fold cysts and polyps, vocal fold immobility, and rarely, pediatric laryngeal neoplasms.

Pediatric dysphonia has shown to have a significant influence on self-esteem, self-image and perceptions of children by peers, and may greatly impact patient socialization and quality of life.4 Furthermore, given the natural vocal transitions that occur as a child grows, certain pediatric voice disorders may be minimized or even overlooked; it is crucial for the pediatric otolaryngologist to pursue thorough, expeditious diagnosis and treatment of these conditions. Clinicians must consider the various factors contributing to vocal dysfunction in childhood, while also tempering parental expectations.

Pediatric Laryngeal Anatomy

Optimal management of pediatric dysphonia requires a thorough understanding of the dynamics and growth of the pediatric larynx. The pediatric voice owns many distinct features and undergoes a complex transition into the adult form. In childhood, the larynx is housed much higher in the neck, with the cricoid cartilage sitting around the C3-C4 level and descending into the adult position at C6 by about age 15.3 (Figure I).

The dimensions of the larynx also undergo significant transition as the child grows, altering the tone, loudness,
Assessment of Pediatric Voice Disorders

In pediatrics, the phrase, “children are not little adults” is commonly applied; this concept certainly holds true in the assessment of voice disorders in children. In most adults, the patient can provide a history of their voice complaints, phonate and speak when asked, and will tolerate an office laryngoscopic examination. In children, it is not uncommon to encounter patients who are silent or cry through an entire exam. For this reason, the multi-disciplinary model of assessing and treating these patients is paramount. Speech language pathologists with specialized training in pediatric voice disorders not only provide valuable assessments, which help point to a diagnosis, they can also establish rapport with children and help them to tolerate the examination. The benefits of this engagement are apparent when the patients need voice therapy as well.

Evaluation of voice disorders in children requires a complete head and exam examination. Anatomic factors affecting speech and language should be assessed in addition to a thorough laryngeal exam. Is there nasal congestion or tonsillar hypertrophy affecting resonance? Is there a history of ear infections and chronic otitis media with effusions and hearing loss? Pediatric patients often present with hoarseness in the context of overall poor speech intelligibility and the examination helps to elucidate each of these factors.

The mainstay of the evaluation, however, remains an examination of the larynx with fiberoptic laryngoscopy or videostroboscopy. In younger children, this is performed with a pediatric flexible fiberoptic endoscope, which can be as small as 2.2 or 2.4mm in diameter. Distal chip videostroboscopy can also be performed, as the endoscopes are available in pediatric sizes (3.1 or 3.2mm). Additionally, there are commercially available pediatric rigid scopes for videostroboscopy, which provide images comparable to those provided by standard adult rigid laryngoscopes.

In most children, evaluation of the larynx can be completed in clinic and does not require examination under anesthesia. The prospect of a scope exam, though, can be terrifying to children and requires patience as well as child and parental education prior to the exam. While laryngoscopy can be sufficient for some diagnoses, videostroboscopy has the additional benefit of the ability to assess glottal closure, mucosal wave propagation and subtle vocal fold lesions. Challenges to the scope exam in children include shorter attention spans, difficulty completing vocal tasks during the exam, and shorter phonation times.

These factors need to be taken into consideration when selecting the mode of evaluation. It is fairly easy to examine a child of any age with a pediatric flexible laryngoscope but laryngoscopy with voluntary phonatory tasks is more commonly successful in children who are at least 3 or 4 years of age. For the less common scenario in which a child cannot tolerate a laryngoscopy, laryngeal ultrasound may also provide information on vocal fold lesions and mobility.

Vocal assessments should also include perceptual evaluations of voice, patient reported outcome measures, and, ideally, acoustic and aerodynamic measures of voice. These instrumental measures of voice allow practitioners to assess the severity of voice disorders and objectively measure treatment outcomes. Inter and intra-rater reliability is strong for the Consensus Auditory Perceptual Evaluation of Voice (CAPE-V) in children. There are multiple options for quality-of-life assessments in the pediatric setting as well. This includes the pediatric voice related quality of life (PVRQOL) survey, pediatric voice outcome survey (PVOS), or pediatric voice handicap index (pVHI). Clinicians should be mindful that these questionnaires are obtained by parental proxy and there may be differences in voice perception and handicap by a parent versus a child.

Diagnoses and Management

Etiologies of pediatric voice disorders are varied, and management depends on an accurate diagnosis. Causes of dysphonia can range from vocal fold lesions, mobility disorders to functional change. Here we will focus on phonotraumatic lesions.

and pitch of the voice. Specifically, the true vocal folds have been shown to undergo a characteristic evolution during childhood years, with an increase in length through time, as well as changes to the mucosal wave-producing lamina propria layer, both of which contribute significantly to vocal transitions as a child grows.3 As an infant, the lamina exists as a single, hypocellular layer, and matures into a more organized, cellular, three-layered structure in adulthood.7

These structural changes are thought to relate to the functionality required at various stages of life and development, with more rudimentary vocal needs as an infant transitioning to more sophisticated vocalization as an adolescent and adult.1

The complexity of laryngeal development and phonation underscores the importance of specialized evaluation and management of pediatric dysphonia. An understanding of the different anatomic features and functional requirements of the larynx at various stages of development is paramount in the proper assessment, as well as medical and surgical management of pediatric voice disorders. In this section, we will focus specifically on the unique assessment and treatment of phonotraumatic lesions seen in children.

Assessment of Pediatric Voice Disorders

In pediatrics, the phrase, “children are not little adults” is commonly applied; this concept certainly holds true in the assessment of voice disorders in children. In most adults, the patient can provide a history of their voice complaints, phonate and speak when asked, and will tolerate an office laryngoscopic examination. In children, it is not uncommon to encounter patients who are silent or cry through an entire exam. For this reason, the multi-disciplinary model of assessing and treating these patients is paramount. Speech language pathologists with specialized training in pediatric voice disorders not only provide valuable assessments, which help point to a diagnosis, they can also establish rapport with children and help them to tolerate the examination. The benefits of this engagement are apparent when the patients need voice therapy as well.

Evaluation of voice disorders in children requires a complete head and exam examination. Anatomic factors affecting speech and language should be assessed in addition to a thorough laryngeal exam. Is there nasal congestion or tonsillar hypertrophy affecting resonance? Is there a history of ear infections and chronic otitis media with effusions and hearing loss? Pediatric patients often present with hoarseness in the context of overall poor speech intelligibility and the examination helps to elucidate each of these factors.

The mainstay of the evaluation, however, remains an examination of the larynx with fiberoptic laryngoscopy or videostroboscopy. In younger children, this is performed with a pediatric flexible fiberoptic endoscope, which can be as small as 2.2 or 2.4mm in diameter. Distal chip videostroboscopy can also be performed, as the endoscopes are available in pediatric sizes (3.1 or 3.2mm). Additionally, there are commercially available pediatric rigid scopes for videostroboscopy, which provide images comparable to those provided by standard adult rigid laryngoscopes.

In most children, evaluation of the larynx can be completed in clinic and does not require examination under anesthesia. The prospect of a scope exam, though, can be terrifying to children and requires patience as well as child and parental education prior to the exam. While laryngoscopy can be sufficient for some diagnoses, videostroboscopy has the additional benefit of the ability to assess glottal closure, mucosal wave propagation and subtle vocal fold lesions. Challenges to the scope exam in children include shorter attention spans, difficulty completing vocal tasks during the exam, and shorter phonation times.

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Vocal assessments should also include perceptual evaluations of voice, patient reported outcome measures, and, ideally, acoustic and aerodynamic measures of voice. These instrumental measures of voice allow practitioners to assess the severity of voice disorders and objectively measure treatment outcomes. Inter and intra-rater reliability is strong for the Consensus Auditory Perceptual Evaluation of Voice (CAPE-V) in children.9 There are multiple options for quality-of-life assessments in the pediatric setting as well. This includes the pediatric voice related quality of life (PVRQOL) survey, pediatric voice outcome survey (PVOS), or pediatric voice handicap index (pVHI). Clinicians should be mindful that these questionnaires are obtained by parental proxy and there may be differences in voice perception and handicap by a parent versus a child.10

Diagnoses and Management

Etiologies of pediatric voice disorders are varied, and management depends on an accurate diagnosis. Causes of dysphonia can range from vocal fold lesions, mobility disorders to functional change. Here we will focus on phonotraumatic lesions.
Voice folds nodules

In the pediatric population, the most common cause of persistent hoarseness remains benign, mid-membranous vocal fold lesions, specifically phonotraumatic nodules. The difficulty in distinguishing lesions such as nodules versus cysts, polyps, and pseudocysts in the adult population is underscored in the pediatric population. The first decision point in managing children with benign vocal fold lesions is often dependent on the question: are these vocal nodules or not? (Figure II).

Nodules are very common in children. By some estimates, rates of dysphonia alone can be as high as 10-11% in school aged children, and of these children 40-60% of them are diagnosed with nodules.11 In pre-adolescence, nodules are more common in boys. After puberty, this trend reverses and nodules become more common in girls. Etiologies for nodules in children include loud talking, screaming, singing, crying, and making sound effects. Family or parental modeling may also be an exacerbating factor.

There is no set algorithm for the treatment of nodules in children. The management decision tree must account for the age of the child, vocal handicap, and any prior treatments. Some studies have shown resolutions of nodules as voice complaints after adolescence in approximately 90% of boys. This percentage decreases to 40-50% in girls.12 In most children, however, voice therapy is the recommended treatment. Surgical excision is commonly offered, given high rates of improvement with voice therapy alone in nodules.

Other benign, mid-membranous lesions

Benign, mid-membranous lesions, such as polyps, cysts, pseudocysts and fibrous masses—distinct entities as compared to vocal fold nodules—are less common in children, but their true incidence is unknown (Figure III). Given the challenges of evaluation for pediatric dysphonia, it is likely that many children diagnosed with nodules, in fact, have other benign laryngeal pathologies.13 For this reason, it is important to follow children diagnosed with nodules, particularly those who do not respond to voice therapy alone or have worsening of their symptoms. Repeat laryngoscopy or videostroboscopy may be valuable in confirming or ruling out a prior nodule diagnosis. As in adults, laryngoscopic findings which may prompt an evaluator to consider diagnoses other than nodules include asymmetric lesions, locations more anterior or posterior to the striking zone of the true vocal folds, and deeper disruption of the mucosal wave.

Treatment for polyps, cysts, pseudocysts, and fibrous masses in kids includes surgical management in addition to voice therapy. The timing and extent of treatment is largely family driven and depends on a child’s ability to meet vocal demands. Factors that may prompt more aggressive treatment include frequent aphonia, painful phonation, difficulties communicating with teachers and peers, as well as vocal stigma and bullying. The decision to pursue surgical management in children with benign vocal fold pathologies must also take into consideration factors such as the ability to adhere to voice rest following procedures, and how this may impact surgical outcomes.

Surgical excision is frequently limited to one side to limit the risk of post-operative scarring. This often leaves a contralateral reactive vocal fold lesion that resolves with time and post-operative therapy. Parents need to be counseled of this pre-operatively so that their expectations for voice change immediately following surgery remain realistic.

Special considerations for the pediatric vocal performer

For the young vocal performer, it is imperative to understand the functional anatomy and constraints of the pediatric voice. Child performers may tend to take on stressful and vocally challenging roles with little preparation or training, which makes them particularly prone to phonotraumatic injuries. Instructors of pediatric vocal performers may advise limiting demanding roles until the child has fully matured from a vocal standpoint, including both full anatomical and technical voice development. Selection of a voice coach in the pediatric performer ought to prioritize an understanding of the unique risks to this population, the propensity for vocal overuse, and the need for a team-oriented approach to this challenging and rewarding practice.

Conclusion

Management of pediatric voice disorders requires a specialized understanding of pediatric laryngeal anatomy as well as the specific impact that these disorders may have on children. Phonotraumatic lesions are common, including vocal fold nodules, polyps, cysts, and fibrous lesions. Evaluation of these lesions in children can be challenging, and require adequate experience, proper equipment, good collaboration with speech language pathologists, and tacitful management of parental expectations. Management of the pediatric vocal performer warrants special considerations, to avoid vocal overuse injury and allow proper voice development prior to demanding roles.

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References

Scalp defect - Reconstruction protocol

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Abstract
The scalp defect reconstruction is one of the challenging procedures for the facial plastic surgeon in term of considering the anatomy and physiology of the scalp. The scalp reconstruction options are multifactorial. The factors that influence reconstruction include size, location, related to the hairline of the defect. However, the surgeon and patient preference play an essential role in selecting the technique to reconstruct the defect along with these factors. In this article, we are covering the related anatomy, detailed reconstruction protocols, and complications of the scalp reconstruction as a review article.


Key words
Scalp defect, Reconstruction, Wound Healing

Clinical Anatomy
The clinical anatomy of scalp is crucial for a better understanding of how to tailor scalp defect repair options. The scalp has five distinct layers which are usually described as SCALP (S: Skin; C:Subcutaneous tissues: A: galea Aponeurosis, L: Loose areolar tissues, and P: pericranium).

The scalp skin adheres as one unit with the subcutaneous layer. The neurovascular bundles run at the subcutaneous tissue layer which has, a significant impact during dissection in terms of preservation of the flap viability. The galea aponeurotica fuses laterally at the temporal line which result in a loose and an inelastic transition zone at this level. So, the flap superior to this line is inelastic and difficult to mobilize, while the inferior is lose rendering elasticity to the overlying skin. The fifth layer is the pericranium, that directly adheres to the calvarium and nourishes the skull bone.

The scalp is supplied by both internal and external carotid artery. The frontal scalp is supplied by both supraorbital and supratrochlear arteries, which are branches of the ophthalmic arteries that originate from internal carotid artery. The temporoparietal part of the scalp is supplied by superficial temporal artery which is terminal branch of external carotid artery.

The occipital and posterior auricular arteries which originate from the external carotid supply the posterior part of the scalp. Below the nuchal line at the posterior part the scalp is supplied by the muscleocutaneous perforators from splenius and trapezius muscles.

The lymphatic drainage of the scalp drain at parotid, jugulodigastric, posterior auricular, and occipital lymph nodes.

The nerve supply of the scalp is provided by three main branches of the trigeminal nerve. Supraorbital and supratrochlear branches of ophthalmic division supply the anterior part of the scalp up to the vertex. Zygomatocteporal branch of maxillary division supplies the lateral part of the scalp up to the temporal line. Auriculotemporal branch of the mandibular division supplies the lateral part of the scalp anterior to the auricle. Greater occipital and lesser occipital nerves which are branches of cervical spinal nerve and cervical plexus respectively supply the posterior part of the scalp posterior to the auricle.

The temporal branch of the facial nerve runs at the midzygomatic arch to supply the frontalis and corrugator muscles accompanied by the superficial temporal artery at the temporoparietal fascia.

The scalp has two main functions which are protection the calvarium and cosmesis as the scalp is the hair bearing skin.
moderate to large defect up to 30 cm² but not in irradiated skin to avoid flap necrosis. In our practice we commonly use O-Z and advancement rotational flaps.

**Free Tissue Transfer**

Free tissue transfer flap is a microvascular flap procedure that can close the medium to large defects up to total scalp defect. It is used to reconstruct defects that have been irradiated before that has jeopardized the blood supply. The tissue transfer flap can be harvested from radial forearm flap which is based on radial artery to anastomose with superficial temporal artery and superficial temporal vein or facial artery and common facial vein. Another option is an anterolateral thigh flap that is based on the perforator arteries.

Although the free flap is a good choice for large defects or irradiated skin scalp it has the morbidity to donor site and mismatching with recipient site.

**Other Procedures**

The hair transplant procedure could be an adjunctive procedure for scalp reconstruction repair to achieve the cosmetic goal especially for these procedures that may followed by alopecia. However, the hair transplant procedure can be used to restore the hair-bearing skin or as a camouflage for the scars.

Tissue expander can be considered as another option especially for distorted hair line defects but not irradiated skin. It will help to produce up to 2.5 times to the defect size depending on the volume of implanted expander.

**Conclusion**

Anatomical background of the scalp is the keystone to achieve optimal reconstruction result. Scalp reconstruction ranges from secondary intention to microvascular reconstruction flap. Local characters of the lesion and general health condition of the patient play an important role to select the best option to reconstruct the defect.

**Case Study**

73 years old presented with temporoparietal lesion as shown in (Figure 4). As part of clinical assessment, an incisional biopsy was done that revealed this as desmoplastic squamous cell carcinoma.

1. **What is your next step.**
   a. Explain to the patient nature of the disease
   b. Discuss with the patient the treatment plan.
   c. Explain to the patient different modalities of management including pros and cons of each.
   
   2. You decided with patient to excise the lesion under local anesthesia. Outline the technical procedure?
      a. Supine Position
      b. Marking the lesion with 5mm free margin
      c. Inject the lidocaine 2% with adrenaline 1:100,000 (Dose 5-7mg/kg)
      d. Perpendicular excision lesion at the loose areolar layer with safe margin
      e. Label the lesion
      f. Hemostasis achievement
      g. Reconstruct the defect either with regional graft, local flap or allograft. (Figure 5)
      h. Apply dressing

3. **What are the potential complications for such management?**
   a. Infection
   b. Bleeding
   c. Hematoma
   d. Failed graft
   e. Residual malignant tissue
   f. Skin mismatch
   g. Alopecia

**Figure 2:** Direction of O-Z flap can be tailored either antero-posterior or lateral to lateral side depend on skin defect size. Note Curvilinear line of incision.

**Figure 3:** Advancement rotational flap is a good option for the lesion close to the hairline.

**Figure 4:** Left Scalp fungated lesion with central necrosis measured 4.5 c.m.

**Figure 5:** Skin graft reconstruct of the scalp defect with full-thickness graft. Fenestrations made to prevent hematoma collection and allow direct contact to underlying tissue.
Clinical challenges in management of keloids: A review of literature

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Abstract
Keloids are one of the frustrating complications of the wound healing process that can affect individuals from functional, cosmetic and psychological point of view. For the surgeon this poses a significant challenge. There are several risk factors in keloid formation, some of which are unavoidable. This paper discusses these risk factors, to minimize the likelihood of keloid formation and manage them. Treating of keloids could range from non-invasive to invasive methods with variable success rates.

Key words
Keloid, Scar, Wound healing

Introduction
Keloid is defined as a proliferative fibrous growth that results from an excessive tissue response to skin trauma¹. This proliferation spreads beyond the confines of the actual incision. Nature of wound healing varies depending on many factors such as the mechanism of wound injury, racial characteristics², and site of the wound. At the cellular level, the type I-III collagen fibers lie in haphazardly connected loose sheets randomly oriented to the epithelial surface³. Overproduction of fibroblast proteins like transforming growth factor-beta (TGF-β) and platelet-derived growth factor (PDGF) in both abnormal wound healing responses suggests pathologic persistence.

Reference
of wound healing or down-regulation of wound-healing cells. There are several risk factors in the formation of keloids which play a role include hormonal balance as expressed by regression after menopause, or increase in size during pregnancy as well as a higher tendency in younger age groups. When the keloids form at aesthetically sensitive areas, it becomes a significant burden for both the patient and the surgeon. So, the full preoperative assessment, trying to minimize these risks is the cornerstone of managing the keloid.

**Clinical Presentation**
A patient with keloid presents with a discolored raised lesion at the wound site which extends beyond its margin. The lesion varies in size and color from one patient to the other (Figure 1). One of the important clinical features of keloid is the propensity for recurrence even after complete excision. The keloid impacts on patients either locally or in general. The local presentation of the keloid ranges from a conspicuous lesion, disfigurement, tingling sensation, severe itching or pain, sensitivity to changes in temperature particularly cold, tenderness and restriction of mobility. The general effects of keloids are psychological impact in terms of decrease self-esteem and in extreme cases depression. Furthermore, the keloid influences the patient’s quality of life either directly or indirectly.

**Management of the Keloid:**
The timing of managing keloid is very crucial and should start as early as possible especially in high-risk patients. The preventive measures of the keloid formation begin when there is a high index of suspicion, for those high-risk patients before keloid formation (Table-1).

<table>
<thead>
<tr>
<th>Management</th>
<th>Mode of action</th>
<th>Timing</th>
<th>Dose</th>
<th>Adverse Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silicone Sheath</td>
<td>• Pressure affect</td>
<td>• Use at first 6 months.</td>
<td>• Positive family history</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Induce dermal layer hydration</td>
<td>• Used as adjunctive therapy</td>
<td>• Wound at aesthetic area</td>
<td></td>
</tr>
<tr>
<td>Oil Lotion</td>
<td></td>
<td></td>
<td>• Type V-IV skin</td>
<td></td>
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<tr>
<td>Massage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Secondary Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical Excision</td>
<td>Surgical Removal</td>
<td>• After 6 months.</td>
<td>10-20mg</td>
<td>Recurrence</td>
</tr>
<tr>
<td></td>
<td>(Ellipse, Z, or Y-plasty)</td>
<td>• Negative psychological impact.</td>
<td>2-4 weeks interval (4-6 months)</td>
<td>Dermal atrophy Telangectasia</td>
</tr>
<tr>
<td>Intralesional Steroid</td>
<td>Decrease production of TGF-β2</td>
<td>• Impaired Mobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Triamcinolone Acetate)</td>
<td></td>
<td>• Failed Primary measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Advance Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>Induce Apoptosis of proliferative cells</td>
<td>• Recurrence.</td>
<td>15-20 Gy 4-5 sessions 24-48hr postoperatively</td>
<td>Carcinogenic</td>
</tr>
<tr>
<td>Chemotherapy (5-FU)</td>
<td>Inhibit fibroblast proliferation</td>
<td>• 50–150 mg per week for a maximum of 16 injections</td>
<td>Pain Hyperpigmentation</td>
<td></td>
</tr>
<tr>
<td>Cryotherapy</td>
<td>Induce tissue ischemia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adjunct Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological Counseling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoid Sun Exposure</td>
<td></td>
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</table>

**Figure 2:** Showing pre- and Post-radiotherapy management of keloid Left: Pre-Radiotherapy. Right: Six Months after radiotherapy.
imperative to minimize skin tension in the operating room. Careful and meticulous handling of tissue and precise wound edge alignment can help limit adverse healing.

The current trend in managing keloid as an office-intervention modality is injection of triamcinolone acetonide. The dose of triamcinolone acetonide is 10-20 mg every 2-4 weeks up to six sessions. It inhibits the fibroblast growth and promotes collagen degradation which can lead to symptomatic improvement in 72% of patients and complete flattening in 64% of lesions. Adverse effect of intraliesional corticosteroids include hypopigmentation, dermal atrophy, and telangiectasia.

Advanced measures in treating recurrent keloids are radiotherapy, chemotherapy, or cryosurgery. However, the response rates to radiotherapy vary dramatically across studies. When used, radiotherapy as single or adjuvant modality of management produced relief of symptoms in 55% of patients, but about two third of the scar showed mild or no change in size (Figure 2). The fact that radiation is a potential carcinogen means it has to be used as an adjusted dose in selected patients.

However, the radiotherapy or injectable steroid could be used as concurrent therapy with surgery to increase the chance of improvement and prevent recurrence especially for those patients who are refractory to single modalities of management.

Cryotherapy has also been used as monotherapy and in conjunction with other forms of treatment for scars. It is thought that cryotherapy induces vascular damage that thought that cryotherapy induces vascular damage that Thought Thought causes anoxia and ultimately tissue necrosis for the keloid. Another option to treat keloid is the use of laser technology. Argon laser was the first amongst lasers to be used for keloid therapy. But because of the minimal improvement in scar flattening, it was abandoned for carbon dioxide, Nd:YAG, and flashlamp-pumped pulsed-dye lasers (PDLs). When the carbon dioxide laser was used as a monotherapy, recurrence rates were 90% or higher. The Nd:YAG laser has been used with encouraging results and recurrence rates around 17%. Over the past decade, the PDLs, which targets oxyhemoglobin, has been shown to provide durable improvement in hypertrophic scars and keloids.

Conclusion
Keloid formation can be a challenging sequela of a pathological wound healing process. Understanding the cellular pathology and risk factors of the keloid play an important role in its prevention and management.

Management of keloids may has to be at multi factorial depending on the severity and intervention time. High success rates are achieved when managing these through multidisciplinary approach.

References:

Algorithm for the management of lateral crural pathology

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Abstract
Nasal tip deformities are often the most challenging aspect of rhinoplasty. The lateral crus (LC) is an integral component of the nasal tripod and deformities relating to LC size, contour and position can affect the nasal tip architecture.

In this article we aim to describe an algorithm for assessment and management of LC pathology and consideration of available surgical techniques.


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Keywords
Nasal tip-plasty, Lower lateral Cartilages, Lateral Crura, alar rim.

Introduction
The nasal tip is a soft and mobile structure. Its architecture is largely defined by two lower lateral cartilages (LLC). The LLC consist of three anatomic sites: medial, intermediate and lateral crus and abnormality of one or more of these structures can give rise to a myriad of nasal tip deformities (Figure 1). Their interplay with the surrounding structures, including the nasal septum and upper lateral cartilages (ULC), as well as the overlying skin and soft tissue envelope (STTE) determines the architecture and aesthetics of the nasal tip.

Lateral Crural (LC) deformities are rarer when compared to medial crural deformities particularly in traumatic noses. Deformities of LC not only cause structural issues with the cosmesis, but also impact nasal function causing nasal obstruction in the external nasal valve region. Surgical procedures to correct lateral crural issues are far more complex than correcting medial crural issues. Inadequate or over resection of the lateral crus can result in secondary issues, including asymmetry, alar retraction, alar rim deformities and even external valve collapse. Unsurprisingly, over-resection of the LC and tip asymmetry is the commonest indication for revision tip-plasty in secondary rhinoplasty cases. In recent years the tip-plasty paradigm has shifted towards increased preservation of the LC and controlled modification of its shape and position to create a more functional tip aesthetics.

In this article we aim to review the anatomy and pathophysiology of LC abnormalities and propose a simple algorithm for assessment and surgical planning.

Anatomy
The size, shape and strength of the lateral crus along with the medial crus constitutes a major tip support mechanism. Anatomically the tip complex is not “an ideal” creation of nature. The two Lateral crura are larger and heavier than the medial crus and constitutes the two limbs of the nasal tripod and the conjoined medial crura act as the third limb of the nasal tripod, supporting the weight of the LC. The usual pathophysiology seen in traumatic cases is a weak, fractured or separated medial crus unable to support the weight of the relatively heavier lateral crus. Therefore, the senior author’s concept in nasal tip surgery is “To make the big guy (lateral crus) smaller and lighter, and the small (medial crus) guy bigger and stronger”.

The LC is a broad thin (0.5mm) cartilage arising from the intermediate crus and the dome laterally towards the...
The LC has four main borders that determine its interaction with surrounding structures. The caudal border follows the alar margin until the mid-point of the rim before turning cephalad. The cephalic border interacts with the caudal segment of the ULC at the scroll area constituting a major tip support mechanism. Its lateral border interacts with the accessory sesamoid cartilages. Medially the LC is continuous with the dome and the intermediate crus. The cartilage is orientated at 45 degrees from the vertical axis.

Lateral crural algorithm

The main aim of constructing this algorithm is to provide a simple, systematic approach to diagnosis of LC deformities and aid in selection of appropriate surgical techniques. We will examine the Size, Shape, Strength and Site of the LC to identify pathologies and recommend surgical strategies, including sutures, grafting and non-suture non-grafting techniques to address these deformities (figure 3).

Pathogenesis of LC deformities: Primary vs Secondary.

Assessment of the nasal tip is the key step that determines surgical planning. Overlooking this important step can result in failure to adequately predict the deformities in the alar cartilages prior to surgical intervention. Apart from the clinical experience of the surgeon, there are no special tests available in predicting the pathogenesis of the deformity.

In assessing the pathogenesis of the LC deformities, we need to make a distinction between Primary deformity (i.e. arising from the LC) or Secondary deformities due to SSTE, ULC deformities or the caudal septum abnormalities. It is important to note this interaction as it must be considered in the surgical plan. For example, a very thick SSTE often encountered in ethnic noses can manifest as bulbosity and the subsequent modification to the underlying cartilage may not appear through this thick skin envelope. An additional factor to consider when assessing the LC is whether the problem is unilateral or bilateral as often there will be different pathologies affecting each side and a degree of asymmetry may exist.

Size

There is a significant variation in width and length of the LC in the population and this varies from Caucasian to the ethnic population.

Lateral Crural Width (broad vs. narrow)

The average width of the LC is approximately 11mm. Broad LC results in excess bulk and bulbosity of the nasal tip. This is the most frequently encountered configuration...
Overlap technique: interruption of the LC and mobilisation of the domal segment to overlap the LC and re-anastomose; the desired length is excised and the LC is reattached with sutures.

An Alternative approach is to excise a segment of the LC and re-anastomose it using sutures, however this can destabilise the LC and result in long term weakness of alar rotation of the nose and vice versa.

Modifications of this technique have been described to utilise the cephalic portion as either grafts, or hinged/ trans-positional flaps in order to strengthen the LC and reduce the anatomical dead space to prevent unpredictable post-op changes.

A narrow LC is more often encountered in revision cases due to previous over resection or less commonly secondary to congenital causes. It can result in structural abnormalities causing pinching and retraction of the alar rim as well as functional impairment due to external nasal valve collapse. A narrow LC requires reconstruction and we advocate the use of alar grafts including LC strut grafts (LCSTRG) with or without alar contour graft (rim graft) (Figure 6).

Lateral Crural Length (short vs long)

The length of the LC along the transverse axis plays an important part in tip projection and rotation, where for example a long LC can result in over-projection and under rotation of the tip and vice versa.

In cases where there is a Long LC we advocate LC overlap to reduce the length and de-project the nose. This is performed by interrupting the LC 5-6mm lateral to the dome, and elevating the medial segment from the underlying skin and allowing it to advance over the lateral segment. This results in a moderate degree of tip de-projection. The LC is then stabilised using suture techniques.

An Alternative approach is to excise a segment of the LC and re-anastomose it using sutures, however this can destabilise the LC and result in long term weakness of alar rotation of the nose and vice versa.

A short LC can result in under-projection and over rotation of the nose and is commonly seen in revision cases due to over-resection and scar contracture. In such situation additional length can be achieved through LC strut grafts or batten grafting. Alar Batten grafting has been utilised in addressing weakened nasal valve to support the LC and the ULC (Figure 8). We harvest this graft from the contralateral conchal cartilage with an extended limb laterally and insert it into a small pocket over the pyriform aperture and secure it sutures to the LC. In addition to allowing extension of the LC and tip projection, it also strengthens the external nasal valve (ENV) by preventing collapse. In our practice, we tend to favour LC strut grafting over batten grafting. Placing a batten graft on top of the LC adds additional weight to an already weakened LC increasing the bulk and delayed post operative chance of external valve collapse.

Shape: Convex or Concave

Assessment of the LC shape should take place along its transverse and vertical planes. Excess convexity is the most common abnormality seen resulting in bulbosity of the nasal tip. Numerous techniques exist for correcting LC of the LC. In this situation a cephalic trim is employed to reduce the width, preserving at least 8mm of LC and the underlying tissue (Figure 5). The cephalic border of the LC tends to curl downwards at the scroll area and it is important to ensure that all of this segment is excised. This procedure creates an anatomical dead space that slightly draws in the LC, causing a minor degree of tip upward rotation. If the underlying soft tissue is grossly disturbed it can result in cephalic migration of the LC and subsequent alar retraction.

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Figure 6: Narrow Lateral Crus. A. annotated image to demonstrate the inadequate width of the LC causing collapse and insufficiency. B. Lateral Crural Strut grafting: cartilage is placed underneath the LC and sutured in place.

Transdomal suturing technique: interruption of the LC and mobilisation of the domal segment to overlap the LC and re-anastomosis; the desired length is excised and the LC is reattached with sutures.

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Figure 7: Long Lateral Crus. Excess length of the LC can result in Tip over-projection and under rotation. A: Lateral crural overlap technique: interruption of the LC and mobilisation of the domal segment to overlap the LC. B: Lateral Crural Excision and re-anastomosis; the desired length is excised and the LC is reattached with sutures.

Figure 8: Alar Batten Grafting. A and B, Contra-lateral conchal cartilage graft is used to create the graft with an extended lateral apex to allow overlap onto the pyriform aperture. C, the graft is then secure to the LC with sutures.
convexity. Most commonly employed are a combination of cephalic trim and suture techniques that either directly or indirectly control the LC convexity. We recommend as the first line, cephalic trim to debulk followed by transdomal suturing (TDS) using either 5.0 PDS or ethilon suture, applying medial tension at the dome to indirectly flatten the LC. If further reduction in convexity is required, then additional Lateral crural reverse plasty can be employed to directly flatten and strengthen the LC14.

Excess concavity of the LC is usually associated with a fracture or a weak spot at the junction of the lateral crus and the intermediate crus. A concave lateral crus is obvious on examination, seen clearly either in a frontal, lateral or ¾ view. The pattern of light reflection and shadowing is altered with excess light reflection at the alar rim and an acute transition from the tip lobule to the alar region. Internally this can cause obstruction of the internal and external nasal valve and the turbulent airflow created due to reduced cross sectional area at these points causes collapse on inspiration.

Minor concavity of the LC without significant nasal valve insufficiency can be successfully corrected using mattress suturing along the transverses plane of the cartilage. Although this technique can be difficult to execute. We find that camouflage grafting is adequate in addressing such minor concavities.

In Severe deformities with significant nasal valve dysfunction, a LC reverse plasty / LC Trun-in Flap (LCTIF) is a useful technique that allows conversion of a grossly concave LC into a convex shape by reversing the orientation of the cartilage (Figure 10). The LC is mobilised and dissected off the vestibular skin. The cartilage is transected at the medial origin of the concavity, flipped over and sutured back to the remnant intermediate crus and vestibular skin.

An alternative method is the Lateral crural turn in suture technique. This can be performed where there is adequate width of the LC preserved. Here, the cephalic half of the LC is mobilised from the soft tissue (Figure 11). A 2mm transverse incision is made medially releasing the cephalic segment and the two concave surfaces are sutured together thereby correcting the concavity and reducing the width of the LC17.

Batten grafts and LC strut grafts can also been used in cases where there is over-resected concave LC to correct the concavity and strengthen the nasal valve.

Strength
Anderson’s tripod theory emphasises the significant role that each LC plays in nasal tip support. We know that the resilience and strength of the LC is a crucial factor in preventing external nasal valve collapse. Assessment of the strength of the LC should take place pre-operatively, and photographic documentation should be obtained of any weakness or collapse particularly on deep inspiration. It must also be noted that certain ethnic noses characteristically have weaker LC cartilages and are associated with thicker skin exerting excess weight20,21 and this should be factored into the surgical plan. Over resection, fracture, and congenital weakness of the LC can also significantly reduce its strength.

A variety of methods exists for increasing strength and support of the LC most of which have been described above. Grafting techniques such as LCGS and batten grafting remain effective methods of increasing strength and LC stability. LC overlay technique for example has been demonstrated in cadaveric studies to increase the strength and resilience of the LC and the nasal tip. Suture techniques such as mattress suturing, interdomal and transdomal sutures are also useful at increasing strength of the LC12,14.

Site
We used the term Site to define 2 aspects of the LC position that requires individual evaluation: 1) LC position from the alar margin 2) LC orientation (i.e. angle of rotation from the midline).

The distance between the caudal border of the LC to the alar margin is approximately 6mm at the mid-point of LC. If this distance increases it can result in alar rim deficiency, retraction and notching of the alar rim. In such situations insertion of an alar rim graft is a useful method of restoring the contour of the rim and strengthening the external nasal valve. This can be done either as part of the primary procedure where the graft is sutured onto the LC, or as a separate incision laterally to insert a ‘matchstick’ graft towards the midline.

The distance from the caudal border of the LC to the rim can also increase due to cephalic malposition of the LC (LCM)24. This is defined as any deviation of the caudal border of the LC away from the alar rim, with a reduction of the angle of orientation between the LC and midline (<30 degrees measured angle from caudal border to the midline).

Cephalic malposition is associated with several characteristics: long alar crease, ball shaped tip, parenthesis deformity and external nasal valve incompetence.

Figure 10: Lateral Crural reverse plasty (turn in flap). A, technical aspects of performing LC reverse plasty (turn in flap). The LC is dissected freely and reversed to turn the concavity into a convexity. B, pre- and post- operative results demonstrating restoration of normal contour of the LC.

Figure 12: Alar Rim graft. The deficiency in the alar rim is marked out. A cartilaginous graft is inserted through a separate incision to restore the contour and increase the strength of the alar rim.
Numerous techniques have been described for correction of LCCM24-27. Insertion of a rim graft caudal to the malpositioned LC has been used previously to bring the Caudal border down. However, LC strut grafting has been described as a more successful method of repositioning the LC. In our practice we fully mobilise the LC from the soft tissue bilaterally and create a rotational pivot around the columella by inserting medial crural fixation sutures with or without a strut graft. This manoeuvre can form an arc of rotation that can relocate the LC caudally, which can then be secured with sutures.

**Discussion**

Control and refinement of the nasal tip is the most difficult aspect of rhinoplasty. Modern rhinoplasty aims to modify the contours of the nasal tip to create a more balanced appearance. A thorough knowledge and understanding of the LLC anatomy and its relationship to the surrounding structures is required for accurate pre-operative planning. We have presented our algorithm for management of the LC pathologies with the aim of simplifying the approach by focusing on key anatomic and physiological characteristics and techniques that can correct and modify these factors to improve nasal tip architecture and function. Most commonly encountered pathology of the LC is a broad convex deformity causing tip bulbosity which is corrected using cephalic trimming and transdomal suturing. Numerous alternative surgical techniques have been described to address other LC abnormalities.

Recent studies have demonstrated and quantified the impact of such techniques on overall nasal tip function28,29. It is clear that a conservative approach to LC resection along with preservation and restoration of structural attachments between the LC can reduce the rates of revision tip plasty. This coupled with addition of structural grafts and suturing techniques as well as variable effects of scar tissue formation can add to the overall nasal tip support.

Given the absence of any consensus regarding the ideal surgical strategy for managing nasal tip deformities, this algorithm merely represents our experience with this pathology and the techniques that have provided us with consistent and satisfactory results. As such our recommendations are a general guidance and should be considered in the context of individual patients.

**Conclusion**

The lateral crus of the LLC is has a 3-dimensional anatomy and constitutes a major tip support mechanism. Its size, shape, site and strength impacts the form and function of the nasal tip. A thorough knowledge of surgical techniques along with fundamental principles of nasal tip architecture is required to control and refine the nasal tip to achieve reproducible, lasting and satisfactory outcomes. Our algorithm aims to address this complex problem in a systematic way.

**References**

Osteoma and Exostosis
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Key words

Introduction
Ear canal exostoses are smooth, sessile and broad-based bony outgrowths that typically arise on opposing surfaces of the ear canal adjacent to the tympanic membrane. They are frequently discussed in the literature alongside ear canal osteomas which, in contrast, are unilateral and tend to lie more laterally in the canal and in relation to the suture lines. Whilst most are incidental findings in asymptomatic patients, problems present as recurrent cerumen impaction. Exostosis surgery should be reserved for failed conservative treatment: >80% external auditory canal narrowing is considered a threshold, beyond which a greater frequency of infections and sequelae occur. This review presents an overview of both exostoses and osteomas, summarising the role of surgery and its associated risks.

Defining exostosis and osteoma
Exostoses develop as two to three areas of laminated peristosseal bone arising from the compact bone that forms the tympanic ring. Histologically, they are composed of concentric lamellae of bone resulting from hyperostosis. Cold water immersion stimulates the successive layering of peristosseal bony matrix, initially on the anterior and subsequently the posterior walls. Osteomas are solitary, unilateral, and pedunculated lesions, related to either the tympanomastoid or – less commonly – the tympanosquamous suture lines. It is uncommon that they become so large as to cause obstruction of the ear canal. Histologically, they have a typical appearance of peristosseal bone, with an outer cortex and inner cancellous trabeculations with abundant fibrovascular channels.

Osteomas and exostoses are distinct clinical entities. Osteomas are benign neoplasms that can occur anytime from childhood, whilst exostoses are considered reactive lesions that occur after puberty. Osteomas are comparatively less common though remain the most common benign tumours of external ear canal. As it is uncommon to be in a position to send a specimen due to the techniques employed in removal, there are scarce reports of the true histopathological findings that distinguish between the entities. The absence of fibrovascular channels has historically been considered to differentiate exostoses from other pathologies. However, Fenton et al. concluded that the presence or absence of fibrovascular channels could not reliably differentiate between the two processes.

Natural history
Colloquially referred to as ‘surfer’s ear’, cold water exposure – and the duration of that exposure – is as reflected by the key factors in exostosis development; a high prevalence in US military divers. Anthropological studies estimate a mean prevalence of aural exostoses in historical populations of 10.8% (range 1.1 to 31.8%); a higher prevalence is recognised amongst aural exostoses in historical populations of 10.8% (range 1.1 to 31.8%); a higher prevalence is recognised amongst those with greater marine or freshwater exposure. The highest prevalence would be expected in populations between 30 and 45 degrees of latitude and this is borne out across meta-analysis of published anthropological studies. A study of Japanese surfers found more severe exostoses were prevalent in those based in colder seawater areas (<16°C). Professional surfing and a self-reported willingness to surf in cold water (<60°F) are associated with increased incidence of occlusive exostoses. Both temporal bone and anthropological studies of exostoses have their inherent limitations, since they include cases of osteoma and minor degrees of bony canal swellings. The ‘clinical incidence’ is reported to be lower at around 0.64%. The difference in prevalence reported in anthropological and clinical studies, and the number of operations performed in small published series, suggests that in most cases exostoses remain asymptomatic or are never diagnosed. An estimate of the ‘surgical incidence’ is between 1.1-5.1 cases/unit/year in Europe to 11 cases/unit/year in larger referral centres from highly populated coastal regions in the US and Australasia.

Exostoses typically begin on the anterior wall, with progressive growth and subsequent appearance of posterior canal wall swellings. The main symptoms are hearing loss and recurrent otitis externa. Conservative management with regular atraumatic micro-suction is often sufficient. Once the ear canal reaches >80% narrowing, the consequences of insufficient access for both topical antimicrobials and effective micro-suction lead to obstruction of normal epithelial migration. Surgery can be considered once conservative measures fail. Secondary surgical indications include access for middle ear procedures, including ossiculoplasty or stapectomy.

Left untreated, ongoing water exposure will continue to stimulate hyperostosis and expansion of exostoses, leading to an increased frequency of sequelae. A ‘surfing index’, based on the number of surfing days/week, better correlates with severity than the total duration of surfing in years. The surfing community is increasingly aware of the advice recommending ear canal protection from cold water immersion, though uptake remains low at 25-54%. Patients should be counselled about the consequences of a return to surfing and encouraged to adopt practices that minimise exostosis recurrence.

Principles of exostosis and osteoma surgery
Beyond exostoses and osteoma, canalplasty is typically undertaken for stenosing otitis externa and surgical access. Exostoses surgery is unique amongst these indications in that the ear canal skin is typically healthy and requires preservation. When either pathologies are significantly obstructive that they cause symptoms, the clinical picture of either osteoma or exostoses is broadly similar and merit a similar surgical approach, albeit exostoses typically occur medial to the isthmus and osteoma in a more lateral location. The goals of surgery are of improved hearing and achieving an ear canal that can be cleaned or self-cleanses. Preoperative imaging provides an appreciation of the course of the facial nerve, its relationship to the annulus, and recognition of the degree of aeration of the mastoid portion of the temporal bone (figures 1 & 2). Several principles of canalplasty ensure the surgery proceeds safely and confidently: (1) surgical access, (2) mean skin preservation, and (3) tympanic membrane protection.

The preservation of healthy meatal skin is a priority to avoid post-operative formation of granulation tissue and a resulting fibrous stenosis. A canal skin flap is typically created as medial as is feasible; radial incisions can be extended to enable dissection of the healthy skin from the exostoses. Prolonged post-operative healing, with a requirement for repeated repacking in the medium to long-term, must be stressed when counselling a patient for surgery. The skin flap is dissected and, once elevated, can be protected using silastic, bone wax or, more commonly, aluminium – sourced from a suture pack – whilst drilling (figure 3). Ensuring adequate lateral exposure permits a safe approach and enables the more medial dissection to occur under direct vision. Sanna et al. emphasise that, whilst drilling, ‘the movement is always parallel to the
typanic membrane or in a medial to lateral direction, never lateral to medial.19.

Accepting that some skin loss will be inevitable, Tos et al.1 recommend a ‘realistic’ approach to flap management. This is achieved by ensuring the bare area of canal is kept to a minimum, firstly through lateral skin elevation and, secondly, protection of the medial skin by maintaining an eggshell of bone, hollowing out the exostosis. Exposed meatal bone may be covered by temporalis fascia grafting or split thickness skin grafting techniques.

The two key structures at primary risk during exostosis surgery are the facial nerve (posteriorly) and the temporomandibular joint (TMJ) (anteriorly). TMJ disruption leads to both increased post-operative pain and a prolonged recovery.16. Tympanic membrane perforation is reported in up to 9%22. Contact between the drill and infection, and conductive healing loss. Osteomyelitis is a frequent post-operative visits for repacking, post-operative or fibrous, prolonged healing and granulations requiring additional complications include restenosis – either bony or fibrous, prolonged healing and granulations requiring frequent post-operative visits for repacking, post-operative infection, and conductive healing loss. Osteomyelitis is a rare but recognised complication.20.

Removal of the anterior exostosis bone is recommended as the initial step, especially when performing a transcanal approach; the posterior canal drilling is not tackled until the tympanic membrane is visible, since the annulus remains the only anatomical relation to the facial nerve in the external auditory canal. The highest risk of injury exists at its postero-superior aspect, arising from a direct or indirect (thermal) injury to the descending portion of the facial nerve. Partial, transient, and delayed facial palsy is reported in up to two per cent, in a large, single-surgeon series.23.

Selection of surgical approach
Exostosis surgery is a procedure that may otherwise be regarded as straight forward. The surgery can be undertaken under either general or local anaesthesia, though general anaesthesia is usually better tolerated. The use of a chisel or micro-osteotome, either solely or in combination with a drill, has been reported to improve safety and tolerance.24,25. The transcanal approach limits access for tackling the anterior exostosis but ensures more rapid post-operative healing.3. An endoscopic technique, using a 2mm osteotome-assisted removal of exostoses, reported improve meatal skin preservation and technique, using an osteotome-assisted removal of exostoses. In two of the largest single-institution published series to date, the approaches reported by Fisher et al.26 were transcanal (69%), endaural (28%) and post-auricular (3%). In contrast, Grinblat et al.27 performed a post-auricular approach in the majority (95.7%). Central to selecting an approach is familiarity and experience with a particular approach allowing an understanding of the orientation of the canal during bone removal.

Identification of the spine of Henlé is a vital initial step performed with significant bony swellings that inevitably distort the canal. This ensures soft tissue elevation proceeds without violation of the lateral canal skin flap. Drilling that is directed towards the superior aspect of the ear canal and into the root of the zygoma can improve this exposure. An endaural approach allows a direct access to the canal superiorly but can limit the size of temporalis fascia graft available for harvest. The post-auricular incision gives better access to the temporalis fascia, without any greater reported complications.28,29. The transcanal approach limits access for tackling the anterior exostosis but ensures more rapid post-operative healing.1 An endoscopic technique, using a 2mm osteotome-assisted removal of exostoses, reported improved facial skin preservation and no intra-operative complications.24. The use of a chisel or micro-osteotome, either solely or in combination with a drill, has been reported to improve safety and tolerance under local anaesthesia.30,31.

Facial nerve monitoring should be considered essential since, in the absence of landmarks for key structures in the
bony external auditory canal, surgical misadventure can lead to significant complications\(^2\). A relatively higher rate of facial nerve injury is recognised following canalplasty\(^2\). It should be highlighted that, whilst widening the posterior canal wall, rolling the patient away from the surgeon will have the effect of positioning the facial nerve between the annulus and surgeon, inadvertently increasing the risk of injury. A technique of addressing only the anterior exostosis via a permeal approach, with effective results and whilst avoiding the risk of facial nerve injury, has been advocated and may have a selective role\(^2\).

Novel surgical techniques reported in the literature, and alternatives to the traditional drill and osteome, include the use of an ultrasonic serrated knife for exostoma removal\(^3\), and the use of piezo technology for both exostosis removal\(^4\) and as part of a trial in osteoma hearing loss, closure of air-bone gap to <10db is reported\(^5\). Outcomes include measures of air-bone gap closure and terms of re-stenosis or complication rates. Audiometric outcomes for exostosis surgery primarily report success in measuring outcomes\(^6\).

Conductive hearing loss, infections or theoretical risks of rare lead to significant complications\(^7\). A relatively higher rate of facial nerve injury is recognised following canalplasty\(^8\). The use of an ultrasonic serrated knife for osteoma removal\(^9\), and the use of piezo technology for both exostosis removal\(^10\) and as part of a trial in osteoma surgery evaluating outcomes in ten patients\(^11\).

Measuring outcomes

Outcomes for exostosis surgery primarily report success in terms of re-stenosis or complication rates. Audiometric outcomes include measures of air-bone gap closure and the avoidance of an iatrogenic conductive or sensorineural hearing loss. When operated on primarily for conductive hearing loss, closure of air-bone gap to <10db is reported in 50%\(^12\).

Pre-operative counselling of patients includes the avoidance of ongoing cold-water immersion with advice to adopt techniques to limit likelihood of recurrence. However, given the patient population, patients may be less likely to restrict themselves from future sporting or professional activities that have caused their symptoms.

Conclusions

Exostosis and osteoma are distinct clinical entities, which rarely lead to significant complications and can be managed conservatively in the vast majority of cases. Conductive hearing loss, infections or theoretical risks of ear canal cholesteatoma are sequelae that may warrant surgical intervention. Distorted anatomy, limited access and proximity of the exostoses to the vertical portion of the facial nerve, TMJ and tympanic membrane, can mean the surgery is challenging and carries greater risk of complications.

Surgical options for managing exostoses include transcanal, endaural, postauricular and endoscopic techniques. Increasing numbers of publications advocate chisel or mini-osteotome removal either in isolation or combined with a surgical drill. Counselling patients prior to exostosis surgery on the risk of re-stenosis requires advice on future avoidance of cold-water immersion and a potential prolonged post-operative healing phase that may require frequent repacking and regular attendance in the outpatient department.

References

Assessment and management of paediatric balance disorders

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Abstract

Children with imbalance present infrequently to the ENT surgeon and are often seen by multiple specialties. The main diagnoses in dizzy children include vestibular migraine, central structural disorders and trauma. Balance disorder can be seen in association with sensorineural hearing loss and/or syndromes. However, children can develop any of the balance disorders that we commonly see in adults.

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Key words

Paediatric, vestibular, balance, migraine

Introduction

Around 14.5% of school age children report at least one episode of dizziness in the previous year. Other data suggests that only 0.7% of children attending hospital ENT consultations clinics do so with vertigo, indicating that large numbers do not seek a referral for medical attention. Children may be seen by paediatricians, otolaryngologists, neurologists or ophthalmologists and often have multiple consultations in multiple specialties, reflecting the wide variety of aetiologies and the anxieties of assessing clinicians in diagnosing dizziness in children.

In many ways, children have similar vestibular physiology to adults and therefore can develop any of the balance disorders seen in adults. In utero, myelination of the vestibular nerve occurs before any of the other cranial nerves. The vestibular system is anatomically intact at birth and undergoes sequential maturation throughout childhood until it is fully developed at around the age of 15.4 Balance maturation is heavily dependant (as in adult vestibular pathologies) on visual and proprioceptive inputs. Evidence of neonatal balance function can be sought by testing the vestibular induced reflexes. Subsequently, in children with vestibular disorders, motor development can be delayed.

In a review of 472 children diagnosed in a specialist balance clinic, the most common vestibular diagnoses were migraine (n=98), children with central structural abnormalities (n=66), children post temporal bone injury (n=54) and children with developmental delay (n=50). Dizziness associated with a peripheral vestibular disorder was most commonly associated with either sensorineural hearing loss (SNHL) or hearing loss associated with otitis media (n=34). Inner ear abnormalities (n=32), vestibular hypofunction (n=21) and vestibular neuritis (n=20) were well represented with fewer patients being diagnosed with Benign Paroxysmal Positional Vertigo (BPPV) (n=8) and endolymphatic hydrops (n=7). Benign Paroxysmal Vertigo of Childhood (BPVC) was diagnosed in 17 of the 472 patients. In contrast; in our secondary and tertiary referral ENT balance clinic, BPVC and migraine make up a much greater proportion of diagnoses in children.

There are, however, many differences between childhood and adult balance assessment. Children express their balance disorder in different terms to adults - the term dizzy may not be used - and they may not be able to describe any preceding factors, tinnitus, hearing loss or their exact sense of motion. Children may be reluctant to play or socialise for fear of falling.

The child may prove challenging to examine and investigate due to the complex nature of the testing involved. There may also be as yet untested medical issues present, such as Usher’s syndrome or cerebral palsy. Significantly, there may be underlying psychological or social care issues.

Referrals

Secondary and tertiary balance clinics with expertise in paediatric dizziness are appropriate for the assessment of the dizzy child. Commonly, assessment is shared with paediatric neurologists, audiovestibular physicians, paediatricians, ophthalmologists and psychologists as appropriate.

Assessment

History

The presenting complaint can be extremely varied, from clumsiness to rotatory vertigo. Table 1 suggests some questions to ask in the history. The first two questions should enquire into the first ever dizzy episode and whether the dizziness is episodic or persistent.

Examination

Examination in children is different to adults, but most elements can be incorporated. It takes longer. Making it fun, with play including games, will allow children to engage with the assessment. Extra tests can be added in - for example, the child can be asked to hop to identify any muscle weakness (muscular dysrophy), or the child could be spun around in the consultation chair (to look for post-rotational nystagmus – this will be absent in vestibular failure). The child can be asked to walk along an imaginary tightrope looking for ataxia and the gait should always be assessed as he/she walks into the consultation room, noting any ataxia or veering to one side.

A detailed neuro-otological examination should be performed. The ears should be thoroughly examined including tuning fork testing. The cranial nerves and cerebellar system should be examined.

Examination of the eyes

Observation of the eyes should be performed in the resting position and during movement to examine for the presence of normal smooth pursuit and nystagmus. Abnormal smooth pursuit may present as saccadic eye movements. Physiological nystagmus can be seen at extremes of gaze but pathological nystagmus always mandates urgent neurological investigation. Nystagmus in the vertical plane is always pathological. For example, down beating nystagmus can be seen in Chiaari malformations.

A Dix-Hallpike manoeuvre can be undertaken to elicit any torsional nystagmus associated with BPPV. Although rare in children, we have seen two eight-year-old children in our clinic with classical BPPV.

Head impulse test may be performed to examine the vestibulo-ocular reflex. It is abnormal if a corrective

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Table 1. History in the paediatric balance patient

<table>
<thead>
<tr>
<th>Questions to ask</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can you describe the first episode?</td>
<td>Positional dizziness is a red flag symptom for a posterior fossa abnormality such as a Chiari malformation.</td>
</tr>
<tr>
<td>What happens during a typical episode?</td>
<td>Positional dizziness may suggest a psychosocial trigger</td>
</tr>
<tr>
<td>Time course of symptoms? Any Precipitants/Triggers?</td>
<td>E.g. positional/situational</td>
</tr>
<tr>
<td>Any accompanying symptoms? E.g. Headache, visual disturbance, tinnitus, hearing loss, loss of consciousness/awareness, drop attacks, vomiting, phono/photophobia</td>
<td>Headache suggests vestibular migraine</td>
</tr>
<tr>
<td>Any recent trauma?</td>
<td>Loss of consciousness and drop attacks are red flags for non vestibular causes</td>
</tr>
<tr>
<td>Is their hearing normal? Does hearing fluctuate?</td>
<td>Balance disorders are more common in those with SNHL. Children with Otis media with effusion are very commonly unsteady.</td>
</tr>
<tr>
<td>Is their vision normal? Have they seen an optician recently? Any recent changes?</td>
<td>Essential for balance development. Poor vision is seen in Usher’s syndrome</td>
</tr>
</tbody>
</table>

Neurodevelopmental history

How is their gait? Do they veer to one side?
Did the child reach their developmental milestones?
Past medical history

Any otological procedures? Previous grommets/mastoid surgery/cochlear implantation
Any arrhythmias? Red flag for Jervell Lange Nielsen syndrome
If female, has menarche began?
If episodes peri-menstrual, this suggests vestibular migraine
Family History

Any familial migraines? Common in mothers of those presenting with vestibular migraine
Any history of episodic ataxia? Episodic ataxia type II
Table 2. Essential investigations for children presenting with severe to profound SNHL

<table>
<thead>
<tr>
<th>Tier 1. Investigations – for all cases</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paediatric history</td>
<td>Including maternal history to identify potential causes</td>
</tr>
<tr>
<td>Family history of deafness</td>
<td></td>
</tr>
<tr>
<td>Clinical examination</td>
<td></td>
</tr>
<tr>
<td>Developmental examination</td>
<td></td>
</tr>
<tr>
<td>Family audiograms in 1st degree relatives</td>
<td>Hearing loss may go undetected in relatives</td>
</tr>
<tr>
<td>ECG</td>
<td>To identify the long QT segment associated with Jervell Lange Nielsen syndrome</td>
</tr>
<tr>
<td>Ophthalmology review</td>
<td>40% of children with hearing impairment have ophtalmic conditions (BAPA guide)</td>
</tr>
<tr>
<td>Connexin 26 mutation testing</td>
<td>Can cause sensorineural hearing loss</td>
</tr>
<tr>
<td>Cochlea/Intracranial auditory neurial imaging</td>
<td>Identifies central causes or anatomical abnormalities</td>
</tr>
<tr>
<td>Urine for microscopic haematuria</td>
<td>For haematuria is associated with Alport’s syndrome</td>
</tr>
<tr>
<td>Any history of episodic ataxia?</td>
<td>Episodic ataxia type II locally available. As with adults, they should be used to support the clinical diagnosis being made.</td>
</tr>
</tbody>
</table>

Table 3. Further investigations in the child with severe to profound SNHL

<table>
<thead>
<tr>
<th>Tier 2 – investigations based upon history and clinical findings</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serology for congenital infections (CMV, rubella, toxoplasma and syphilis)</td>
<td>Treatment can prevent further hearing loss</td>
</tr>
<tr>
<td>Haematology and biochemistry</td>
<td></td>
</tr>
<tr>
<td>Thyroid function testing</td>
<td>Either as part of Pendred syndrome or other syndromes</td>
</tr>
<tr>
<td>Immunology testing</td>
<td></td>
</tr>
<tr>
<td>Metabolic screen</td>
<td></td>
</tr>
<tr>
<td>Renal ultrasound</td>
<td>If Branchio-oto renal is suspected</td>
</tr>
<tr>
<td>Clinical photography</td>
<td></td>
</tr>
<tr>
<td>Chromosomal studies</td>
<td></td>
</tr>
<tr>
<td>Referral to a genetician</td>
<td>Consider in all cases</td>
</tr>
<tr>
<td>Vestibular investigation</td>
<td>Consider in all cases</td>
</tr>
</tbody>
</table>

Table 4. Vestibular Migraine diagnostic criteria

| A. At least 5 episodes with vestibular symptoms of moderate or severe intensity lasting 5 minutes to 72 hours |
| B. Current or previous history of migraine according to the International Classification of Headache disorders |
| C. One or more migraine features with at least 50% of the vestibular episodes: Headache with at least two of the following characteristics: one sided location, pulsatile, aggravated by activity, moderate to severe pain – Photo or phono-phobia – Visual aura |
| D. Not better accounted for by another diagnosis |

Table 5. IHD Diagnostic Criteria for BPVC

| A. At least 5 attacks fulfilling criteria B and C |
| B. Vertigo occurring without warning, maximal at onset and resolving spontaneously after minutes to hours without loss of consciousness |
| C. At least one of the following five associated signs of symptoms: Nystagmus, ataxia, vomiting, pallor, fearfulness |
| D. Normal neurological examination, normal audiometric and vestibular function between attacks. |
| E. Not attributable to another disorder |

Headache society classification for the diagnosis is noted in Table 5. Management of BPVC is supportive, with reassurance that symptoms will usually settle. Children and parents should be forewarned about potential migraines in adult life.

Head trauma in children

Children may experience post-concussive syndromes and the same range of traumatic conditions as adults, although they are seen much less frequently in the balance clinic. 81% of children in a case series of 247 patients seen in a sports medicine clinic following trauma, with a confirmed diagnosis of concussion, showed evidence of a vestibular deficit. Patients with vestibular deficit took longer to recover and return to school than those without. BPPV can occur after head trauma in children.

Tumours/central structural disorders

O’Reilly et al noted that 66 of 472 children (13.9%) had a central structural diagnosis. In our 14 year tertiary level balance experience, we have not seen any children present with a brain tumour. In Rima et al’s analysis of 119 patients, none had a brain tumour but one (0.8%) had a Chiari 1 malformation. Patients with a Chiari I malformation commonly present with a sub-occipital throbbing headache worsened by activity. Menière’s type hearing loss and tinnitus, together with neurological signs (spinal cord disturbance and lower cranial nerve palsies) Downbeat nystagmus is a feature on Hallpike testing. Diagnosis is with MRI, both essential and urgent as posterior fossa tumours can also present in this way.

Vestibular disorders in children with hearing impairment

Imbalance and Otitis media with Effusion (OME)

The presence of an effusion in the middle can cause imbalance12,13 and is not an uncommon

Vestibular disorders in hearing children

Vestibular migraine (VM) in children

VM is the commonest vestibular disturbance in children and follows the same diagnostic criteria as in adults, according to a 2012 consensus statement by the members of the Barany society and the International Headache Society. (Table 4).

Patients suffering both migraine and VM are very sensitive to sensory stimuli, especially during attacks, and are also likely to have motion sickness.

In general, the examination should be normal between attacks but episodic hearing impairment and nystagmus can be seen. There is diagnostic overlap with Menière’s disease. Management should focus initially on the avoidance of dietary triggers, avoiding dehydration, ensuring sensible sleep patterns and stress avoidance. Menstruation can also trigger migraines and we modify this in some children.

Medication can be considered when attacks happen three or more times per month. Magnesium aspartate has been advocated. Medication for non-vestibular migraines are also thought to be effective. No randomised controlled trials exist for the treatment of VM and the help of a paediatrician or neurologist may be needed in prescribing for these children. Generic migraine treatment guidelines are outlined for both adults and children by the European Federation of Neurological Sciences. For children, Paracetamol, Propranolol, Dexamethasone and Toptrana can be effective for acute attacks. For prevention, Flunarazine or Propanolol are effective. We also use Pizotifen for our children.

Benign Paroxysmal Vertigo of Childhood (BPVC)

This condition is seen in around a fifth of children presenting with imbalance. Usually affecting those 3-4yrs old, it causes episodic short-lived vertiginous episodes. A significant number go onto develop migraines later in life and BVPC is considered a precursor. The International
presentation. 58% of children with long-term effusions show evidence of vestibular dysfunction, with 96% of these improving after insertion of ventilation tubes. The pathophysiological effect of an effusion is currently theorised to be due to the diffusion of substances from the effusion to the inner ear, or caused by pressure changes. It seems therefore reasonable that if the history and examination fit with a presentation of OME, ventilation tubes are trialled.

**Imbalance and SNHL**

SNHL is of particular importance, since in this cohort between 20 and 70% have vestibular dysfunction. 50% of congenital hearing loss in the developed world is due to genetic abnormalities with 30% of this group being syndromic. The aetiological investigation of patients with SNHL is outlined in Table 2 and 3.

There are some notable syndromes with vestibular dysfunction and SNHL as key features. Early recognition can lead to appropriate onward referral and prediction or prevention of further sequelae. It may also be especially important for genetic screening and family planning.

**Usher’s syndrome**

Usher’s syndrome is an autosomal recessively inherited condition causing SNHL, retinitis pigmentosa and often vestibular dysfunction.

Three types of Usher’s syndrome are recognised. Type 1 has congenital severe to profound hearing loss, vestibular dysfunction and childhood onset of retinitis pigmentosa. Type 2 has moderate to severe hearing loss with no vestibular dysfunction and late onset retinitis pigmentosa. Type 3 has progressive SNHL with varying dysfunction of the vestibular system and onset of retinitis pigmentosa.

**Pendred’s syndrome**

This autosomal recessive disorder is the most common hereditary cause of SNHL and is due to a mutation in the Pendred’s syndrome. This autosomal recessive disorder is the most common hereditary cause of SNHL and is due to a mutation in the SNAP27 gene. Despite the high incidence of congenital hearing loss and childhood onset of retinitis pigmentosa, only a small proportion of children exhibit both conditions due to variable expressivity.

**Jervell Lange Nielsen Syndrome**

This is an autosomal recessive inherited triad of SNHL, long QT segment and syncopal attacks. There is a 50% risk of mortality in untreated patients before the age of 15. Treatment of the cardiac element is with beta-blockers although, even with treatment, cardiac events are still noted to occur. Cochlear implantation is an option for those with profound SNHL.

**Post-infectious vestibular dysfunction**

Vestibular Neuronitis (VN) occurs often follows a viral infection, causing signs and symptoms due to unilateral vestibular failure or hypofunction. There is usually a positive head impulse test, horizontal nystagmus and normal neurological examination. Treatment is supportive and children tend to recover much more quickly than adults.

**Meniere’s Disease**

Meniere’s disease is diagnosed in less than 2% of paediatric balance patients. There is some diagnostic overlap with vestibular migraine.

**Summary**

Whilst representing a small proportion of ENT practice, accurate diagnosis and management of paediatric balance disorders is key in childhood development. A multidisciplinary approach is often needed. As such, children may first present to general ENT clinics, particularly those with hearing loss. An awareness of the spectrum of disorders is recommended.

**References**

New flaps in head and neck reconstruction

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Abstract
The use of microvascular free tissue transfer to reconstruct head and neck oncological defects is commonplace. Incremental development and modification of techniques and workhorse flaps is how patient and donor-site morbidity is improved. This article will discuss the applications of 2 flaps that are gaining popularity as well as the concept of fascial only flaps in head and neck reconstruction.


Key words
MSAP; medial sural artery perforator
SCAF; supracutaneous artery island flap
Free fascial flap, osseo-fascial flap

Introduction
The use of microvascular free tissue transfer to reconstruct head and neck oncological defects is now commonplace. Oncological and reconstructive surgeons are able to offer patients alongside a tailored reconstruction. As surgery and techniques develop, truly ‘new’ flaps in head and neck reconstruction are a rarity. Incremental development and modification of current or out-of-favour flaps is more likely. Flaps are often revisited out of either necessity due to the requirements of the defect or due to the status of the patient in terms of flap availability or potential donor site morbidity. This article will discuss the applications of 2 flaps that are gaining popularity as well as the concept of fascial only flaps.

MSAP
The medial sural artery perforator flap (MSAP) is gaining popularity in head and neck reconstruction as an alternative to the workhorse radial forearm free flap (RFFF) when a thin pliable flap is required. Cavadas et al first described its clinical application in 2001 for the free flap reconstruction of lower limb defects. The medial sural artery arises from the popliteal artery and travels in an intramuscular course within the medial gastrocnemius muscle. Markings are made in the standing position as described by Kim et al. Mark the popliteal crease and its perforator is usually cited at approximately 12cm from the popliteal fossa to the medial malleolus. Perforators are identified using a handheld doppler. Along this line, Kim et al identified one perforator at 8cm from the popliteal crease within a distal semicircle of 2cm radius. Another perforator is usually cited at approximately 12cm from the crease.

Technique:
Using a 2-team approach, the patient is supine on the table with one hip abducted and knee flexed in a ‘frog-leg’ position. The flap is raised from the opposite of the table using a 2-team approach. Perforator imaging should be performed and full weightbearing should commence the next day. Benefits of the MSAP flap when comparing to the RFFF include the ability to provide a scar that can be well-concealed and closed primarily without the need for a skin graft (Table 1). It also preserves the RFFF if required for future surgeries. Also the immobilization of the wrist combined with complications such as poor aesthetics, superficial radial nerve sensory loss in 32% of cases and poor functional outcome described by Kim et al. Superficial radial sensory nerve loss in 32% of cases and poor functional outcome described by Kim et al.

| Table 1. Profile of MSAP flap, Adapted from Chalmers et al.18 |
|-----------------|------------------|------------------|
| Blood Supply    | Medial Sural Artery branch off the Popliteal artery |
| Size of Artery  | 1.8mm            |
| Vascular Clipping | 3.1mm          |
| Pedicle length  | 11.1cm           |
| Number of perforators | 2               |
| Flap dimensions | 5x8cm            |
| Flap thickness  | 7.1mm            |
| Donor site      | Closed primarily in 91% of cases (32/35) |

Benefits:
Improved donor site morbidity
Avoiding sacrifice of major artery to the hand
Primary closure when flap dimensions of 4-5cm needed
Harvest times similar to RFFF

Limitations:
Transfer of hair-bearing skin in males
Vessel size discrepancy
Perforator harvest techniques required
Careful patient selection as thickness can result in bulky flap and poor functional outcome

Figure 1: Medial sural artery identified proximally. Intramuscular dissection with the 2 perforating vessels in vessel sloops.
Left partial glossectomy reconstructed with a free MSAP flap.
delayed healing or tendon exposure in 13-22% are avoided\(^1\). Limitations are that the vascular anatomy is not as predictable as the RFFF. Commonly, the vessels are small and vessel size mismatch. Flap thickness is not as thin as that of the forearm so identifying the right defect and assessing the thickness of the caif prior to surgery is essential.

**SCAIF flap**

Whilst the MSAP flap is gaining popularity as a free flap in head and neck reconstruction, the application of the supraclavicular artery island flap (SCAIF) is becoming more widespread as a pedicled alternative to a free flap\(^1\).\(^2\)\(^3\). The workhorse pedicled flap in head and neck reconstruction is the muscle only or musculocutaneous pectoralis major flap. This is a thick and non-pliable flap that sacrifices a functional muscle. Donor site contour irregularity as well as a bulky pivot point over the clavicle that may also continue to contract means that alternative flaps should be considered. In many cases the indication is for salvage surgery or the patient is deemed not fit to undergo a free tissue transfer. The pedicled SCAIF flap addresses a number of these problems.

Lamberty described an axial supraclavicular flap in 1983 centered on the fasciocutaneous supply from the supraclavicular artery\(^4\). In 1997 Pallua et al. then described the successful use of the supraclavicular artery island flap in the release of burn contractures to the neck\(^2\).\(^3\). Since then, its use and applications have increased in the head and neck region allowing reconstruction of tongue, intraoral, through-and-through cheek defects as well as circumferential pharyngoesophageal defects, management of tracheostomal fistulas and also contour defects following parotid surgery\(^4\).\(^5\)\(^6\). With this versatile flap that can be raised in less than an hour in experienced hands, planning, technique, careful handling of the pedicle and reducing pressure around the pivot point is essential for success\(^7\).\(^8\).\(^9\).

**Technique:**

A handheld doppler probe is used to identify the SCA in the triangle formed between the clavicle, sternocleidomastoid and the external jugular vein (Figure 2). It is consistently found at the posterior aspect of the clavicle 2cm from the sternum notch. The SCA should then be traced along its axial course towards the shoulder tip. The SCA branches from the origin of transverse cervical artery and the external jugular vein (Figure 2). The axial course of the artery is marked and the flap dimensions can be drawn.

Flap dimensions of 16-41cm can be raised most reliably within 5cm of the most distal doppler signal\(^9\). Depending upon the patient, donor site widths of 5-8cm can be closed primarily. If a wider flap is needed then a full-thickness skin graft can be taken from the ‘dog-ear’ excess upon primary closure around the shoulder and applied to the secondary defect. The flap is raised distal to proximal in a subfascial plane. Identification of the pedicle and skeletonizing the vascular plexus will aid in the reach and rotation of the flap on inset. Preservation of cervical nerves will also provide a sensate flap. A broad subcutaneous tunnel is raised in the neck to pass the flap into the desired defect. Careful attention is made to ensure that the tunnel is released enough so as to minimize compression on the vessels. For an intraoral defect, the flap is rotated 180° and the flap that lies within the tunnel is deepithelialized. For a pharyngeal defect, the midportion of the flap is deepithelialized and the flap is tubed with the skin along the inside of the tube\(^9\).

Benefits of the SCAIF is that it provides a thin pliable fasciocutaneous flap in patients that may not be suitable for a free flap reconstruction (Table 2). It also does not burn any reconstructive bridges allowing free flap reconstruction in the future or a pedicled pectoralis major in salvage conditions. It has also been shown to be reliable in patients who have undergone level IV or V neck dissections as well as previous irradiation therapy\(^9\).\(^10\).\(^11\).

A relative contraindication is if a level IV or V radical neck dissection has taken place and there is no documentation if transverse cervical artery has been preserved\(^9\).

Limitations of any pedicled flap is the reliability of the distal portion of the flap. Kokot et al. presented a case series of 45 patients with a SCAIF reconstruction. Total flap loss was seen in 2 cases, partial necrosis in 8 cases and dehiscence of the flap inset in 11 cases. They identified that flap length >22cm, smoking or history of radiotherapy was associated with flap complications\(^9\). The results are similar to other authors\(^9\).\(^11\).

**Fascial only free flaps**

With the concept of modifying flaps and revisiting previous innovations, the use of fascial flaps in head and neck reconstruction is also increasing. Consideration of a fascial flap fulfills a number of goals. For intraoral lining it undergoes rapid reepithelialisation and provides a thin covering which is ideally suited for ongoing dental rehabilitation\(^12\). In addition, the donor site morbidity profile of flaps such as the osseofascial radial forearm flap, the osso-adipofascial fibula flap or a fascial-only ALT is improved\(^13\)\(^14\) (Table 3).

The possibility of using the free ALT as a vascularized fascial flap was first proposed by Koshima et al. in the repair of an abdominal defect\(^15\). Since then, relatively little has been published on fascial only ALT flaps. Bhadikamkar et al used 6 free and one pedicled fascial ALT flap to reconstruct the occipital scalp as well as upper and lower limb defects\(^16\). The ALT was raised using a standard technique. The skin and fat was then excised off the flap and in order to have a very thin reconstruction, the flap was grafted with a split-thickness skin graft. The donor sites were closed directly. This technique of grafting onto the thin vascularized layer is useful if cover of an external defect is required and is used by other authors for similar limb defects\(^17\). Whilst debulking and thinning of the flap once it is raised in the standard way is a well-used technique, to improve the donor site morbidity further, using a long curvilinear incision, the superficial Scarpa’s fascia and deep fascia overlying the rectus femoris can be raised with the perforators so that no skin is excised at all. Cherubino et al describe 11 cases of a fascial ALT in the head and neck including 8 orbital exenteration, 1 forehead reconstruction and 2 palatal reconstructions following maxillectomy\(^18\). The deep fascia was then grafted with a split-thickness skin graft or a dermal template. No complications were reported. Grafting onto fascia can be unpredictable which is why use of an artificial dermal template can be used. Similarly leaving a layer of vascularized loose areolar tissue over the fascia will improve take.

We have had recent success in a number of young patients where the donor site morbidity profile was important as well as for a thin vascularised flap with a long pedicle (unpublished). Partial and subtotal tongue defects that also require some added soft tissue volume

### Table 2. Profile of SCAI flap

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Supply</td>
<td>Supraclavicular artery 3-4cm from the origin of transverse cervical artery</td>
</tr>
<tr>
<td>Size of Artery</td>
<td>1-2mm</td>
</tr>
<tr>
<td>Pedicle length</td>
<td>20cm</td>
</tr>
<tr>
<td>Flap dimensions</td>
<td>5x20cm to allow primary closure</td>
</tr>
<tr>
<td>Flap thickness</td>
<td>5-10mm</td>
</tr>
<tr>
<td>Donor site</td>
<td>Closed primarily when width 5-8cm</td>
</tr>
<tr>
<td>BENEFITS</td>
<td>Thin pliable skin with good colour match</td>
</tr>
<tr>
<td></td>
<td>Raised in under an hour, reducing operative time and flap surgery</td>
</tr>
<tr>
<td></td>
<td>Reliable in previous neck dissection, RT and salvage cases</td>
</tr>
<tr>
<td>LIMITATIONS</td>
<td>Careful technique needed to avoid pedicle twist or compression</td>
</tr>
<tr>
<td></td>
<td>Flap dehiscence and distal tip necrosis is main concern</td>
</tr>
</tbody>
</table>

### Table 3. Profile of fascial flaps

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Supply</td>
<td>ALT, RFFF, Fibula – raise using standard techniques without a skin island</td>
</tr>
<tr>
<td>Flap dimensions</td>
<td>The fascia can be harvested beyond the dimensions of the standard fasciocutaneous flap design</td>
</tr>
<tr>
<td>Flap thickness</td>
<td>5-10mm if raised with superficial fat (flora/pas)</td>
</tr>
<tr>
<td>Donor site</td>
<td>Closed primarily</td>
</tr>
<tr>
<td>BENEFITS</td>
<td>Thin pliable flap</td>
</tr>
<tr>
<td></td>
<td>Will contour well into any defect</td>
</tr>
<tr>
<td></td>
<td>Avoids transfer of hair bearing</td>
</tr>
<tr>
<td></td>
<td>Thin mucosalisation permits dental rehabilitation</td>
</tr>
<tr>
<td></td>
<td>Donor site closed 100% of the time avoiding need for a skin graft</td>
</tr>
<tr>
<td></td>
<td>Reports that sensation is improved if skin spared</td>
</tr>
<tr>
<td>LIMITATIONS</td>
<td>Inset may be less secure than skin as graft on the tissues is released</td>
</tr>
<tr>
<td></td>
<td>Intraoral healing tends to be sloughy in the early stages</td>
</tr>
<tr>
<td></td>
<td>Seroma rates at the donor site may be increased</td>
</tr>
</tbody>
</table>

\(^{1}\) \(^{2}\) \(^{3}\) \(^{4}\) \(^{5}\) \(^{6}\) \(^{7}\) \(^{8}\) \(^{9}\) \(^{10}\) \(^{11}\) \(^{12}\) \(^{13}\) \(^{14}\) \(^{15}\) \(^{16}\) \(^{17}\) \(^{18}\)

\[\text{Figure 2: Supraclavicular artery is identified in the triangle inferiorly by the clavicle, medially by the posterior border of the sternocleidomastoid and laterally by the external jugular vein with the handheld doppler. The axial course of the artery is marked and the flap dimensions can be drawn.}\]
The utilization of fascial flap component is perhaps best suited to clefted flaps that a required to reconstruct composite defect requirements. A segmental mandibulectomy and check mucosal resection is one such defect. The requirements of a bony reconstruction are of a bony reconstruction. Mucosalisation will occur on all exposed surfaces. The authors have no conflicts of interest to declare.

Acknowledgements

The authors have no conflicts of interest to declare.

References


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6470
Management of unilateral vocal fold immobility

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Abstract
Unilateral vocal fold paralysis (UVFP) is a common problem in voice clinics. In recent years, the management of patients with UVFP has changed because of improvements in endoscopic equipment and the advent of new injectable materials. Materialisation procedures have become more readily acceptable, and it is now possible to treat some patients quickly and simply in clinic, obviating the need for surgical procedures in the operating theatre. A “watch and wait” approach is now no longer considered reasonable, and early intervention is suggested in the vast majority of patients who are symptomatic.

In this article, a variety of techniques is described for achieving materialisation of the paralysed vocal fold.

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Key words
Unilateral vocal fold paralysis
Injection medialisation/Injection laryngoplasty
Thyroplasty/Medialisation laryngoplasty
Laryngeal reinnervation

Presentation
The clinical scenario of the patient with a unilateral vocal fold paralysis (UVFP) will be familiar to most otolaryngologists: the patient will typically have a breathy and quiet voice; there may also be a diaphragmic (pitch unstable) quality. Many patients will instinctively engage the cricothyroid muscles (obviously innervated by the external branch of the superior laryngeal nerve) in an effort to achieve glottic closure: this results in tensioning of the vocal folds, and hence a high-pitched voice. The effort required to produce voice in this situation, combined with the loss of air through the incompetent glottis, leads to rapid vocal fatigue and often hyperventilation, as the patient is taking multiple breaths in the middle of sentences.

The loss of adequate glottic closure impacts on swallowing function, with aspiration of (in particular) liquids, but also saliva. Spontaneous coughing on the patient’s own secretions is not uncommon. The loss of glottic competence also means that the strength of the cough is diminished (characteristically described as “bovine”). It is now known that silent aspiration is not uncommon. The loss of glottic competence also means that the strength of the cough is diminished (characteristically described as “bovine”). It is now known that silent aspiration results in excess morbidity and mortality1.

The degree of breathy dysphonia is very variable and is a function of the position taken by the vocal fold: in general, a vocal fold sitting in a median/paramedian results in better glottic closure, and hence a stronger voice (fig 1a, b). Conversely, a vocal fold sitting in a lateral position (fig 2a, b) will result in a very breathy voice. Most treatments for UVFP are aimed at pushing the paralysed vocal fold into a more medial position.

Figure 1A: paralysed left vocal fold sitting in a very lateral position, hence with a high degree of glottic incompetence – on inspiration.

Figure 1B: paralysed left vocal fold sitting in a median position, hence with good glottic closure – on inspiration.

Figure 2A: paralysed left vocal fold sitting in a very lateral position, hence with a high degree of glottic incompetence – on attempted phonation – a large gap is seen resulting in a very breathy voice.

Figure 2B: paralysed left vocal fold sitting in a very lateral position, hence with a high degree of glottic incompetence – on attempted phonation – a large gap is seen resulting in a very breathy voice.

Aetiology
The incidence of different aetiologies of UVFP will vary from centre to centre, often determined by other surgical specialties within the hospital: in a centre with a very active vascular surgery department, for example, carotid surgery may be a major causative factor; in a large thyroid centre, thyroidectomy may be the leading cause.

Multiple studies have reviewed the aetiology of UVFP; the estimated incidences are as follows:

- Idiopathic ~ 30%
- Iatrogenic ~ 30-50%
- Cervical spine surgery
- Thyroid/parathyroid surgery
- Upper oesophageal surgery
- Carotid endarterectomy
- Thoracic/cardiac surgery
- Tumours – 10-30%
- Lung, oesophagus, thyroid
- Others – 10%

Trauma, inflammatory conditions, neurological disease

Investigation
Having established the presence of a UVFP the aetiology should now be determined: this may be obvious at the outset (after neck surgery, for example). The neck should be examined, paying particular attention to the course of the vagus and recurrent laryngeal nerve; any palpable masses should undergo targeted investigation (often in the form of cross-sectional imaging and fine-needle aspiration).

In the clinic, subjective assessments should be made of the patient’s voice; a patient-reported questionnaire (e.g. Voice Handicap Index) and a clinician-reported rating (e.g. GRBAS, Grade-Roughness-Breathlessness-Asthma-Strain) should be performed. Other useful measurements include the maximum phonation time (MPT), which is shortened in breathy dysphonia and should increase with intervention.

In certain cases, there may be a role for electromyography (EMG): this can help to determine prognosis and may help to direct management. Favourable EMG findings may prompt the clinician to “watch and wait” rather than to intervene early; however, as will be shown below, early intervention is now very straightforward and leads to better long-term outcomes, so prolonged periods of clinical observation (as has been advocated in the past) are generally no longer appropriate.

If a patient is keen to avoid intervention, EMG testing can help to guide them (and the clinician) as to the likelihood of spontaneous recovery of the UVFP – whether the aetiology is idiopathic or iatrogenic.

If the cause of the UVFP is not clear from the history and clinical examination, cross-sectional imaging (CT or MRI) should be undertaken to cover the course of the vagus and recurrent laryngeal nerve on that side. In the case of a right UVFP, this should cover the skull base to the CA joint rather than a nerve palsy, the patient should undergo an examination under general anaesthetic to palpate the CA joint to assess its mobility.

Multiple studies have reviewed the aetiology of UVFP; the estimated incidences are as follows:

- Idiopathic ~ 30%
- Iatrogenic ~ 30-50%
Management
The management of UVFP has changed significantly in recent years: in the past (and in many of the currently-circulating textbooks), a period of clinical observation (“watchful waiting”) was advocated. This approach was based on the fact that interventions to medialise the paralysed vocal fold would generally have involved procedures in the operating theatre, often under general anaesthetic.

However, the advent of newer injection materials, combined with better outpatient endoscopic systems, has made it relatively straightforward to undertake medialisation procedures in the clinic in an awake, unanaesthetised patient.

If the recurrent laryngeal nerve is transected (either deliberately or accidentally) in the course of a surgical procedure, it might (if the surgeon is appropriately trained) be reasonable to perform a primary end-to-end nerve anastomosis. In general, any patient with recurrent nerve paralysis who wishes to participate in normal vocal activities will require a thyroplasty. In many centres the assistant is a speech and language therapist who can be expected to address the dysphonia, but also the swallowing dysfunction if there is aspiration (either coughing on swallowing liquids, or aspiration seen on functional endoscopic evaluation of swallowing (FEES) or on a contrast swallow). In certain patients, a period of clinical observation may be necessary to place the patient nil-by-mouth and instigate enteral (nasogastric or gastrostomy) feeding.

Procedures to medialise the paralysed vocal fold aim to provide bulk to the paraglottic space, pushing the medial vibratory edge of the vocal fold to the midline so that glottic closure can be improved. The medialisation material may either be injected directly into the vocal fold (vocal fold medialisation injection (injection laryngoplasty)) or may be placed into the paraglottic space via a window in the thyroid cartilage (Isshiki Type 1 Thyroplasty (medialisation laryngoplasty)).

Medialisation injection
Vocal fold medialisation injection (injection laryngoplasty) is relatively easy to perform under local anaesthetic in the clinic setting. Equipment requirements are minimal: a distal chip endoscopic system is essential, along with local anaesthetic and the injection material. The injecting surgeon is assisted by a colleague who passes the endoscope; in many centres the assistant is a speech and language therapist or a junior doctor.

It is being increasingly recognised that early medialisation (within a few weeks or even days) following the onset of the UVFP improves long-term outcomes: a series of studies has demonstrated that the longer the delay in performing a medialisation procedure, the more likely it is that the patient will require a thyroplasty in the future. There is therefore little justification for “watchful waiting”, and this is radically altering clinical practice amongst laryngologists.

It is also possible to perform injection medialisation under general anaesthetic, but this has some disadvantages: many of the patients in this cohort have multiple comorbidities, so a general anaesthetic may be contraindicated. Patients having a palliative procedure will frequently not wish to have a day-case procedure, or may be too unwell to do so.

There are further advantages to performing injections in the clinic setting:

- The degree of medialisation achieved can be judged in real time, allowing for precision in assessing the amount of material needed. If the injection is performed under general anaesthetic, there is no way of judging how much should be injected.
- The improvement in voice can be assessed by asking the patient to phonate during the procedure. More injection material can then be injected if required.
- Different materials can be used, the most common of which are:
  - Calcium hydroxylapatite (Radiesse™ Voice, Prolaryn™ Plus, Renú™ Voice) is easy to handle and requires no specific preparation. It has a typical duration of action of around 12-18 months.
  - Hyaluronic acid (HA) (various proprietary preparations, including Restylane®). This typically lasts around four months. It is therefore ideally suited to those patients in whom a resolution of the UVFP is anticipated, and restores the voice for the intervening recovery period.
  - Dissolvable gels (Renú™ Gel, Radiex⃝ Voice Gel, Prolaryn™ Gel) are synthetic products that have a similarly short duration of action (typically a few months) as hyaluronic acid (HA), and are used in similar situations to HA.
- Medialisation injection – techniques under local anaesthetic
  Injection medialisations can be performed percutaneously or per-oroally.

Figure 3: Trans-thyrohyoid.

Figure 4A: Trans-thyrohyoid approach – the needle is seen entering the upper surface of the (paralysed) right vocal fold, taking care to direct the needle lateral to the vocal ligament (hence into the thyroarytenoid muscle).

Trans-thyroid cartilage
In this approach, the airway is not entered, but the injection needle is passed through the thyroid cartilage into the paraglottic space. This technique can be more difficult if there is calcification of the cartilage.

Per-oroal
A long rigid needle is curved to pass over the tongue base towards the larynx. A disadvantage of this technique is the “dead space” in the relatively long needle, so some material is lost.
The management of unilateral vocal fold paralysis (UVFP) has changed over the years. Early injection (preferably within a few minutes) was recommended in many cases, but it is now acknowledged that the best outcomes occur after a period of voice rest. Early injection is no longer sufficient and the voice outcomes are not demonstrably better when an arytenoid procedure is performed at the same time as thyroplasty, suggesting that thyroplasty alone is usually sufficient.

Per-oral

All the local anaesthetic techniques described above take just a few minutes to perform and the patient will typically leave the clinic a few minutes after it is completed. Some clinicians advocate voice rest in order to allow the injection points to epithelialise, and thus to avoid injection material extruding.

Ishikii Type 1 Thyroplasty (Medialisation Laryngoplasty)

If a medialisation injection has been performed but the patient’s voice subsequently deteriorates, the injection can be repeated, but consideration should be given to performing a thyroplasty. This procedure is performed in the operating theatre under local anaesthetic, often with some sedation. A skin-crease incision is made at the level of the cricothyroid membrane on the side of the UVFP. A subplatysmal layer is developed, the strap muscles are separated in the midline and the thyroid and cricoid cartilages are exposed.

Markings are made to delineate the position of the vocal folds: the anterior commissure is located exactly halfway between the upper and lower borders of the thyroid cartilage. A window in the thyroid cartilage is fashioned at the level of the paralysed vocal fold; the position of the window is then checked by passing a trans-nasal flexible endoscope. At this point, an implant material (which may be silastic, Gore-Tex® ribbon, metal or other) is placed through the window into the paraglottic space. The position of the medialised vocal fold is checked endoscopically, and the patient is asked to phonate to check the quality of voice.

The incision is then closed in layers. Voice rest is often advised for two days.

Various different arytenoid procedures have been described:

Arytenoid adduction

Having dissected around the posterior border of the thyroid lamina, the muscular process of the arytenoid is located, and a suture is placed through it and then pulled forwards and secured anteriorly to rotate the arytenoid medially, mimicking the action of the lateral cricoarytenoid (LCA) muscle.

Adduction arytenopexy

The inferior constrictor is detached from the thyroid lamina, the cricothyroid joint is disarticulated, the superior thyroid ligament divided and the posterior border of the thyroid lamina retracted anteriorly. The pyriform fossa mucosa is swept away. Inferior to this, the posterior cricoarytenoid muscle (PCA) is identified and followed superiority to its insertion into the arytenoid. The PCA is then divided at the cricoarytenoid joint and the joint is entered with scissors. After division of the posterior joint capsule fibres, the body of the arytenoid is then sutured postero-medially onto the cricoid facet.

Arytenoid repositioning procedures are perceived as being technically complex and are not in widespread use in the UK.

Laryngeal reinnervation

As has already been discussed, if the recurrent laryngeal nerve is transected at the time of neck surgery, it can be primarily repaired, with or without the use of a nerve interposition graft.

Non-selective reinnervation procedures aim to restore tone and bulk to the paralysed vocal fold, but do not achieve normal laryngeal movement. A branch of the ansa cervicalis is anastomosed to the distal stump of the recurrent laryngeal nerve. Early studies are showing promising results, but improvements in voice often take several months to be seen, so the reinnervation is often combined with a temporising medialisation injection with (for example) hyaluronic acid.

Studies are planned to compare thyroplasty with laryngeal reinnervation, and a feasibility study is underway.

Conclusions

The management of unilateral vocal fold paralysis (UVFP) is changing: it is no longer acceptable to adopt a period of clinical observation (“watch and wait”) after a UVFP is identified: early medialisation injection is required to optimise long-term outcomes. Early injection (preferably under local anaesthetic in the clinic) reduces the subsequent...
risk of the patient requiring laryngeal framework surgery (thyroplasty). Laryngeal reinnervation is a novel technique and is currently under evaluation: its potential advantages over thyroplasty will become clear with further study.

References


A summary of the management of pulmonary nodules in head and neck cancer patients

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Abstract
The management of pulmonary nodules is challenging. Until recently little was known about the incidence and significance of pulmonary nodules in patients with head and neck cancer (HNC). This article summarises some of the British Thoracic Society (BTS) guidelines as well as recent evidence more specifically related to patients with HNC and lung nodules.

Patients presenting with HNC have a higher incidence of pulmonary nodules and a higher risk of malignancy than other groups. In contrast to the British Thoracic Society (BTS) guidelines, which use size to guide the need for serial scans, follow up imaging in all HNC patients with nodules irrespective of size is indicated.


There were no grants used to support the study.


Key words
Pulmonary nodule, Head and neck cancer, Computerised tomography (CT), Risk factors

Introduction
The investigation and management of pulmonary nodules in the head and neck (HNC) population has been poorly understood for years. Many nodules are incidentally detected in patients on staging computerised tomography (CT). The prevalence is reported to be 11%-33% in high-risk patients1. Being able to estimate the risk that pulmonary nodules are either metastatic from the primary disease or represent a new primary malignancy is critical to planning the management of head and neck cancer patients.

In 2015 the British Thoracic Society (BTS) produced a guideline for the management of lung nodules, this was the first guideline to include guidance for patients who already had a known malignancy2. However, the evidence used to generate the BTS guidance included only 182 head and neck cancer patients3,4.

Many patients who pass through the HNC multidisciplinary team (MDT) are smokers and as such at increased risk of having bronchogenic malignancy, metastatic disease and also benign lung nodules. Previously, UK guidance for head and neck cancer recommended that local policies were developed to guide in the investigation of pulmonary nodules in the HNC population1.

Summary of the BTS guidance
Pulmonary nodule is a well or poorly circumscribed, approximately rounded structure that appears on imaging as a focal opacity and is both a3 cm in diameter and surrounded by aerated lung5. The management of lung nodules has evolved due to the increase in evidence on the subject and access to imaging including high resolution CT and PET-CT has improved.

The management approach to lung nodules in the 2015 BTS guidance is based on the size of the nodule and the presence of risk factors. When assessing the risk of malignancy within nodules, 30 studies were included in the BTS guidance. They identified both clinical and
radiological characteristic risk factors that increased the probability of malignancy. Nine risk factors were identified using multivariate analysis (Table 1).

On reviewing the literature a number of studies looking at lung nodules in the HNC population have now been published. Five studies in the BTS guidance derived composite prediction models based on the combination of clinical and radiological multivariate logistic regression analysis12-16. Those deemed most appropriate and now used on the BTS website were the Brock and Herder models. Herder et al16 validated a Mayo clinical model and used fluoroexoxyglucose-positron emission tomography (FDG-PET), including extrathoracic malignancy in as a risk in their model.

In 2013 Alford et al17 found that patients with higher grade primary HNC, with initially indeterminate lung nodules were more likely to have lung metastases than those with a lower grade malignancy. Fukuhara et al 2014 investigated lung nodules in 332 patients with HNC. Their multivariate analysis identified factors correlating with the risk of lung metastasis. Lung nodules at the initial CT scan in patients with advanced disease were at increased risk with an OR of 2.82.

Beech et al24 identified lung nodules in only 13% of their study group of 239 patients who had HNC, none proved to be malignant on follow up. They did not include patients with sub 5mm nodules.

A study by Green et al 2017 included 400 consecutive head and neck cancer patients. They found that 58% of patients had non-calcified lung nodules with a 6% malignant rate at follow up. Other studies have reported higher rates from 10.8-19.0%26-31.

The study by Green et al25 found that age was the only risk factor associated with the presence of lung nodules. The only risk factor found to be independently associated with malignancy was the stage of the HNC. Advanced disease (stage III+IV) was associated with increased risk in comparison with early stage (stage I+II) disease, with an OR of 10.64. Malignancy was confirmed on the first scan following initial staging in 10 out of the 11 cases.

The BTS guidance identified size as a predictive factor and concluded that there was an OR of 1.1 for every 1mm increment. In contrast to the BTS Guideline, the Green et al paper30, found neither the actual size nor the grouped size was associated with the risk of malignancy. The data showed that there is a significant risk even in the smaller nodules, likely due to there being two causes of malignant nodules to consider, metastasis and new lung primaries. If BTS guidance had been applied 117 smaller nodules would have been excluded however 5 (4.3%) were later shown to be malignant. All were confirmed as malignant within 12 months of initial detection.

### Table 1: Table outlining the patient and radiological risk factors that increase the risk of a malignant pulmonary nodule.

<table>
<thead>
<tr>
<th>Patient Risk Factors</th>
<th>Radiological Risk Factors</th>
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<tbody>
<tr>
<td>Age</td>
<td>Nodule diameter</td>
</tr>
<tr>
<td>Current or former smoker</td>
<td>Spiculation</td>
</tr>
<tr>
<td>Pack years of smoking</td>
<td>Upper lobe location</td>
</tr>
<tr>
<td>Previous history of extra-pulmonary malignancy</td>
<td>Plural indentation</td>
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<tr>
<td></td>
<td>Volume doubling time.</td>
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</table>

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![Edinburgh Head and Neck Cancer Lung Nodule Follow-up Guidelines](image.png)

**Solid and Ground Class Nodules**

Solid nodules with volume doubling time >400 days or

**Ground glass nodules - Repeat scan at 2 and 4 yr scans**

Stage 1A: if stable or 4 yr

**Only if volume measurement not**

3 month scan

1 year scan

Nodule size for further work up

**>25% increase size or VDT <600 days**

Brock risk assessment

Biopsy PET NDM

*Figure 1: Flow chart demonstrating the local Lothian policy for the management of lung nodules in HNC patients.*
References


Practical Application

For patients who have a small or indeterminate nodule and early stage HNC undergoing uni-modality treatment, interval imaging should be arranged following completion of initial treatment. The time to interval scan will be determined by the size of nodule in question as <6mm nodules rarely grow sufficiently fast to make re-imaging in less than 6 months worthwhile.

For those patients who require dual modality therapy, the treating team should consider re-assessing the chest between treatment phases, particularly for high volume nodules. If the nodules remain unchanged, treatment will continue as planned with an interval scan at 12 months.

For those with evidence of progression, re-assessment of treatment goals is required before continuing with aggressive therapies in the presence of a secondary malignancy or metastatic disease.

Conclusion

Overall the risk of malignancy within the lung nodules of patients with HNC are low. However, in contrast to lung nodules in other patient groups, size is a poor predictor of malignancy. By appreciating the low but significant risk of malignancy within lung nodules in patients with HNC, clinical teams can plan treatment effectively and arrange interval imaging in order to tailor the goals of therapy to the individual case appropriately.

References


Robotic surgery for head and neck cancer

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Abstract
Transoral robotic surgery (TORS) is a novel technique in the management of head and neck tumours. Head and neck cancer can be treated with either non-surgical or surgical means. Resective surgery has traditionally involved ‘open’ approaches with significant functional impairment to speech and swallowing, whilst other side effects, TORS offers an enhanced open surgical experience with minimally invasive surgical techniques and a magnified 3-dimensional endoscopic view, providing a minimally invasive surgical approach compared to open surgery. With the increasing incidence of high-risk Human Papilloma Virus positive (HPV+) oropharyngeal cancer in a younger cohort of patients, whom once cured of cancer have longer to live with the side effects of radiation and concurrent chemotherapy treatment, TORS is an alternative primary treatment option in selected patients with similar oncological results and potentially better functional outcomes compared to non-surgical therapy. This in-depth review will cover the rationale for TORS and its application in the multidisciplinary management of head and neck cancer.

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Key words
Robotic surgery, TORS, head and neck cancer

Introduction
Head and neck cancer comprises a heterogeneous group of tumours arising from various subsites of the head and neck region. The vast majority originate from squamous epithelium of the upper aerodigestive tract, with head and neck squamous cell carcinoma (SCC) the 6th most common malignancy worldwide. Dependent on stage of disease, head and neck cancer can be treated with either surgery +/- adjuvant (chemo)radiotherapy or upfront radiotherapy +/- concurrent chemotherapy (CRT).

Surgery for head and neck cancer is based on well-established oncological principles of resecting the tumour with an appropriate margin of normal tissue, whilst also managing the neck with either an elective or therapeutic neck dissection. Traditional open surgical approaches, which have been tried and tested for decades, require large incisions and invasive approaches to various parts of the upper aerodigestive tract, and whilst permitting en bloc resection of tumour with clear margins, results in significant post treatment functional impairment in speech and swallowing amongst other side effects. With the evolution of newer radiation delivery techniques for head and neck cancer, publication of phase III trials non-surgical trials promoting the organ preservation paradigm that reported comparable outcomes, there has been a shift over the past 20 years towards non-surgical treatment for most advanced head and neck cancers, with surgery reserved for salvage treatment.

Transoral microsurgery (TOLM) emerged as an alternative to open surgery for oropharyngeal, supraglottic and glottic tumours, providing the option of primary surgical treatment for head and neck cancer with reduced morbidity. However, despite TOLM providing excellent oncological control for certain head and neck subsites such as the oropharynx and supraglottis, the learning curve in gaining proficiency is steep, and there are technical limitations from operating in 2 dimensions with a laser cutting tool whose maneuverability is limited by line of sight. In addition, use of the laser frequently involves cutting through tissue to ascertain depth of disease, with further addition, use of the laser frequently involves cutting through tumour to ascertain depth of disease, with further sampling to ensure clear margins, which is fraught with difficulty and controversy in assessing pathological margins.

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Transoral microsurgery (TOLM) emerged as an alternative to open surgery for oropharyngeal, supraglottic and glottic tumours, providing the option of primary surgical treatment for head and neck cancer with reduced morbidity. However, despite TOLM providing excellent oncological control for certain head and neck subsites such as the oropharynx and supraglottis, the learning curve in gaining proficiency is steep, and there are technical limitations from operating in 2 dimensions with a laser cutting tool whose maneuverability is limited by line of sight. In addition, use of the laser frequently involves cutting through tissue to ascertain depth of disease, with further sampling to ensure clear margins, which is fraught with difficulty and controversy in assessing pathological margins.

Epidemiology of Oropharyngeal Cancer
The incidence of high risk human papillomavirus positive (HPV+) oropharyngeal OPC (OPC) is rising. There is good epidemiological data showing increased numbers of HPV-related oropharyngeal cancer around the world10-14, particularly in younger men in their 5th decade. The precise aetiology of HPV related OPC remains under consideration, but the hypothesis that HPV positivity is associated with increased incidence in younger men is predominately seen in younger men in their 5th decade.

Table 1. Prevalence (%) of HPV-positive oropharyngeal cancers around the world10

<table>
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<tbody>
<tr>
<td>Worldwide</td>
<td>5.2 (4.7–5.6)</td>
<td>10.0 (9.0–11.0)</td>
<td>15.0 (13.0–17.0)</td>
<td>20.0 (17.0–23.0)</td>
</tr>
<tr>
<td>North America</td>
<td>12.5 (11.0–14.0)</td>
<td>24.0 (22.0–26.0)</td>
<td>36.0 (34.0–38.0)</td>
<td>48.0 (46.0–50.0)</td>
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<tr>
<td>Europe</td>
<td>28.0 (26.0–30.0)</td>
<td>36.0 (34.0–38.0)</td>
<td>44.0 (42.0–46.0)</td>
<td>52.0 (50.0–54.0)</td>
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</table>

Various types of active and passive surgical robots have been trialed, mainly by urologic and orthopaedic surgeons, in the 1980s and 90s, but the daVinci Surgical Robotic System (Intuitive Surgical Inc. Sunnyvale, California, USA) has been the only commercially available surgical robot since the early 2000s. Using this platform Weinstein et al reported the first transoral robotic surgical (TORS) series for the treatment of oropharyngeal cancer (OPC) in 2007. Unique advantages of the daVinci surgical robot include: an enhanced 3 dimensional (3D) endoscopic view with 10x magnification for the operating surgeon seated comfortably at the console (Fig. 1), miniature wristed instruments on a separate patient cart with a much wider range of movement compared to the human hand, elimination of tremor, and additional arms for retraction and suction via the patient side surgical assistant. To date the vast majority of robotic surgery for head and neck cancer has been done for the treatment of OPC; therefore, this review will focus predominantly on the role of TORS for oropharyngeal cancer.

Justification for considering surgery as primary treatment modality for Oropharyngeal Cancers

HPV-Positive Squamous Cell Cancers
Several studies have shown that the radical doses of chemoradiotherapy (CRT) used to treat head and neck cancer (with the aim of organ preservation) cause significant patient morbidity in the short and long term. Whilst the use of radiotherapy with concomitant chemotherapy improves survival and locoregional control compared to radiotherapy alone15,16, it also increases the burden of acute toxicity, with mucositis being one of the main acute symptoms. Trotti et al demonstrated in a systematic literature review, which included data from 6,181 patients, that 80% experienced significant mucositis, with resultant hospitalisation of 16%, and modification of radiotherapy regimes in 11%. Severe mucositis was higher with the use of altered fractionation protocols, compared to conventional radiotherapy17.

We also know that acute radiation toxicities can persist into the long term, although this is often underreported or underestimated18. Mackay et al performed a meta-analysis of 230 patients included in 3 large trials (RTOG 91-11, RTOG 97-03 and RTOG 99-14) to investigate whether patients experienced toxicity over 6 months after radiotherapy treatment. Over 43% of patients who had no pre-treatment dysfunction, were found to have on-going grade 3 or higher toxicity and had continuing use of a gastrostomy tube for feeding or had died from a cause probably secondary to laryngeal dysfunction. Those with higher T stage, increasing age or a primary tumour in the larynx or pharynx were most at risk of long-term toxicity. Long term dysphagia after CRT requiring permanent gastrostomy or nasogastric tube for nutrition is also a recognised side effect19-21. Despite improvements in the delivery of head and neck radiation treatment, such as
the TORS group and 11% in the non-surgical group.\(^25\) Noting that gastrostomy tube prevalence decreased for after surgery (risk reduction by 57%) over time. It is worth TORS-based treatment had lower gastrostomy tube rates.

\[\text{al.}^\text{27} \text{ showed that up-front TORS de-intensified adjuvant radiotherapy, survivorship issues are a major concern. For patients receiving CRT, top priorities at various time points are consistently xerostomia and dysphagia, the former being a side effect seen with radiation therapy alone. Prospective observational studies suggest that the long-term radiation side effects of xerostomia and dysphagia could be avoided with a primary TORS approach. Results from an observational study of 74 patients treated with TORS and adjuvant therapy and 46 patients treated with definitive CRT, showed that primary TORS resulted in significantly better salvia-related quality of life compared to definitive CRT at 1, 6, 12, and 24 months (\(p < 0.001\), \(p = 0.035\), \(p = 0.005\), \(p = 0.007\)). With the advent of TORS as a surrogate marker of poor swallowing, the retrospective matched cohort study of Sharma et al.\(^\text{28}\) identified that patients who received TORS-based treatment had lower gastrostomy tube rates after surgery (risk reduction by 57%) over time. It is worth noting that gastrostomy tube prevalence decreased for both treatment groups, with 3% of gastrostomy tube patients in the TORS group and 11% in the non-surgical group.\(^\text{28}\) Similar findings were identified in a systematic review involving 20 case series,\(^\text{26}\) including 8 IMRT studies (772 patients). While oncological outcomes were comparable between the two treatment groups, the adverse events profile was different: xerostomal stenosis (4.8%) and osteoradionecrosis (2.5%) for IMRT, haemorrhage (2.4%) and fistula (2.5%) for TORS.

The TORS technique for tonsil cancer involves en bloc resection of the tonsil and underlying superior constrictor muscle, together with a cuff of soft palate and tongue base, whilst aiming for histologically negative margins. This procedure has been well described,\(^\text{29}\) and the key operative steps involved are:

- incision through the pterygomandibular raphe to identify the parapharyngeal space with the aid of the medial pterygoid muscle tendon;
- separating the constrictor muscles from the parapharyngeal fat and mobilising the superior pole of the tonsil with an adequate cuff of tissue from the soft palate;
- progressive dissection in the parapharyngeal space to free the stylopharyngeal and pharyngeal constrictors, mobilising tongue base mucosa and deep tissue between the anterior and posterior tonsillar pillars;
- resecting at least a centimetre segment of styloglossus to ensure a histologically negative margin;
- making index cuts on the posterior pharyngeal wall to avoid resection of excessive amounts of mucosa and progressive transaction of the constrictor muscle along with the stylopharyngeal musculature to achieve an en bloc resection.

While some authors recommend sutureing the posterior pharyngeal wall to the posterior aspect of the soft palate to avoid nasal regurgitation, the authors have not specifically found this to be an issue. Postoperatively the tonsil defect (Fig. 2) is left to heal by secondary intention, and complete mucosalisation normally takes place within 6 weeks. Patients commence oral diet well in advance of this and are usually free of nausea gastric feeds within days.\(^\text{30}\)

**Base of Tongue Cancers**

TORS is also used to treat early stage (T1 and T2) tongue base cancers, however these tumours are less common and

![Clinical photograph of the defect following lateral oropharyngectomy.](image-url)
The majority of these cancers are small (<1 cm) tumours arising in Waldeyer’s ring, i.e. lymphoid tissue of the pharynx, tonsils, base of tongue, and oropharynx. TORS lingual tonsillectomy is widely used in the evaluation of head and neck cancer patients. As per available systematic reviews and meta-analyses, the overall reported complication rate from TORS lingual tonsillectomy is low, with a 5% rate of post-operative haemorrhage as the main complication.

The natural history of CUP is unclear, making diagnosis and management planning particularly difficult in these cases. Identification of the primary tumour is highly desirable as the patient may receive site-specific treatment, avoids wide-field radiation side effects, or the additional morbidity associated with surgical intervention, and is associated with better oncological outcomes. PET-CT is a widely used in the evaluation of head and neck CUP and is now accepted as a key component of the diagnostic protocol, performed prior to panendoscopy and biopsy proven for carcinoma, but no obvious primary tumour is identified following thorough clinical examination and appropriate investigations. Of these unknown primaries, over 90% represent SCC, with adenocarcinoma, melanoma, and rarer histological subtypes making up the rest.

The systematic review by Fu et al. demonstrates the incremental benefit of lingual tonsillectomy for TOLM or TORS in the detection of occult primary head and neck SCC when the comprehensive diagnostic workup of clinical examination, cross-sectional imaging, PET-CT and panendoscopy is performed. A biopsy of the primary tumour is not necessary in cases where the tumour bed has been surgically debulked. This debate is limited by the small sample size of included studies, inter-institutional and inter-surgeon variation in the technique for performing TOLM or TORS lingual tonsillectomy, and publication bias, which biases the institutions that record favourable results more likely to publish their data.

The standard of care for recurrent oropharyngeal cancers is open surgical resection. In selected cases, TORS has shown good oncological outcomes with low morbidity from a contralateral lingual tonsillectomy needs to be considered. Overall morbidity from TOLM and TORS lingual tonsillectomy was low, with a 5% rate of post-operative haemorrhage as the main complication.

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The role of PET-CT in recurrent oropharyngeal cancer is to detect tumour recurrences that are not visible on conventional imaging. PET-CT is widely used in the evaluation of head and neck cancer and is now accepted as a key component of the diagnostic protocol, performed prior to panendoscopy and biopsy. PET-CT provides additional primary tumour detection rates over conventional imaging techniques of between 37% and 46% with a sensitivity of up to 97% and low specificity of 68-79%. However, FDG-PET-CT is limited by its inability to detect small (2-3 cm) tumours, normal physiological tracer uptake by tissues such as salivary glands, lymphoid tissue, and muscle can result in a high false-positive rate, or false-negative result in situations where pathological 18F-FDG uptake is considered physiological.

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Robotic surgery for other Head and Neck Cancer subsites

Nasopharyngeal Cancer

Radiotherapy with or without chemotherapy remains the gold standard treatment for nasopharyngeal cancer. Whilst loco-regional control has improved with non-surgical treatment over the years, local recurrence rates can be as high as 20% following CRT70. Nasopharyngectomy via the daVinci, such as the single port (SP) system 78, may be repaired transorally with using the needle driver instrument of the daVinci robot. TORS total laryngectomy is a technically demanding procedure that requires the surgeon to acquire a considerable robotic surgery experience before undertaking the operation.

TORS total laryngectomy is limited to a number of published case series71,72, with the main aim of reducing the morbidity associated with open salvage total laryngectomy i.e. pharyngocutaneous fistula.

In situations when a concurrent neck dissection is not required, TORS laryngectomy requires less soft tissue dissection and produces a much smaller pharyngotomy defect which can be treated transorally with using the needle driver instrument of the daVinci robot. TORS total laryngectomy is a technically demanding procedure that requires the surgeon to acquire a considerable robotic surgery experience before undertaking the operation.

Additional benefits of robotic head and neck surgery that are still in the development phase include: augmented reality,16,19 where the ability to superimpose cross-sectional imaging on the console surgeon’s endoscopic view of the operating field will promote safer surgery by facilitating the avoidance of critical neurovascular structures, whilst an improved rate of negative margins could be achieved with optical imaging using injected ‘fluoresce conjugated antibodies’ to specific tumour markers101,102 and built in endoscopic filters within the robotic system, allowing the surgeon to visualise disease that would otherwise have remained ‘hidden’. Finally, advances in the field of artificial intelligence103 undoubtedly drive down costs and promote innovation.

SUMMARY

Robotic head and neck surgery is a novel, safe, and effective procedure for treating selected head and neck cancer patients, in particular HPV+ OPC. Technological advances in robotic equipment, molecular biology, optical imaging, and artificial intelligence offer exciting prospects for the future. Several clinical trials are exploring the role of robotics in head and neck cancer and their results are expected to significantly change the management of head and neck cancer in the near future.

References


The risk-benefit ratio of chemoradiation treatment in head and neck squamous cell carcinoma: value of extranodal spread and margin status

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Abstract

Application of chemoradiation treatment for head and neck squamous cell carcinoma (HNSCC) promises options for organ preservation and improved survival. However, chemoradiation is associated with a significant increase in side-effects compared to radiation alone. Studies in postoperative HNSCC suggest that the presence of extranodal spread and positive surgical margins may justify a choice for postoperative chemoradiation. In the present paper we summarize the strengths and weaknesses of the evidence this justification is based on. We conclude that the risk-benefit ratio of chemoradiation treatment for HNSCC is suboptimal and needs further improvement.

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Key words

Head and neck cancer, extranodal extension, surgical margins, outcomes

Introduction

Head and neck squamous cell carcinoma (HNSCC) includes a diverse collection of malignancies. These share a common derivation from the upper aerodigestive tract mucosa, under the influence of an array of intrinsic (genetic) and extrinsic (tobacco, alcohol, HPV) causative factors. The resultant nature of HNSCC is highly variable, unpredictable, and (potentially) aggressive, with a large proportion of patients presenting with advanced stage disease. Although aggressive treatment is often required, this is complicated by the anatomically dense and functionally important head and neck region and substantial comorbidity that typify affected patients. These features do not allow much room for therapeutic experimentation, as the balance between the grave consequences of undertreatment, and unnecessary side effects of overtreatment is understandably precarious.

Few scenarios illustrate the divide between such competing clinical interests better than the consideration of chemoradiation therapy in the management of HNSCC. On the one hand, the advent of chemoradiation has rendered clear benefits. For example, primary chemoradiation offers the potential for organ preservation without survival compromise in the setting of advanced, but operable HNSCC. This avoids debilitating surgical resections, and offers functional preservation in a significant proportion of patients. Chemoradiation also has the ability to improve outcome by approximately 5-8% compared to radiation alone, in the adjacent setting, or in cases of inoperable HNSCC. However, chemoradiation is associated with significant side effects. Compared to the modest 5-8% survival benefit over radiation alone, chemoradiation doubles the risk of grade 3/4 toxicity from 25% to 50%. In other words, the number needed to treat (NNT) accounts to approximately 20, while the number needed to harm (NNH) is only 2-3. It is clear from comparing these numbers that the risk-benefit ratio of chemoradiation therapy is out of balance which an obvious cause for concern and debate.

The present paper discusses the value of extranodal extension (ENE) and surgical margin status in optimization of the risk-benefit ratio of chemoradiation application in HNSCC.

Extranodal extension

The presence of lymphatic metastasis is an important prognostic factor in HNSCC, with its presence associated with a 50% reduction in survival. Among patients with lymphatic metastasis, risk can be categorized further based on the site, number, laterality, proportions and location of the affected lymph nodes. However, the most ominous nodal hallmark of reduced clinical outcome is ENE.

ENE is defined as extension of metastatic tumor deposits through the lymph node capsule. The incidence of ENE in metastatic neck dissection specimens is approximately 50%. Accumulating evidence suggests that ENE is associated with suboptimal treatment outcomes. Rough estimates depict that ENE is associated with a three-fold increased risk of regional relapse and a two-fold increased risk of distant metastasis. A meta-analysis of 1620 patients by Dunne et al suggests 5 year survival of 58.1% for ENE negative patients, compared to 30.7% for ENE positive patients, with an odds ratio of 2.7. The authors concluded that ENE is related to a 50% drop in the 5y survival rate for a given TNM stage.

Significant debate surrounds the question whether ENE is an independent predictor of outcome. Although some support this relationship, several studies failed to attribute independent prognostic significance. Several observations may explain this discrepancy. Firstly, the presence of ENE is strongly associated with other nodal prognostic factors. For example, Woolgar et al demonstrated that the incidence of ENE increased with increasing size of lymph nodes and/or metastatic deposits, increasing number of involved lymph nodes, presence of concomitant extracapsular metastases (relative to primary tumor), proportion of involved nodes (relative to surgical nodal yield), and location of diseased nodes in more caudally located neck levels. Non-comprehensive inclusion of such factors in multivariate models accounts at least in part for the observed discrepancy. The same accounts for the presence or absence of facial nerve paralysis which may explain variability in study results. A recent study by Wreesmann et al sought to objectify this issue in a more empirical fashion. Based on this work, ENE extent has been included into the 8th edition of the TNM system, at a generic cut-off of 2mm.

Altogether, the issues above continue to fuel debate. This has cast doubt on whether ENE is an truly intrinsic expression of aggressive tumour biology, or rather a meaningless epiphenomenon of advanced nodal disease. This continued debate is sustained by unavailability of an objective and widely accepted definition of clinically relevant ENE.

Surgical margins

Surgery remains a central backbone of HNSCC treatment, and its desired outcome is removal of all cancer cells from the surgical field. This is usually achieved by the anatomically dense and functionally important anatomy within the head and neck region, as it competes with the goal to preserve the non-affected normal tissues for optimal functional and cosmetic outcomes. The surgical field may only achieve this ultimate aim of the surgical field increases the risk of local recurrence in a linear fashion. This is not only due to the mere presence of cancer cells postoperatively, but also to their increased chances of survival in the growth factor-enriched environment.
hypoxic postoperative wound bed. Postoperative tumor persistence also serves as an indirect reflection of aggressive tumor biology, as it is often associated with poor prognostic factors (high stage, perineural invasion, infiltrative growth pattern) which complicate successful removal.

Histopathological examination provides a suboptimal estimate of postoperative tumor persistence. A distance of 5mm (or more) between the invasive tumor front and resection margin is designated as a negative margin, and uniformly accepted as a threshold at which the risk of tumor persistence and associated tumor recurrence reaches an acceptable range. Anderson and colleagues conducted a meta-analysis which showed that margins less than 4mm have a significantly higher chance of recurrence and should dictate further treatment. A distance between 1-5mm is deemed a close margin, while a positive margin is diagnosed when tumor cells are present within 1mm of the specimen rim, according to the Royal College of Pathologists.

The prognostic significance of margins status has been subject of multiple, predominantly retrospective studies. For example, positive margin status was found to be associated with a dramatic increase in risk of local recurrence and disease-specific survival. A study by Sutton and colleagues on 200 oral tongue cancer patients suggested that risk of local recurrence is increased almost 5-fold in the case of a positive margin (12% versus 55%), with a more than 7-fold decreased in 5y disease specific survival (11% versus 77%). Although the independent prognostic value of positive margins is universally accepted across the scientific community, this margin is less well supported for close margins. This is partly due to variability in its definitions, and the slightly arbitrary selection of the 5mm cut-off, which is not supported by sufficiently convincing evidence. For example, empirical analysis of the margin cut-off suggests that a clinically more relevant cut-off between close and negative margins is located close to 2mm distance. Additional confusion is created by the inadequate correction for associated poor prognostic factors through multivariate analysis. Altogether, these issues compound upon the already tremendous base of variance, such that a significant variability may be introduced at different levels of the analytic process, including the surgical collection, handling, orientation, tissue processing, and microscopic assessment, which remains difficult to standardize.

Markers of chemoradiation benefit

Although retrospective studies suggest that clinicopathological factors such as ENE and suboptimal margins could serve as markers of HNSCC with a higher risk of recurrence and mortality, the ambiguity described above questions their validity as convincing indicators for benefit of treatment intensification. For this reason, several prospectively randomized trials were organized to study this issue. Unfortunately, these studies demonstrate significant variation as well. A trial by Laramore et al compared low-risk HNSCC (clear margins, no ENE) to high-risk HNSCC (ENE or positive margins). The study showed that high-risk HNSCC benefited from chemotherapy addition to postoperative radiation therapy. However, only margin status was a significant predictor of outcome, while ENE was not. Subsequent studies from MD Anderson Cancer Center by Peters and Ang published similar comparisons of high and low-risk HNSCC based on margins, ENE and other factors. Randomization for different adjuvant treatment intensities revealed benefit in the case of high-risk HNSCC, and ECS rather than margins as a predictor of this effect. Some of this heterogeneity was resolved by two subsequent trials, both of which included high-risk HNSCC only, and randomized patients to PORT with or without chemotherapy. Although both trials defined high-risk HNSCC using different clinicopathological factors, ENE and suboptimal margins were defining factors shared by these studies. The original publication of both trials revealed that oral recurrence was improved by approximately 5.8% when chemotherapy was added to PORT. A retrospective post-hoc analysis of data from both trials combined revealed that this benefit was only observed in cases characterized by ENE, positive margins or both. These trials suggest that the observed benefits of chemotherapy addition to PORT in post-surgical HNSCC patients with ENE or positive surgical margins translates into a number needed to treat of approximately 20.

Limitations of evidence

Since publication of the EORTC22931 and RTOG9501 trials, recommendations and guidelines with regard to adjuvant treatment of HNSCC have been dominated by the conclusions of these trials and their combined data analysis (fig. 1 and 2). This has led to a universal recommendation of chemotherapy addition to PORT in post-surgical HNSCC patients exhibiting ENE and/or positive surgical margins, which has been included in the vast majority of guidelines. The resultant increase in post-operative chemoradiation application has rendered an increased understanding of treatment-associated complications and long-term side effects. It is now firmly established that addition of chemotherapy to PORT doubles the risk of grade 3/4 complications, from approximately 25% to 50%. This translates into a NNH of approximately 3.2 This may be viewed as a conservative estimate, as long term toxicity, such as fibrosis of masticator, laryngopharyngeal and esophageal muscles and nerves continue to accumulate over time. The significant imbalance between the NNT and NNH of adjuvant chemoradiation treatment of HNSCC has fueled critical revision of the evidence supporting it. Over the years, criticism has mounted with regard to the generalizability and validity of the findings rendered by these postoperative chemoradiation trials. Concerns surround their inclusion profile, which included a predominance of laryngeal, hypopharyngeal and oropharyngeal SCC, which are most commonly treated by non-surgical means. In contrast, oral cavity SCC, favored to be treated with a surgical approach, represented a minority within the study population. Also, the HPV status of the oropharyngeal carcinomas, a marker of chemoradiation sensitivity independent of ENE status, remains unaccounted for in the data analysis. However, the most pertinent criticism surrounds the lack of multivariate confirmation of the prognostic role of ENE and margin status. This omission failed to rule out potential confounders of the findings, as both trials included a differential array of risk factors with variable associations to the presence or absence of ENE and/or margin status. A pertinent example includes the 57% of EORTC and 94% of RTOG patients characterized by advanced N2/N3 neck disease. Absence of multivariate correction for this possible confounder leaves it unclear whether the observed outcome effect associated with ENE and or margin status is independent of such nodal volume parameters including number, size and location of involved lymph nodes. This argument is strengthened by recent data suggesting that patients without ECS and positive margins experience significant benefit from adjuvant chemoradiation treatment, especially in the presence of advanced nodal stage. Altogether, these findings undermine the basis of chemoradiation addition based on ECS and/or margin status alone, which is especially poignantly evident in the setting of low-stage HNSCC with ENE/positive margins, or high-stage patients without ENE/positive margins.

Conclusion

Chemoradiation treatment has greatly influenced the management of advanced HNSCC. However, the risk-benefit ratio of this treatment is a concern, as the NNH greatly outweighs the NNT. Since 2004, the surgical margin status have been widely used as markers to help select patients that may benefit from chemoradiation, and thereby improve this risk-benefit ratio. However, the data underlying this practice are ambiguous and not supported by rigorous statistical analysis. Patients with advanced HNSCC are often focused upon cure, and willing to sacrifice. In the case of chemoradiation consideration, physicians involved in the care of these patients should thoroughly depict the current risk-benefit balance of this
treatment, and the lack of convincing benefit markers, in order to help patients take a balanced decision.

References


An analysis of 302 minimally invasive parathyroidectomy patients over a 12-year period – is day-case surgery safe?

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Abstract

Purpose
Traditionally, a bilateral neck parathyroid exploration has been the standard treatment for primary hyperparathyroidism (pHPT) due to parathyroid adenoma. This usually requires a hospital inpatient stay. However, with the help of imaging, minimally invasive parathyroidectomy (MIP) has an excellent cure rate and minimal morbidity. The aims of this study are to investigate the accuracy of pre-operative radiological localisation in relation to operative findings, demonstrate the safety and efficacy of open-MIP (O-MIP) and show that this can be safely carried out as a day-case procedure. A review of the literature is also performed.

Methods
A retrospective review of 302 consecutive patients who underwent O-MIP for pHPT due to solitary parathyroid adenoma (April 2006 - March 2018) was performed. All patients were initially investigated by an endocrinologist to confirm pHPT and had pre-operative localisation imaging using ultrasound scan and 99mTc-sestamibi.

Results
79%(n=239) were female and 21%(n=63) male. 81%(n=245) had concordant pre-operative USS and MIBI scans. When the scans were concordant, there was 98%(239/245) identification of parathyroid tissue confirmed by intra-operative frozen section. Overall, 94%(n=230) had parathyroid tissue confirmed by intra-operative frozen section. Mean operative time was 61 minutes.

Analysis of results showed increasing trend of performing this procedure as day-case: 26% (14/53) were day-case from 2006 to 2009, 62% day-case (73/118) from 2010 to 2013 and 98% day-case (128/131) from 2014-2018.

There were no re-admissions due to hypocalcaemia, recurrent laryngeal nerve injury or wound haematoma.

Conclusion
O-MIP can be performed safely as day-case. Accurate localisation is the key to successful O-MIP.


Key words
“Hyperparathyroidism”, “Daycase”, “Parathyroid”, “Minimal Access Surgery” and “Minimally Invasive Parathyroidectomy”

Conflict of Interest
The authors declare that they have no conflict of interest.

Introduction
Primary hyperparathyroidism (pHPT) is the commonest cause of hypercalcaemia in the outpatient population. Primary hyperparathyroidism is usually caused by a solitary adenoma (80-85%), hyperplasia (10-15%), double adenoma (2-5%) or parathyroid carcinoma (<1%).1 Surgical treatment in the form of parathyroidectomy is the only definitive treatment of choice in the symptomatic patient, which has shown to improve health-related quality of life.2,3

In 1925, Mandel performed the first successful parathyroidectomy, and since then, traditional surgical practice has been the cervical incision with bilateral neck parathyroid exploration (BNE) approach.4

In the 1980s, due to advances in the preoperative localisation methods, new techniques were being described. These techniques include minimally invasive parathyroidectomy (MIP), minimally invasive radio-guided parathyroidectomy, video-assisted parathyroidectomy and endoscopic parathyroidectomy.5

Figure 1: Incision.

Figure 2: Carolot Bundle.

The specific post-operative risks of concern for parathyroidectomy include haemorrhage or bilateral recurrent laryngeal injury causing airway obstruction, and symptomatic hypocalcaemia causing tetany. However, with a technique such as open minimally invasive parathyroidectomy (O-MIP), the procedure can be performed using a small skin incision, sited over the suspected location of the adenoma based on the scans performed. This generally means that there is less tissue dissection, and because meticulous haemostasis is paramount for clear surgical field, the risk of post-operative haemorrhage causing airway obstruction should be lower. Also, with the help of pre-operative scans, O-MIP tends to be done unilaterally, which means bilateral recurrent laryngeal injury resulting in airway problems is rare.

There have been a small number of studies recently reported in the literature that have shown parathyroidectomy can be done safely as a day-case with an increasing trend in day-case parathyroidectomy.5,15,17,22,23,24,28 Here we present our experience of 302 consecutive patients who

Since then there has been plethora of studies that have described the technique and good outcomes of MIP.2,24

Conventionally, parathyroid surgery is done as an inpatient procedure. In 2000, the NHS Plan set a goal of increasing the proportion of elective procedures performed as day-cases as this would provide a means of helping the NHS to achieve its targets of treating more patients faster. Therefore day-case procedures are a key component of NHS modernisation. The Department of Health’s 2002 Day Surgery Operational Guide was then published as an aide to improve efficiency in day surgery units.27 Day-case surgery is defined as admission and discharge on the same day for planned surgical procedures. Day-case procedures have a number of benefits, including patient preference for a shorter hospital stay, reduced risk of hospital-acquired infections as well as its financial benefits. The appropriateness of whether a procedure can be done as day-case depends on the preoperative patient assessment, the operation itself, the discharge plan, and postoperative support.
underwent O-MIP over a 12-year period in a single institution, the majority of which underwent day-case surgery.

**Materials and Methods**
A retrospective case notes review of 302 consecutive patients who underwent O-MIP from April 2006 to March 2018 was conducted. These were patients who underwent O-MIP for pHPT with pre-operative imaging suggestive of solitary adenoma.

Theatre database were used to identify patients’ sex, age, date and duration of surgery. Patient records were reviewed for source of referral, pre-operative symptoms, pre-operative localisation imaging, operation findings, mode of anaesthesia, pre- and post-operative biochemical findings, and any complications encountered.

All patients were investigated initially by an endocrinologist to confirm the diagnosis of pHPT. Following this diagnosis all patients underwent radiological imaging using ultrasound (USS) with or without 99mTc-sestamibi scan (MIBI). The senior author performed all exploratory surgery electively and their admission was planned as a day-case procedure under general anaesthetic (GA) (unless specifically identified pre-operatively that inpatient procedure was required). Approximately 5% of patients were offered surgery under local anaesthetic (LA), either as a patient choice or due to multiple morbidities of the patient. LA involved deep cervical nerve block along with subcutaneous infiltration.

The surgical criteria for a day-case procedure were single adenoma. The patient must also have fit the agreed local protocols for patient assessment and these would include social and medical factors.

The main reasons for inpatient stay in this patient group would have included logistical reasons for patients travelling from out of region, significant co-morbidities or social circumstances such as having a responsible adult escort the patient home and provide support for the first 24 hours.

**Results**

**Patient demographics**
Out of the 302 patients identified, 239 were female and 63 were males (female to male ratio was 3.8:1). The mean age in years was 60 (standard deviation: 12.7) and median age was 61 (range: 18-91).

O-MIP was performed using a 2-2.5cm skin incision (Figure 1) sited over the suspected location of the adenoma based on the pre-operative scans. The carotid bundle is exposed by retracting the medial border of the sternocleidomastoid and lateral border of strap muscles (Figure 2). The thyroid lobe is rotated medially and the enlarged gland identified and excised (Figure 3).

Intra-operative frozen section was performed to confirm that parathyroid tissue had been removed. On confirmation a haemostatic agent made of an oxidized cellulose polymer was placed in the wound bed (Figure 4) and the skin wound was closed with an absorbable suture and the patient sent to recovery. Drains were not routinely used.

The first post-operative serum calcium and parathyroid hormone (PTH) levels were measured at 4-6 hours after the procedure. Patients were generally discharged the same day with a 1-week course of 1000mg oral calcium three times daily and 1 µg of alfacalcidol once daily. This was given to slow down the sudden drop of calcium levels and prevent post-operative hypocalcaemic symptoms. The patient was given a biochemistry request form and instructed to attend the hospital 3 days prior to the clinic appointment for serum calcium and PTH evaluation. An outpatient consultation was arranged 6 weeks post-operatively.
Symptoms
Majority of patients were asymptomatic and findings were incidental (171/302). 58/302 had musculoskeletal symptoms as their primary symptom; 47/302 presented with renal calculi, and the rest of patients presented with abdominal pain (13/302), psychological symptoms (10/302) and metabolic symptoms (3/302).

Pre-operative imaging and operative localisation concordance
Pre-operative USS and MIBI scans were concordant in 245/302 patients (81%) of cases. When the scans were concordant, there was 98% (239/245) identification of parathyroid tissue confirmed by intra-operative frozen section. Overall, 94% (285/302) had parathyroid tissue confirmed by intra-operative frozen section.

Operative findings
In total, 5% (15/302) of patients underwent the procedure under LA. None of the LA cases required intra-operative conversion to GA. The mean operative time in minutes was 61.4 (Standard deviation: 24.7) and this included the waiting time for frozen section.

The commonest location where the adenoma was identified operatively was on the right at the lower pole of the thyroid (119/302). The second commonest location where the adenoma was identified operatively was on the left at the lower pole of the thyroid (105/302).

Biochemical tests
The mean pre-operative calcium level was 3.00 mmol/L and the mean post-operative (at follow up appointment) PTH level was 6.7 pmol/l. (Paired t-test, p< 0.0001).

The mean pre-operative calcium level was 3.00 mmol/L and the mean post-operative (at follow up appointment) calcium level was 2.50 mmol/l (Paired t-test, p= 0.0001). Normocalcaemia was achieved in 95% (286/302) of patients.

Inpatient vs Daycase
Analysis of results show increasing trend of performing this procedure as day-case: 26% (14/53) were day-case from 2006 to 2009, 62% day-case (73/118) from 2010 to 2011, 93% (167/186) from 2012 to 2013.

Operative complications
In total, 319 cases (105/302) were hospitalised following surgery. 2 patients developed postoperative pneumonia, 7 patients suffered from postoperative hypocalcaemia (1 permanent, 2 temporary), 6 patients developed postoperative wound infections (3 permanent), 1 patient had postoperative pneumothorax and 1 patient developed postoperative haematoma.

Table I. MIP Studies - Average hospital stay, percentage of day-case procedures, cure rate and complications

<table>
<thead>
<tr>
<th>Study</th>
<th>Study size</th>
<th>Average hospital stay for MIP (days)</th>
<th>Day-case procedures (same day discharge)</th>
<th>Cure rate</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohen et al 2005</td>
<td>139 patients</td>
<td>0.2</td>
<td>86%</td>
<td>99%</td>
<td>1 postoperative neck swelling</td>
</tr>
<tr>
<td>Carr et al 2006</td>
<td>67 patients</td>
<td>Not reported</td>
<td>0%</td>
<td>97%</td>
<td>1 return to theatre for postoperative bleed</td>
</tr>
<tr>
<td>Pang et al 2007</td>
<td>500 (Australia)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>97%</td>
<td>3 permanent unilateral vocal cord palsy, 7 temporary unilateral vocal cord palsy, 3 haematoma (no operation), 2 reoperation for bleeding</td>
</tr>
<tr>
<td>Soon et al 2007</td>
<td>349 patients in MIP group (Australia)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>97%</td>
<td>3 temporary unilateral vocal cord palsy, 3 haematomas, 1 postoperative hypocalcaemia, and 3 surgical site infections</td>
</tr>
<tr>
<td>Mkhai et al 2007</td>
<td>150 patients (UK)</td>
<td>Not reported</td>
<td>95%</td>
<td>100%</td>
<td>3 temporary unilateral vocal cord palsy, 1 haematoma</td>
</tr>
<tr>
<td>Shinido et al 2008</td>
<td>186 patients (US)</td>
<td>Not reported</td>
<td>95%</td>
<td>100%</td>
<td>2 patients developed postoperative pneumothorax, 1 temporary unilateral vocal cord palsy, 1 wound haematoma managed conservatively</td>
</tr>
<tr>
<td>Kiminori et al 2010</td>
<td>167 patients (Japan)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>93-98%</td>
<td>1 temporary unilateral vocal cord palsy, 2 patients had postoperative bleeding that required reoperation</td>
</tr>
<tr>
<td>Hessman et al 2010</td>
<td>75 in MIP group (Sweden and Denmark)</td>
<td>Not reported</td>
<td>0%</td>
<td>97%</td>
<td>4 haematoma, 1 postoperative wound infection, 1 permanent unilateral vocal cord palsy</td>
</tr>
<tr>
<td>Udaltzov et al 2011</td>
<td>1037 in MIP group (US)</td>
<td>0.2</td>
<td>85%</td>
<td>99%</td>
<td>0.77% Recurrent laryngeal nerve injury, 0.1% hypocalcaemia, 0.1% needed tracheostomy, 0.19% neck haematoma, 0.19% cerebral vascular accident, 0.1% pneumonia, 0.19% seizure</td>
</tr>
<tr>
<td>Parameswaran et al 2013</td>
<td>86 patients (UK)</td>
<td>Not reported</td>
<td>93%</td>
<td>100%</td>
<td>Prolonged temporary hypocalcaemia following surgery was experienced in 2 patients, necessitating treatment (but not readmission)</td>
</tr>
<tr>
<td>Parameswaran et al 2014</td>
<td>331 patients in MIP group (UK)</td>
<td>Not reported</td>
<td>66%</td>
<td>Not reported</td>
<td>Not reported specifically for MIP group, but for all parathyroidectomies (n=776) – 6 transient hypocalcaemia, 12 permanent hypocalcaemia, 3 wound infections</td>
</tr>
<tr>
<td>Chow et al 2015</td>
<td>105 patients (Hong Kong)</td>
<td>Not reported</td>
<td>24%</td>
<td>98%</td>
<td>1 permanent unilateral vocal cord palsy, 2 temporary unilateral vocal cord palsy, 7 suffered temporary hypocalcaemia</td>
</tr>
<tr>
<td>Jollat et al 2015</td>
<td>118 patients in MIP group (Switzerland)</td>
<td>1</td>
<td>0%</td>
<td>95%</td>
<td>1 permanent unilateral vocal cord palsy, 3 temporary unilateral vocal cord palsy, 31 suffered temporary hypocalcaemia</td>
</tr>
<tr>
<td>Kay et al 2017</td>
<td>119 patients in MIP group (US)</td>
<td>Not reported</td>
<td>Not reported</td>
<td>98%</td>
<td>Not reported</td>
</tr>
<tr>
<td>Sawant 2017</td>
<td>58 patients (UK)</td>
<td>Not reported</td>
<td>90%</td>
<td>Not reported</td>
<td>No major complications</td>
</tr>
</tbody>
</table>

Figure 7: SPECT scan showing left lower pole parathyroid adenoma.
The most-studied modalities for localisation are nuclear medicine scans, including ultrasound (USS), 131I-MIBI, and 99mTc-sestamibi. While BNE is of value in more complicated cases, the majority of solitary adenomas may be accurately and cost-effectively localised with USS and MIBI scans. In concordance with the USS scan localisation, in 83% of cases, the majority of adenomas were successfully located. However, there was no significant difference in the time taken to locate the adenoma between nuclear medicine scans, ultrasound, and BNE.

We have reviewed the implications of the findings of the common locations of parathyroid adenomas and the current literature on parathyroid surgery to improve healthcare and patient care. Our study contributes to the safety and efficacy of day-case OMIP.

References


6. Cohen MS, Finkelstein SE, Brunt LM, Haberfeld E, Kangrga I, D’Sain A, Jaffe HR, Mehta K, Rabow MD, Fairman BR, Leventhal S, Berger LS (2011) The key to successful O-MIP. With appropriate patient selection, experienced multidisciplinary team (including endocrinologists, radiologist and surgical team), and support systems in place for patients, O-MIP can be performed safely as a day-case procedure.


Abstracts: ENT Masterclass Trainees’ Gold Medal 2018

Insulin Like Growth Factor Receptor 1 (IGF-1R) and Radiotherapy Resistance in Laryngeal Squamous Cell Cancer (LSCC)

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Introduction
Salvage surgery is the only option for radiotherapy failure in LSCC, but is associated with high morbidity. There is a need to identify biomarkers of radioresistance, to inform treatment decisions. Epidermal growth factor receptor (EGFR) associates with radioresistance in head and neck cancer (HNSCC), and type insulin-like growth factor receptor (IGF-1R) correlates with radioresistance in other tumour types. We recently reported that IGF-1R associates with advanced T-stage, HPV negativity and adverse survival in HNSCC. Here, we evaluated IGF-1R and EGFR in predicting radiotherapy failure in LSCC.

Methods
We scored membrane, cytoplasmic and total (membrane plus cytoplasmic) EGFR and IGF-1R using immunohistochemistry on biopsies and salvage laryngectomies from 63 LSCC patients, including 41 treated with radiotherapy (23 long-term remission, 18 local recurrences) and 22 with primary laryngectomy.

Results
IGF-1R scores were higher in the biopsies of the radiotherapy failure group, with scores in the membrane of 3.07 vs 1.0 (p=0.004), cytoplasm 3.36 vs 2.17 (p=0.18) and total IGF-1R 6.43 vs 3.17 (p=0.01) compared with those achieving long-term remission. IGF-1R expression was positively associated with tumour size and EGFR expression and was unchanged following radiotherapy. EGFR scores did not correlate with radiotherapy outcomes. Patients undergoing primary laryngectomy had higher T and N stage (p<0.05) and higher tumour IGF-1R (8.3 vs. 3.17, p=0.02) than those achieving long-term postradiotherapy remission.

Conclusions
These results suggest that IGF-1R associates with radiotherapy resistance in LSCC. Treatments accounting for IGF-1R status, or molecular therapies targeting this receptor, may have merit in patients whose tumours overexpress IGF-1R.

How do head and neck cancer cells regulate macrophage response in vitro?

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Background
Head and neck cancer is the sixth most common malignancy worldwide with squamous cell carcinomas comprising the overwhelming majority. Cancer survival and proliferation is dependent on the ability of recruiting monocytes and converting them into tumour promoting Tumour Associated Macrophages. The aim of this study was to set up an in vitro human head & neck cancer model to study macrophage behaviour in the tumour microenvironment and to identify the genes specifically expressed for an immune suppressing role.

Methods
2D and 3D models using human macrophage cell line (THP-1) with head & neck squamous carcinoma cell lines (HNSCC) and their conditional medium were used. Cytokine production and gene expression were examined by ELISA and real-time quantitative PCR, respectively. Cell aggregation and migration was assessed using time-lapse microscopy.

Results
1) TNFα was transiently produced at 24 hours co-culture and reduced within 48 hours, partially due to TNFα use by HNSCC cells. 2) Macrophage adherence and migration toward HNSCC occurred immediately after co-culture, but not observed in controls. 3) IL-35 introduction into the HNSCC and THP-1 co-culture caused a significant reduction in TNFα production by THP-1 cells. 4) Co-culture of THP-1 with HNSCC increased gene transcription of IL-35 subunits in addition to CD200 and IL-10.

Conclusions
HNSCC produce soluble and membrane bound proteins that induce TNFα production in macrophages and convert macrophages into a tolerogenic Tumour Associated Macrophage phenotype. Antagonism of this tolerogenic pathway could be a novel therapeutic target in the treatment of HNSCC.

Assessment of labyrinthine function in patients with chronic middle ear disease using combined VHIT and BC-VEMP testing

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4 Department of Audiology, Ipswich Hospital, Heath Rd, Ipswich IP4 5PD

Objective
To assess vestibular function in patients with confirmed middle ear disease. To evaluate the additional time needed to incorporate vestibular testing into routine pre-operative clinical assessment.

Setting
Ear Nose and Throat Department from a Tertiary Referral Centre.

Patients
Twenty patients awaiting surgery for chronic middle ear pathology were recruited with the following aetiological breakdown: cholesteatoma (11), otosclerosis (2), chronic discharging ear (4), perforation (2) and meatal stenosis (1).

Interventions
All patients under went underwent bone-conduction ocular and cervical vestibular evoked myogenic potentials (BC-VEMPs) in both ears. Video head impulse testing (vHIT) was conducted for the lateral, anterior and posterior canals for both ears also. The time taken to complete the tests was recorded separately.

Results
The average time taken to complete the ocular and cervical VEMP tests was 5.7 ± 2.0 and 9.1 ± 1.9 minutes respectively for both ears. The time needed for vHIT testing of all six semicircular canals was 6.8 ± 2.0. Using a combination of vHIT and VEMP, abnormal findings were found in 16 of the 40 ears tested (40%).

Conclusions
This study has confirmed that a combination of vHIT and VEMP testing can provide a practical method of assessing the vestibular apparatus of patients with chronic middle ear pathology. With an average test time of less than 20 minutes and a pick-up rate of 40%, this new test paradigm provides an effective method of evaluating this ordinarily difficult-to-test patient cohort.
A Systematic Review of Tyrosine Kinase Inhibitors and Thyroid Neoplasia

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All authors have given permission for submission.

Introduction
Of all endocrine tumours thyroid cancer is the commonest; representing approximately 1% of all malignancies. Annual incidence data for thyroid cancer in the UK from 2008 shows 5.1 per 100,000 women and 1.9 per 100,000 men are affected. The incidence of thyroid cancer is increasing globally, mostly due to an increase in papillary thyroid carcinoma (PTC).

The mainstay of treatment for thyroid cancer is surgical resection, and patients with more advanced disease will also receive radioiodine (RAI) ablation; however, 5–15% of patients are refractory to such treatment. The prognosis for these resistant patients is incredibly poor. For these patients alternative adjuvant treatments such as tyrosine kinase inhibitors (TKI) are now available but not very commonly used.

This systematic review examined the current evidence for the efficacy of the TKI that have been used to treat advanced thyroid cancer concentrating on the four FDA approved drugs for the treatment of advanced or radioiodine refractory thyroid cancer.

Design and Results
Medline, Embase and Google Scholar were searched with the Key search terms of thyroid cancer, thyroid neoplasia and tyrosine kinase inhibitor. Individual TKI were also searched on the above databases.

35 phase II and phase III trials were identified. Most were double blind randomised. The resulting clinical trials were then reviewed with respect to tumour response rate and side effect profile.

Conclusions
There is evidence of efficacy however the side effect profile is concerning and as such patient choice remains a key factor.

Grommets or hearing aids for otitis media with effusion in children?

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Introduction
Otitis media with effusion (OME) is common in childhood and in children with persistent OME, grommets or hearing aids are recommended. We aimed to compare the outcome of children undergoing either treatment in 2015 and 2017.

Methods
Retrospective notes review of all children who underwent grommet insertion between April to July 2015 and 2017. We also assessed simultaneous hearing aid referral pathway of those that preferred not to have grommets inserted.

Results
In 2015, there was an average of 70 days’ waiting time from referral to hearing aid fitting whilst the average waiting time for grommet insertion was 36 days. In 2017, the waiting time for grommet insertion increased to 52.4 days. The average pathway duration from referral to discharge for hearing aids was 19 months. We found both in 2015 and 2017 a significant number of children who were referred for hearing aids required multiple pre-fit appointments due to fluctuating hearing loss. A total of 61 children underwent grommet insertion in 2015 compared with 47 in 2017. Complications from grommet insertion were low for both years studied.

Conclusion
This project allowed us to personalise treatment of children with OME taking into account not only urgency of the intervention but also the parents' reliability for follow up. Challenges of using hearing aids for children with fluctuating hearing were also highlighted. Grommet insertion may be a more cost effective treatment for OME compared with hearing aids.

Giant parathyroid adenomas of the neck – A minimally invasive approach

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Introduction
Sporadic primary hyperparathyroidism, characterised by hypercalcaemia and raised parathyroid hormone levels, is due to a solitary parathyroid adenoma in 80%–85% of cases. Presenting symptoms including fatigue, polyuria, polydipsia, polyuria, bone pain, constipation, depression, and associated conditions, including nephrolithiasis and haematuria. A normal parathyroid gland weighs 38 - 59mg. A “giant parathyroid adenoma” is defined as a pathological weight greater than or equal to 3.5g. We present a case series of 17 giant adenomas and discuss the challenges of a minimally invasive surgical approach in these technically more difficult cases.

Methods
A case note review of 17 giant adenomas operated on at a single institution between 2006 and 2017 by the senior author was performed. There were 8 males and 9 females, with a median age of 62.1 years. Of note, patients had dual modality imaging consisting of an ultrasound and sestamibi scan to determine the presence and position of parathyroid adenomas.

Discussion
Our case series of 17 demonstrates that adenomatous glands up to 26g in weight can be excised using a minimal invasive open approach. The success of the minimal invasive approach for such large glands we believe is due to pre-operative work carried out by a dedicated multidisciplinary parathyroid team.

They are then reviewed in a parathyroid ENT clinic and are booked for day-case minimally invasive parathyroidectomy. Data was collected on patient demographics, symptoms, biochemistry, ultrasound and sestamibi results, operation outcomes, complications and histopathology.

Results
The location of the glands in the pre-operative imaging was 100% concordant with the intra-operative location. The weight of the adenomas ranged from 3.5g – 26g with a mean of 6.36g. Histology confirmed all the glands to be benign. All patients had a complication-free postoperative period.

Discussion
Our case series of 17 demonstrates that adenomatous glands up to 26g in weight can be excised using a minimal invasive open approach. The success of the minimal invasive approach for such large glands we believe is due to pre-operative work carried out by a dedicated multidisciplinary parathyroid team.
Brain waves and electrode interactions - objective assessment of auditory processing in cochlear implant users

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Background
Despite the great success of cochlear implant (CI) technology, there is still substantial unexplained variability in hearing outcomes. Much of this variability may be related to differences at the electrode-neural interface and subsequent auditory processing. The aim of this study was to determine whether EEG can be used to objectively assess auditory processing in CI users.

Methods
Fifteen adult CI users were recruited to the study. Auditory processing was assessed by measuring ability to discriminate neighbouring CI electrodes using two methods. The objective method utilized EEG to measure the ‘auditory change complex’ (ACC) which is cortical potential in response to a change in an ongoing stimulus. The behavioural method involved a simple discrimination task. Electrode discrimination and speech perception were tested at multiple time points during the first 12 months after switch-on.

Results
There was a strong relationship between behavioural and objective measures of electrode discrimination. The amplitude of the ACC increased significantly with CI experience, providing evidence for remarkable auditory plasticity, even in pre-lingually deafened adults. Interestingly, in several cases, objective discrimination developed prior to behavioural discrimination, indicating that stimuli can be encoded in the auditory pathway but not accurately perceived. In addition, a significant relationship between speech perception and electrode discrimination was found.

Conclusion
The ACC is a valid measure of electrode discrimination in CI users and may provide information over and above behavioural testing. We suggest that such objective measurements could be used to guide management of CI users.

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