

Speech Management for Children with Cleft Lip & Palate: State-of-the-art
 Webinar series by the *Cleft Palate & Craniofacial Committee*

Webinar #2

Assessment: Cleft Palate Speech/ Velopharyngeal Dysfunction

2nd March 2022, 12.00-13.30 GMT
 Ms. Yoshiko Takei, Japan & Dr. Debbie Sell, UK

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Structure

- Part 1 Perceptual assessment
- Part 2 Supplementary approaches
- Part 3 Oral Examination
- Part 4 Instrumentation
- Part 5 Broader aspects of speech assessment

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Part 1 International Classification of Functioning, Disability and Health (ICF)

World Health Organization (WHO, 2001)

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    graph TD
        HC[Health Condition  
(disorder / disease)]
        B[Body Functions & Structures]
        A[Activities]
        P[Participation]
        E[Environmental Factors]
        PR[Personal Factors]

        B <--> A
        A <--> P
        E --> B
        PR --> A
        E --> P
        PR --> P
        B --> HC
        A --> HC
        P --> HC
    
```

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Perceptual Speech Assessment

Multiple Purposes:

- +Clinical
- +Quality control/Audit
- +Service evaluations
- +National registries
- +Commissioners of services
- +Research

Outcomes based on:

- high quality speech recordings
- a standard speech sample
- trained reliable listeners

https://clispi.com/Sell_et_al_2009

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Additional Risk Factors for Speech Problems in Cleft

- +Velopharyngeal dysfunction (VPD)
- +Structural anomalies: fistulae, occlusion, dentition
- +Hearing
- +Syndromic diagnoses

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Why is Cleft Speech Perceptual Assessment more challenging?

- +Cleft palate speech is complex: articulation, *nasality*, *nasal airflow*, *voice*
- +Several *interacting* parameters assessed *simultaneously*
- +Sounds *not/rarely* in sound systems of languages eg implosives
- +Narrow phonetic transcription
- +Reliability

Point of interest

- +Cleft Speech 'Universal' but increasing evidence of impact of language differences in phonology emerging

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Need for Narrow Phonetic Transcription

- +At the "core" of what we do **Gerratt et al, 1991**; indispensable **Howard and Heselwood 2002**
- +International Phonetics Alphabet (IPA) and ExtIPA 2015
- +Helpful websites:
 - +<https://www.seeingspeech.ac.uk/>
 - +<https://teaching.ncl.ac.uk/ipa/practical-exercises.html>
 - +<https://www.phonetics.expert/>
- +Phonetic Cleft Cribsheet

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Example of Phonetic Cleft Cribsheet

Cleft Speech Diagrams with Phonetic Transcription

Sell et al 2009

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Great Ormond Street Speech Assessment (GOS.SP.ASS.)

Sell et al, 1994, 1999

- +Systematic approach
- +Documentation
- +Agreed speech sample
- +Training DVD

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Standard Speech Sample

- + Conversational speech
- + Rote speech
- + Single word sample
- + Sentence repetition including high and low pressure and nasal sentences

eg

/t/ **Tim** is **putting** a **hat** **on**

/l/ **Laura** **will** **wear** a **yellow** **welly**

/m/ **Mum** **came** **home** **early**

Henningsson et al., 2008 <https://cislpi.org>

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Consonant Production Assessment

	Labial					Alveolar					Post-alveolar					Velar					Glottal				
	m	p	b	f	v	l	r	d	s	z	ʃ	ʒ	ʒ	ʃ	ʒ	ŋ	ŋ	k	g	h	ʔ	ʔ	ʔ	ʔ	ʔ
Initial																									
Final																									

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Cleft Speech Characteristics (CSCs)

- Anterior**
 - Dentalisation
 - Lateral
 - Palatal
 - Double articulation
- Posterior**
 - Backing to velar
 - Backing to uvular
- Non Oral**
 - Pharyngeal
 - Glottal
 - Active nasal fricatives
- Passive**
 - Nasal realisation of fricatives & plosives
 - Weak/nasalised consonants
 - Absent pressure consonants
 - Gliding fric/affric

Sell et al, 1994, 1999, Harding et al 1996, John et al 2006

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Consonant Production

	Labial	Alveolar	Post-alveolar	Velar	Glottal
Initial	p, b, m	t, d, n, l, r, s, z	ʃ, ʒ, ʧ, ʤ	k, g	ʔ
Final	p, b, m	t, d, n, l, r, s, z	ʃ, ʒ, ʧ, ʤ	k, g	ʔ

Transcription of speech:

CLEFT TYPE CHARACTERISTICS INDEX

DEVELOPMENTAL ERRORS: *stopping [k, g] → [k, g]*

SUMMARY OF SPEECH PATTERNS

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Phonological Analysis

- + Def. 'Phonological analysis identifies error processes or patterns in sound classes and specific contexts, resulting in an inability to signal meaningful contrasts'
- + Developmental immaturities → phonological delay
- + Cleft speech characteristics → phonological disorder, described often as 'phonetic constraints with phonological consequences'

Harding Bell & Howard 2011

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Universal Parameters Henningsson et al 2008

Consonant Production Errors – Sentences

0 = Within normal limits/None
1 = Present [(v) all that apply]:

- abnormal backing of oral targets to post-uvular place
 - to pharyngeal
 - to mid-dorsum palatal
 - to velar
 - to uvular
- nasal fricative
 - phoneme specific
 - not phoneme specific
- nasal consonant for oral pressure consonant
- nasalized voiced pressure consonants
- weak oral pressures
- other oral misarticulations
- developmental articulation/phonological error

X = Missing data

No information about:

- Frequency of occurrence
- Which consonants affected
- Phonological patterns

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Stimulability

- + Important part of the assessment
- + Informs potential for change with current structure
- + Informs the therapy programme
- + Def. child's ability to immediately modify a speech production error when presented with an auditory and visual mode Miccio 2009
- + No additional phonetic cues Bernthal et al

Helpful Tip: In Cleft assessment we do.....

- give additional instructions eg bring the tongue tip between the teeth
- test out a /s/ using a novel sound eg ts.....

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Stimulability

CONSONANT PRODUCTION

STIMULABILITY: *v n [k] g [ʃ] [ʒ] [ʧ] [ʤ]*

	Labial	Alveolar	Post-alveolar	Velar	Glottal
Initial	p, b, m	t, d, n, l, r, s, z	ʃ, ʒ, ʧ, ʤ	k, g	ʔ
Final	p, b, m	t, d, n, l, r, s, z	ʃ, ʒ, ʧ, ʤ	k, g	ʔ

Transcription of speech:

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Nasal Resonance and Nasal Airflow

FORMAL NAME: *INSTRUMENTAL NASAL RESONANCE WITH PALATE AND/OR VELUM*

FORMAL ABBREVIATION: *INSTRUMENTAL NASAL RESONANCE*

REVISIONS: *Original 01-12-1988*

NAME: *.....*

DATE: *.....*

EXAMINER: *.....*

REVISIONS: *.....*

CONSONANT PRODUCTION

CONSONANT	Labial	Alveolar	Post-alveolar	Velar	Glottal
Initial	p, b, m	t, d, n, l, r, s, z	ʃ, ʒ, ʧ, ʤ	k, g	ʔ
Final	p, b, m	t, d, n, l, r, s, z	ʃ, ʒ, ʧ, ʤ	k, g	ʔ

DEVELOPMENTAL ERRORS:

SUMMARY OF SPEECH PATTERNS:

SPRACHELUNG AND TYPICAL CHARACTERISTICS:

REVISIONS OF INSTRUMENTAL NASAL RESONANCE:

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Severity and Consistency

- + **Severity** – often mild, moderate, severe
- + Better reliability of scalar points when defined
- + **Consistency**
 - + Of a target in different word positions
 - + Sound classes
 - + Across the speech hierarchy eg syllables, words, sentences, conversational speech

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Hypernasality [ĩ ẽ õ] [b̃ d̃ g̃]

- + Def. excessive nasal resonance perceived during speech production
- + Rate severity and consistency
- + Complex to rate as influenced by lots of factors
- + Reliability challenging and variable

Helpful Tips:

- + Listen to low pressure sentences – where no nonoral and nasal airflow errors – easier to rate hypernasality
 - + English 'We were away all year'
 - + Japanese 'aoi ie wa ijo' 'The blue house is good'
- + /p/ and /b/ in syllable repetitions/words
- + Active nasal fricatives can lead to hypernasality

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Hyponasality

- + Def. Reduction or absence of expected nasal resonance associated with nasal consonants and vowels adjacent to them
- + Severity and consistency rating
- + Associated with nasal obstruction eg upper respiratory tract infection, pharyngoplasty, deviated nasal septum, enlarged turbinates, tonsils & adenoids

Helpful Tips:

- + Listen to nasal loaded sentence
 - + English 'Mum came home early'
 - + Japanese 'Mama wa mame o maita' 'Mum throws the soy beans'
- + Hyponasality and hypernasality may co-occur


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Nasal Airflow Errors

- + Def. audible escape of air from the nasal cavity
- + Nasal emission (hissy) [p̃ t̃ k̃ s̃]
- + Nasal turbulence (turbulent) [b̃ s̃]
- + Accompanying, or replacing a fricative/affricate → nasal fricative [ñ]
- + Rate severity and consistency

Helpful Tips:

- Not heard on glottals/pharyngeals
- Not heard on low pressure sentences
- Nasal emission: Source can be fistula or VPI or both



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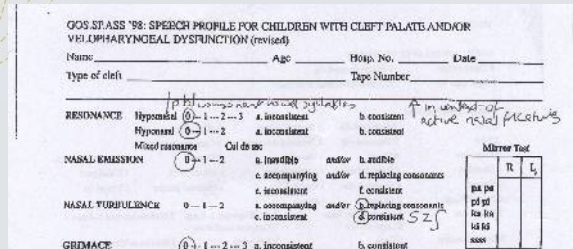
Grimace

- + Speech accompanying behaviour affecting the visual appearance of speech
 - + absent
 - + nasal flare
 - + nasal grimace - nostrils and upper lip
 - + facial grimace - mid and upper face
- + Consistency rating

Indicative of VPI or learnt behaviour which persists after VPI corrected

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Example of GOS.SP.ASS.Nasal Resonance and Nasal Airflow



RESONANCE
 Hypertal (0) = 1-2-3 a. inconsistent b. consistent
 Hyponasal (0) = 1-2 a. inconsistent b. consistent
 Mixed resonance
 Cui de sac

NASAL EMISSION
 0 = 1-2 a. non/absent and/or b. and/absent
 c. accompanying and/or d. replacing consonants

NASAL TURBULENCE
 0 = 1-2 a. accompanying and/or b. consistent
 c. inconsistent and/or d. replacing consonants

GRIMACE
 0 = 1-2-3 a. inconsistent b. consistent

	R	L
nasal flare		
nasal grimace		
facial grimace		
nasal emission		

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Voice

- +Structural laryngeal pathology associated with some syndromes
- +Majority muscle tension voice disorders +/- mucosal changes eg vocal nodules and inflammation
- +Causes are likely to be multifactorial: compensation (VPD), hyperfunction (non-oral articulations), conductive hearing loss, nasal breathing, psychogenic

Helpful Tip:
+Dysphonia can mask hypernasality

Cavalli, 2011

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VPC-Rate

- +VPC - RATE: perceptual judgement of velopharyngeal function based on connected speech for clinical purposes
- +Validated 3-point scale of
 - + 'competent/sufficient'
 - + 'marginally incompetent/insufficient'
 - + 'incompetent/insufficient'

Lohmander et al. 2017; Brunnegard et al. 2020

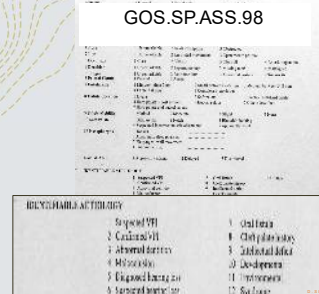
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Differential Diagnosis

- +Abnormal resonance with/without accompanying nasal airflow
- +Speech sound disorder
 - +related/unrelated to current or history of structural constraints
 - +with or without phonological consequences,
 - +dyspraxia
 - +hearing related

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Aetiological Factors



- +Identify significant aetiological factors
- +Assessment determines
 - +Referral to other disciplines
 - +Potential for therapy
 - +Need for investigations/physical management

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Part 2 Supplementary Approaches


- Mirror test
- Nose holding test
 - Hypernasal speech
 - Nasal air emission
 - Active nasal emission & passive nasal emission

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Mirror Test Kummer, 2020

- Used to determine the presence of nasal emission
- A mirror is held under the nose
- Fogging of the mirror indicates nasal emission
- Timing matters – More fogging at the beginning and the end of the speech
 - Nasal breathing
 - Lowering of the velum
- Inaudible nasal emission – Monitor



Peterson-Falzone et al, 2017 Y. TASEI 2022

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Nose Holding Test Assessment of Hypernasal Speech

- Ask patient to repeat vowels (or oral sounds)
 1. with the nose unoccluded
 2. with the nose occluded
- No change in resonance
⇒ normal velopharyngeal function
- Change in resonance
⇒ hypernasality is indicated
Kummer, 2020

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Nose Holding Test Assessment of Nasal Air Emission

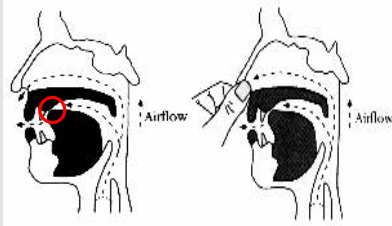
- Ask patient to repeat high pressure sounds
 1. with the nose unoccluded
 2. with the nose occluded
- No change in pressure sounds
⇒ normal velopharyngeal function
- Increase in oral pressure
⇒ presence of nasal air emission suggested
Kummer, 2020

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Passive Nasal Fricative

- Structurally related
- Articulation is normal
- Incomplete stricture in the oral cavity

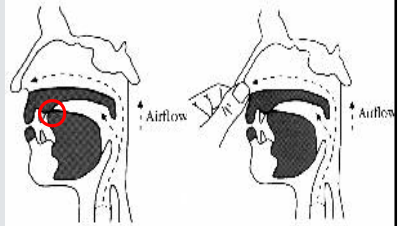


Sell and Grunwell, 2001 Y. TAKEI 2022 33

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Active Nasal Fricative

- Mislearning
- Phoneme specific
- Articulation is altered
- Complete stricture in the oral cavity



Sell and Grunwell, 2001 Y. TAKEI 2022 34

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Active Nasal Fricatives

- May occur in children with repaired cleft or children without cleft or velopharyngeal dysfunction
- Often have history of middle ear disease
- Affects fricatives and/or affricates e.g. /s/, /z/, /ʃ/, /ʒ/, /tʃ/, /dʒ/
- Plosives are fine, and not hypernasal
- Treated by speech therapy – surgery will not fix it!
- Vowel specific active nasal error in Japanese Yamashita and Michi, 1991
 - Vowels /i/ /u/ and syllables followed by these vowels e.g. /ki/ /ku/
 - Often misdiagnosed as having hypernasal speech
 - Syllabic nasals in English?

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Part 3 Oral Examination - Tools



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Oral Examination

What to look for:

- Clues to poor muscle movement?
- Signs of submucous cleft palate?
- Fistula?
- Tonsils?
- Pharyngoplasty/flap/buccinator?
- Palate length?
- Dentition and occlusion?

VP closure takes place out of the line of intraoral view!

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Dentition

Kummer, 2020
Johnson and Sandy, 1999

<p>Common dental anomalies</p> <ul style="list-style-type: none"> • missing teeth • rotated or malaligned teeth • supernumerary teeth • protruding premaxilla 	<p>Impact on articulation?</p> <ul style="list-style-type: none"> • Observe tongue position and movement during speech • Distortions due to structure? misarticulation?
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Occlusion

Kummer, 2020
Johnson and Sandy, 1999

Class II malocclusion		<ul style="list-style-type: none"> • Difficulty with lip closure for /p,b,m/
Class III malocclusion		<ul style="list-style-type: none"> • Distorted alveolar targets /t,d,s,z/ • /f,v/ reversed
Anterior open bite		<ul style="list-style-type: none"> • Interdentalization of alveolar and palatoalveolar targets

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Oro-Nasal Fistula

	<ul style="list-style-type: none"> • Check the size and location • <u>Small</u> – asymptomatic • <u>Medium</u> – nasal air emission • <u>Large</u> – hypernasality <p style="text-align: right;">Kummer, 2020</p> <ul style="list-style-type: none"> • Consonant distortion: <ul style="list-style-type: none"> • Anterior sounds more affected than posterior sounds <p style="text-align: right;">Shelton and Blank, 1984</p> <ul style="list-style-type: none"> • Avoidance • Tongue plugging • Nasal regurgitation
--	--

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Cause of Nasal Emission Fistula? VPI? or Both?

- Compare the occurrence of nasal emission on anterior sounds (eg. /p/, /t/) and posterior sounds (eg. /k/) Kummer, 2020
 - More nasal emission on anterior sounds ⇒ fistula could be the source
 - No difference among sounds ⇒ VP valve could be the source
- Temporal obturation of fistula using eg. chewing gum, Gutta percha
 - Nasal emission diminished ⇒ fistula could be the source
 - No difference in nasal emission ⇒ VP valve could be the source
- Often needs multidisciplinary approach Sell et al, 2006
 - Referrals for instrumental assessment

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Submucous Cleft Palate

Kummer, 2020

- Bifid uvula
- Translucent blue area – zona pellucida
- notch at junction of hard and soft palate found by palpation
- Incorrect muscle alignment – during phonation

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Submucous Cleft Palate

Additional Factors

- Short palate
- Poor velar elevation
- Often confirmed on nasendoscopy
- Check the history
 - Conductive hearing loss
 - Nasal regurgitation

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Red Flags for Poor Velopharyngeal Function

- Hypernasal resonance
- Nasal emission and/or turbulence
- Passive, posterior and/or non-oral CSCs
- Nasal regurgitation
- Fistula at the junction of the hard and soft palate or in the soft palate

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Part 4 Investigations

- Instrumental Examination of VP closure
 - Nasometry
 - Nasendoscopy/ Nasopharyngoscopy
 - Lateral cephalometric X-rays
 - Videofluoroscopy

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Nasometry


- Measures the amount of nasal and oral acoustic energy during speech
- Nasalance score calculated
 - 0—very little nasal resonance
 - 100—excessive nasal resonance
- Score is compared to normative data
 - Should be aware of normative values for the child's language/dialect when interpreting e.g. cutoff score of 30 often used in Japanese
- Useful for measuring changes in resonance over time
 - Effect of time, growth, intervention (surgery, prosthesis, speech therapy)



Van Lierde et al, 2006 Rieger et al, 2002

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Nasometry




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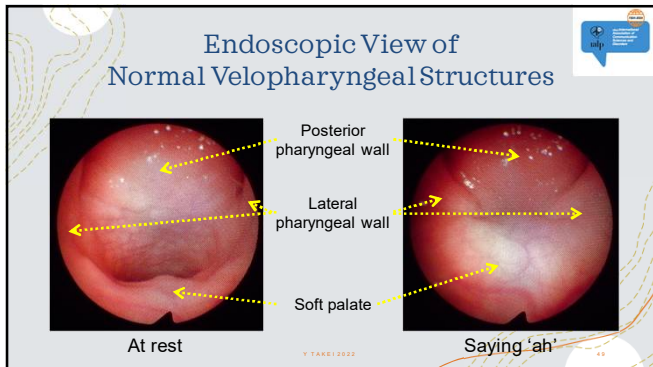
Nasendoscopy

Kummer, 2020

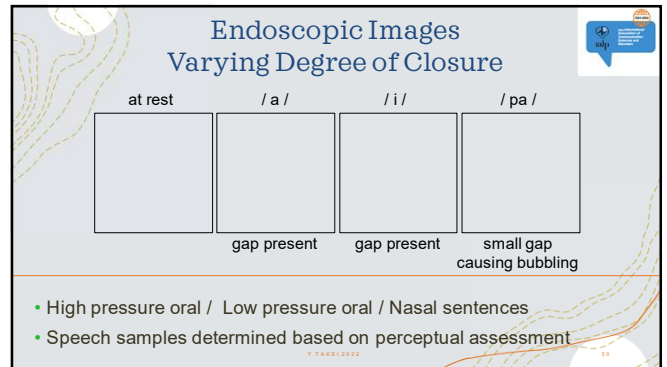
- Passing a flexible fibre-optic scope through the nose into the nasopharynx
- Allows visual observation of
 - Structure relating to VPD
 - Function of VP mechanism during speech
- Helps determine
 - Cause of VPD
 - Recommendations for treatment



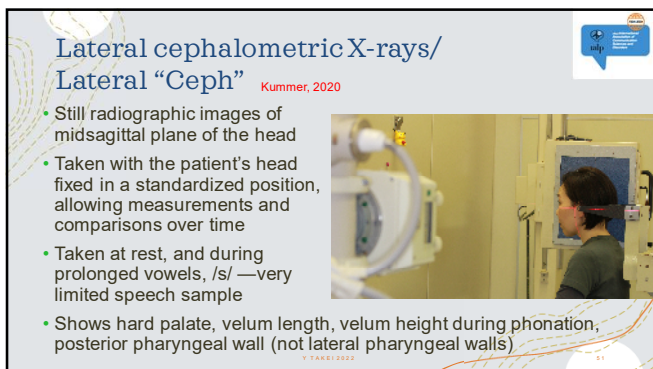
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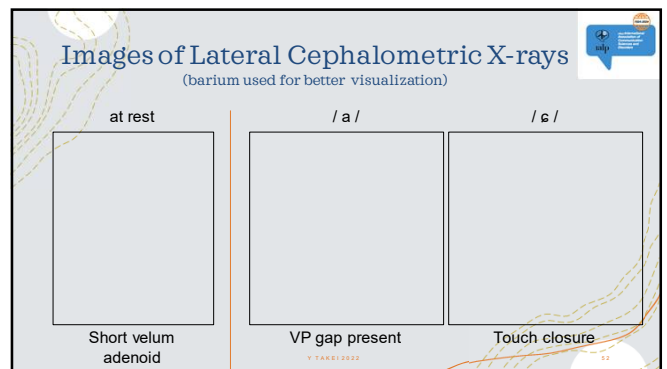
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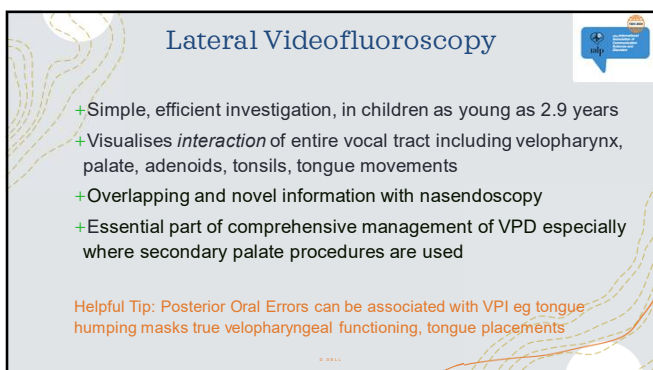
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22q11.2 Deletion Syndrome

- + Velofacialcardiac Syndrome, Shprintzen's Syndrome, DiGeorge Sequence
- + Prevalence: 1 in 2000-4000 live births; a complex, multi-system autosomal dominant condition
- + Physical: Congenital heart disease, palatal abnormalities +/-VPD, immunodeficiency, hypocalcaemia, severe feeding/gastrointestinal differences, with subtle dysmorphic facial features
- + Developmental delay, learning disability, attention deficit hyperactivity disorder, autistic spectrum disorder, anxiety, depression, schizophrenia
- + Evolving condition <https://www.maxappeal.org.uk/consensus-document>

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Relevant Assessment Issues in 22q11.2DS

- + Severe hypernasality and prevalent glottal/ pharyngeal articulation – diagnostic indicator of 22q11.2DS
- + Complex speech diagnosis: phonological delay/disorder, CSCs, VPI, dyspraxia, hearing loss
- + Significant receptive and expressive language impairments; some nonverbal until 3 - 4 years or language deficits emerge in school age
- + Expressive language delay; implications for VPI asst.
- + Complex VPI aetiology: implications for management

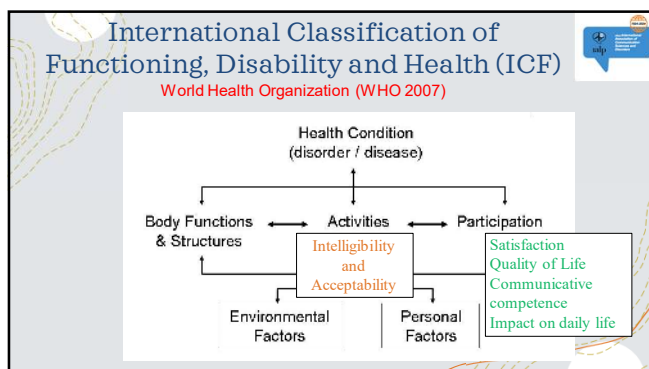
Solot et al 2019

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Part 5: Broader Aspects of Speech Assessment

- + Increasing recognition of need to move beyond the impairment towards client centred outcomes that 'matter most to patients and their families' Allori et al 2016
- + Focus on the consequences of speech impairment
- + Children with VPD and their parents perceive a more negative quality of life Barr et al 2007

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Functional and Person-Centred Speech Outcomes Activity

- + Many functional global speech outcomes published - *intelligibility, acceptability, understandability* but rated by the SLT
- + Intelligibility in Context Scale - Validated parent report measure including 7 communication partners, aligned with the ICF model
- + Available in many languages

<http://www.csu.edu.au/research/multilingual-speech/ics>

McLeod et al 2012

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Participation

- + Importance of communication exchange - speaker's message and communication partner's impressions/responses Havstam and Lohmander, 2011
- + Poor speech affects communication participation of the speaker and the communication partner, but not a straightforward relationship Stock and Feragen 2016
- + Personal factors of the speaker (eg. resilience) and environmental factors (eg. one to one or group setting)

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Participation cont.

- + CLP management mapped onto ICF-CY codes [Neumann and Romonath 2012](#); [Cronin et al 2020](#)
- + Validated tools:
 - + Focus on the Outcomes of Communication Under Six (FOCUS®) [Thomas-Stonell et al. 2010](#);
 - + Shortened version FOCUS-34 [Oddson et al. 2019](#)
 - + SPAA-C: [McLeod, 2004](#)
<https://www.csu.edu.au/research/multilingualseech/spaa-c>

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Patient Reported Outcomes Measures (PROMs)

- + VPI Effects on Life Outcomes (VELO) [Skirko et al 2012; 2013](#)
- + Parent (VELO-P) Youth (VELO-Y)
 - + eg. I find it difficult to understand my child; I get sad because of how I talk
- + CLEFTQ [Wong-Riff et al 2017](#); [Klassen et al 2018](#)
- + SPEECH SCALE Targets patient perception related to the mechanics of speaking
 - + eg. Q08 I need to try hard to speak well
 - + eg. Q10 I need to speak slowly to be understood
- + SPEAK SCALE Focuses on the psychosocial effects of speaking
 - + eg. Q02 My speech makes it hard for me to make new friends
 - + eg. Q08 I worry that my speech is hard to understand

<http://qportfolio.org/cleft-q/#toggle-id-1>

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In Summary, Clinical Speech Assessment in Cleft/VPD

- + Detailed assessment using transcription, with impact on activity and participation
- + Oral examination
- + Determine aetiological factors and need for further assessments
- + Differential diagnosis
- + Underpins a therapy programme
- + Indicator of a structural anomaly or syndrome

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