Airway Assessment

Conscious level

Temporo-mandibular joint (1,2,3,4)

Nasal access

Dentition

Oral access (1,2,3,4)

Mandibular morphology

Soft Tissue morphology, pathology

Speech, swallowing, breath sounds

Cranio-cervical junction (1,2,5)

Cervical spine (1,2,5,6,)
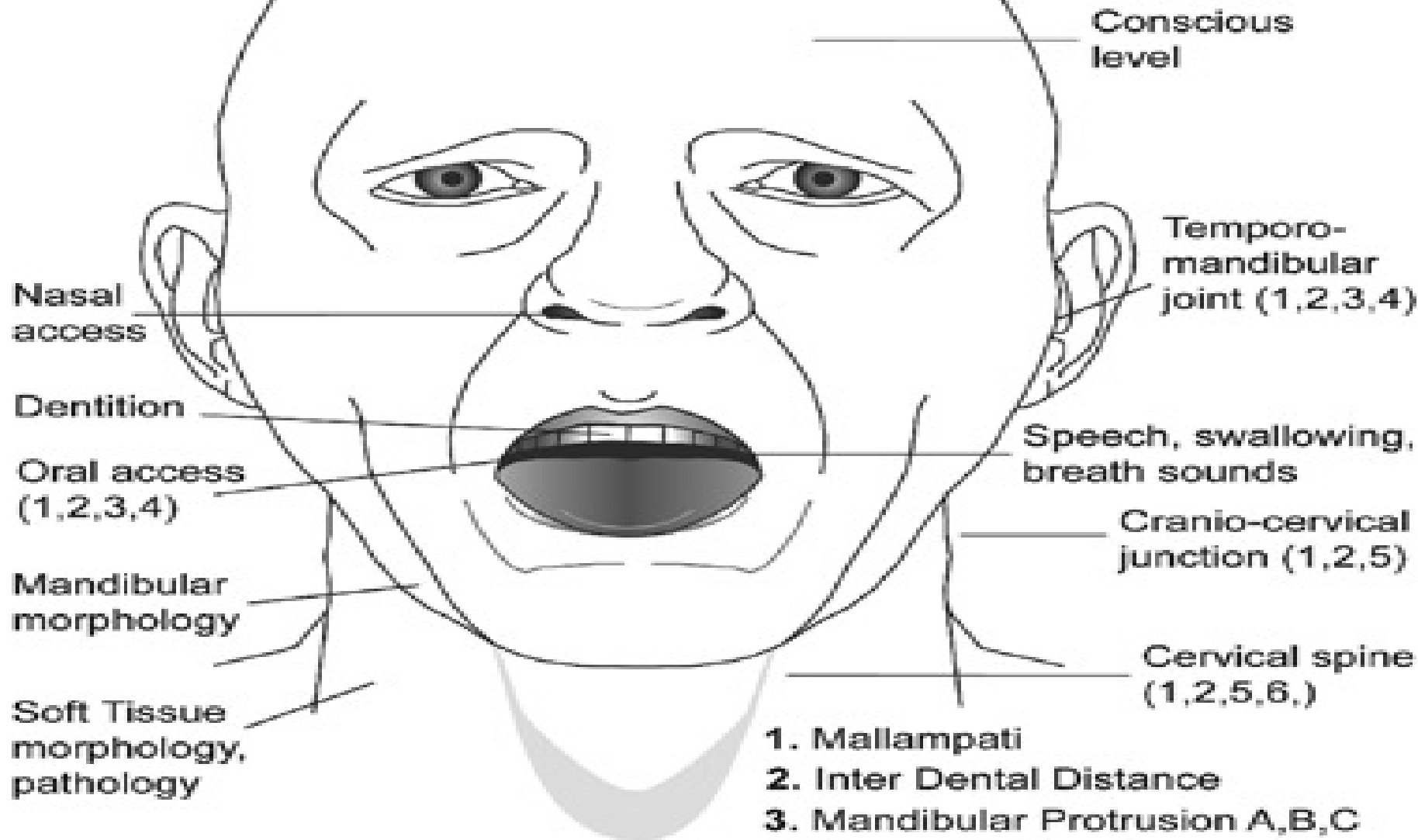
1. Mallampati
2. Inter Dental Distance
3. Mandibular Protrusion A,B,C
4. Upper Lip Bite Test
5. Thyro-mental Distance
6. Cervical Spine Movement

'Look before you Leap'

'Future behavior depends on Past'

'Unexpected Difficult Airway - a fact of life'

- Is there information about any previous airway difficulties?
- How difficult will it be to bag-and mask ventilate?
- How difficult is it to place a supraglottic airway?
- How difficult will it be to intubate the patient?
- How difficult will it be to perform an infraglottic airway?
- What is the risk of aspiration?
- How easy will they be to extubate safely?
- Is there any altered cardiorespiratory physiology?
- What is the impact of the surgery on the airway?
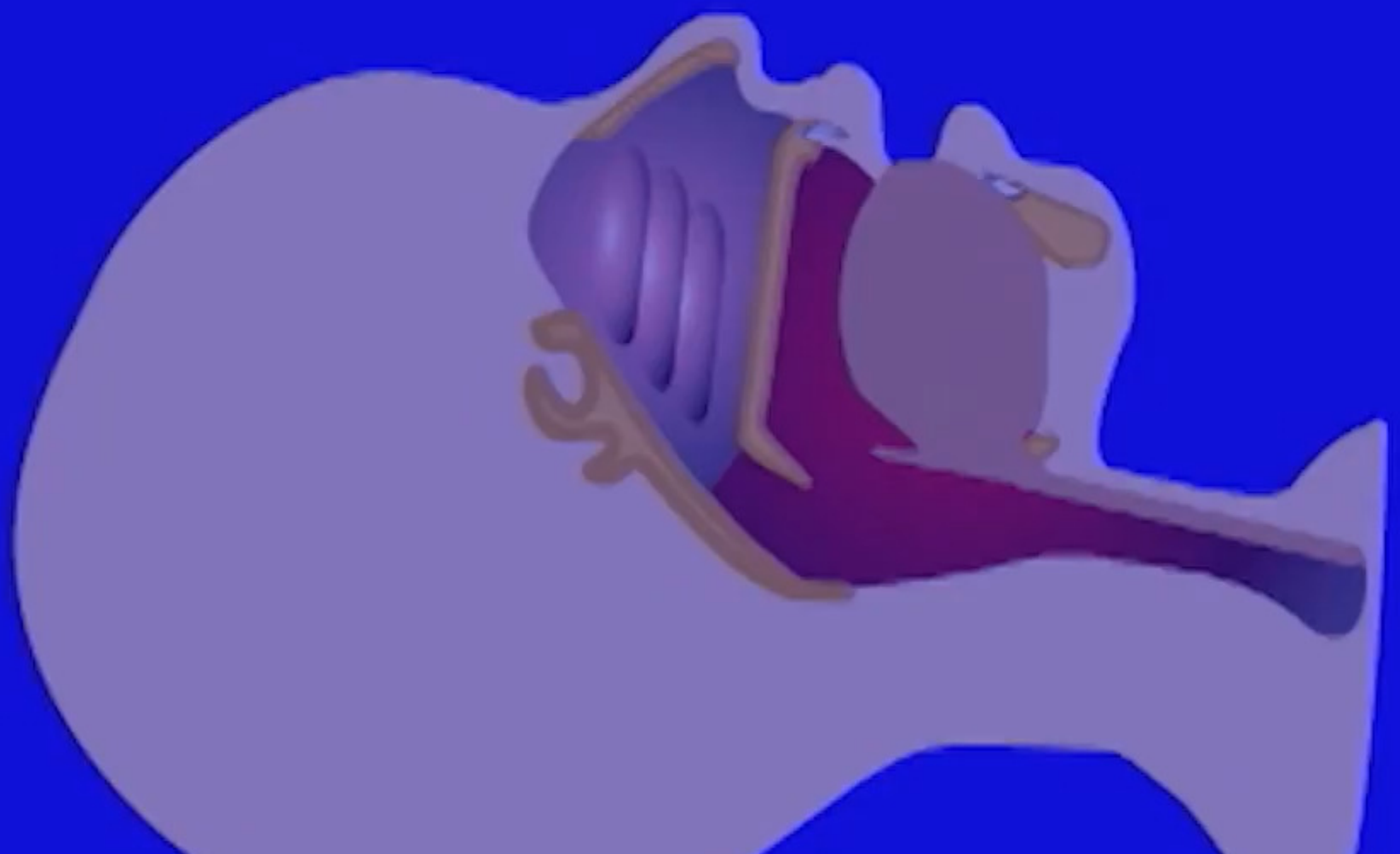
Dilator muscles of the Upper Airway

- Levator Pallati – Nasopharynx
- Genioglossus - Oropharynx
- Hyoid muscles - Laryngopharynx

Potential Obstruction Sites

- Nares :   DNS, Mucosal edema/polyp
- Foreign Body

- Large Tongue,Lingual Tonsil etc

- ↓ tone of Dilator Muscles of Upper Airway: OSA, ↓FRC

Primary Motto

- Patency
- Ventilation
- Oxygenation
- Protection

- Passive Oxygenation
- Bag & Mask Ventilation
- Supraglottic Airway
- Endotracheal Intubation
- Infraglottic Surgical Airway

HAN'S MASK VENTILATION GRADING SCALE

CLASSIFICATION	DESCRIPTION
GRADE I	VENTILATED BY MASK
GRADE II	REQUIRES AIRWAY ADJUVANTS + / - MUSCLE RELAXANTS
GRADE III	GRADE II + REQUIRES TWO PROVIDERS
GRADE IV	UNABLE TO MASK VENTILATE WITH OR WITHOUT MUSCLE RELAXANTS

Predictors of difficulty to face mask ventilate

(OBESE)

1. The **O**bese (body mass index > 26 kg/m2)
2. The **B**earded
3. The **E**lderly (older than 55 y)
4. The **S**norers
5. The **E**dentulous
   (=BONES)

- Patient having ≥2 of the predictors likely to have difficult mask ventilation

(MOANS)

- MOANS

This is identicle to BONES except 'M'.

-**M**ask seal difficult due to receding mandible,syndromes with facial abnormalities,burn,stricture etc.

-**O**besity, upper airway Obstruction

-**A**dvanced age

-**N**o teeth

-**S**norer

Sniffing Position –
Ear to Sternal Notch Position

- Originally described by Chevalier Jackson as the "Boyce-Jackson" position in 1913

- Termed 'the sniffing position' by Magill in 1936

- Three Axis Alignment Theory (TAAT)

- Two Curve Model

- Three Column Model

THREE AXIS ALIGNMENT THEORY

- **Bannister** and **MacBeth** proposed the 3 axis alignment theory in 1944

- **Horton** et al –   Neck flexion -35º
Head extension -15º

        Head elevation – 31-71mm

- External Auditory Meatus in line with the Sternum

Oral

Pharyngeal
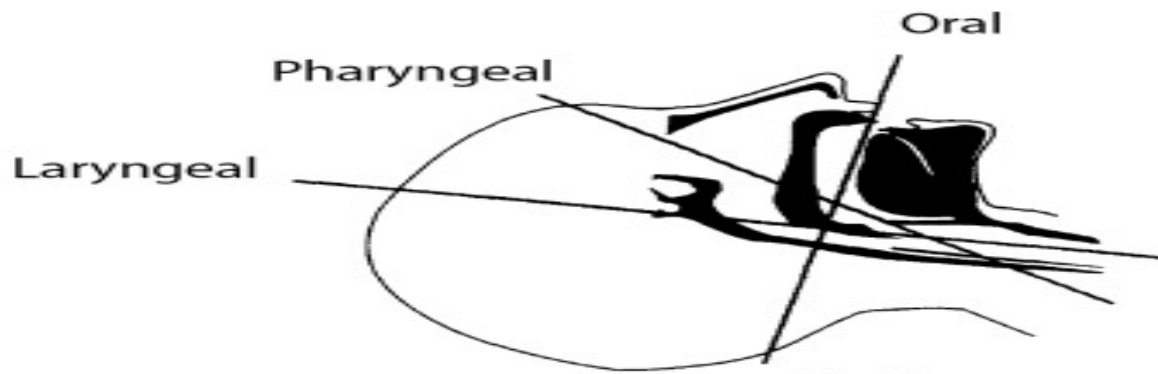
Laryngeal

a. The 3 axes of the
airway with the head in
a neutral position.

Oral

Pharyngeal
Laryngeal
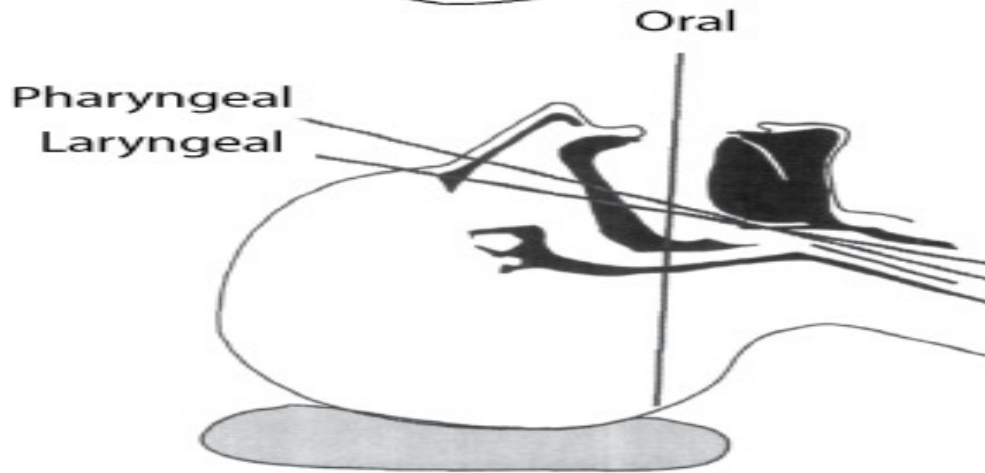
b. The 3 axes
with the head in the
"sniffing" position.

Pharyngeal   Oral
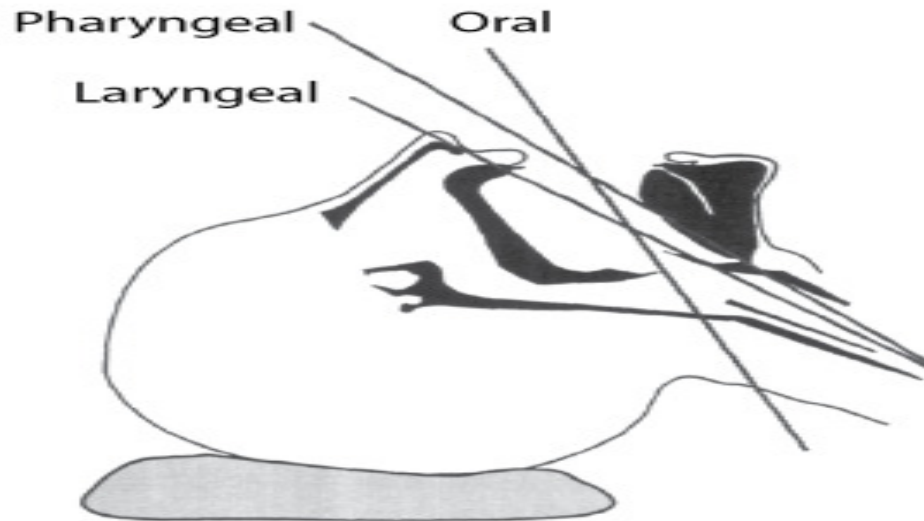
Laryngeal

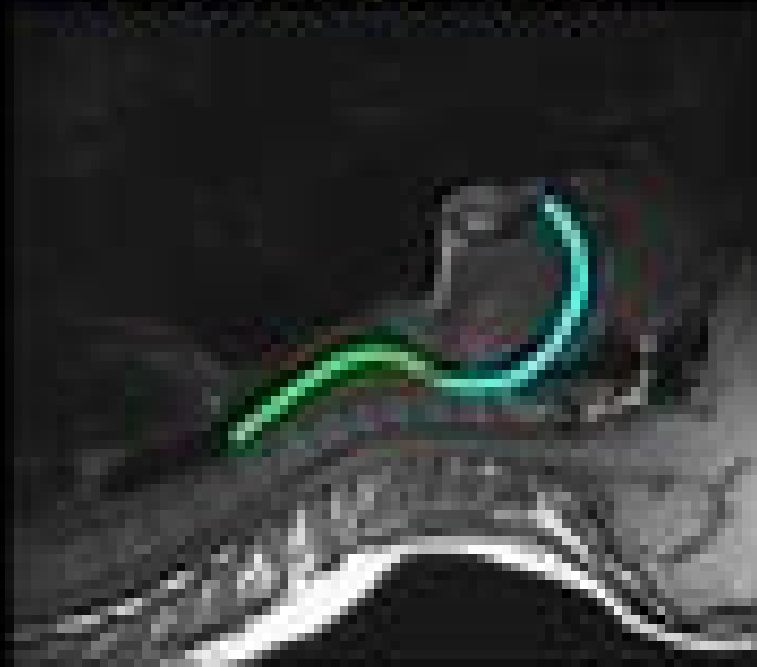c. The 3 axes after
extending the head.

TWO CURVE THEORY

- Primary curve is the **Oropharyngeal curve**
- secondary curve is the **Pharyngo-glotto-tracheal curve**
- Point of inflection is the base of the epiglottis, the tangent of this point is the laryngeal vestibule axis
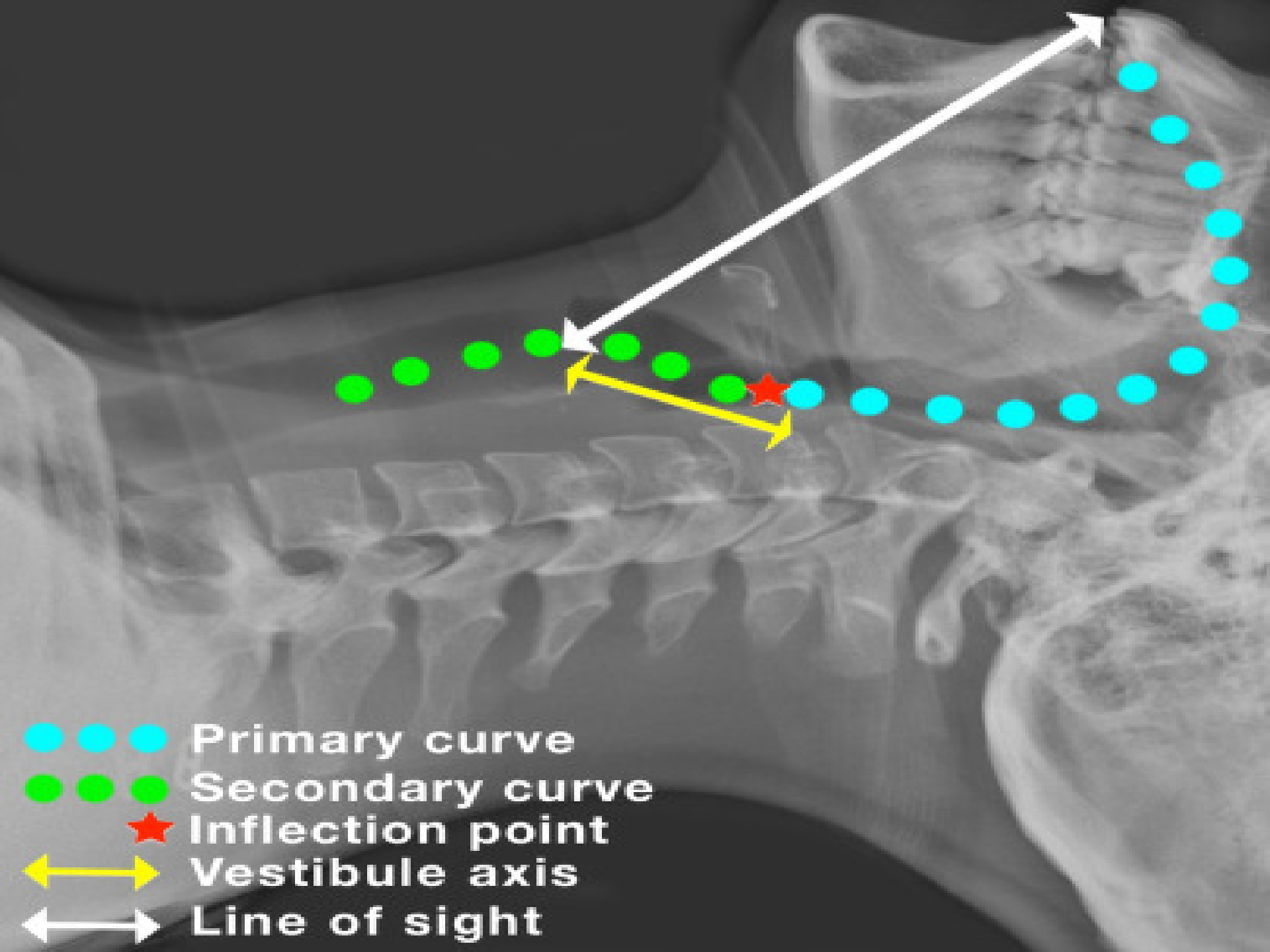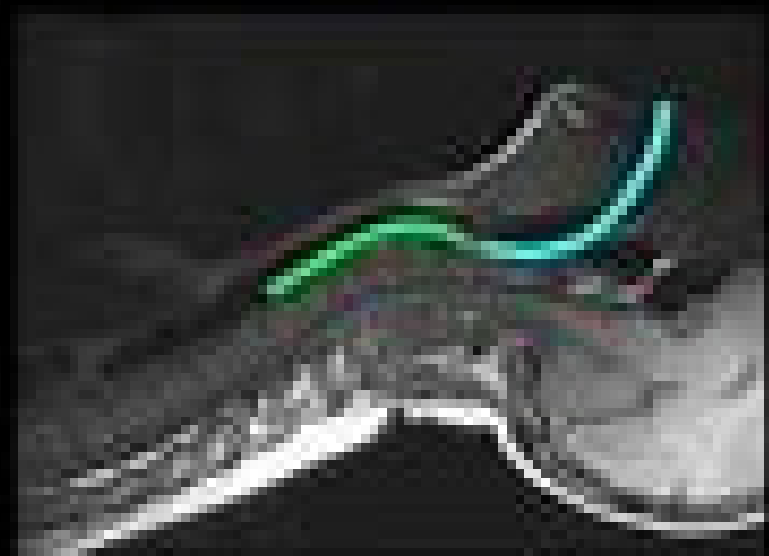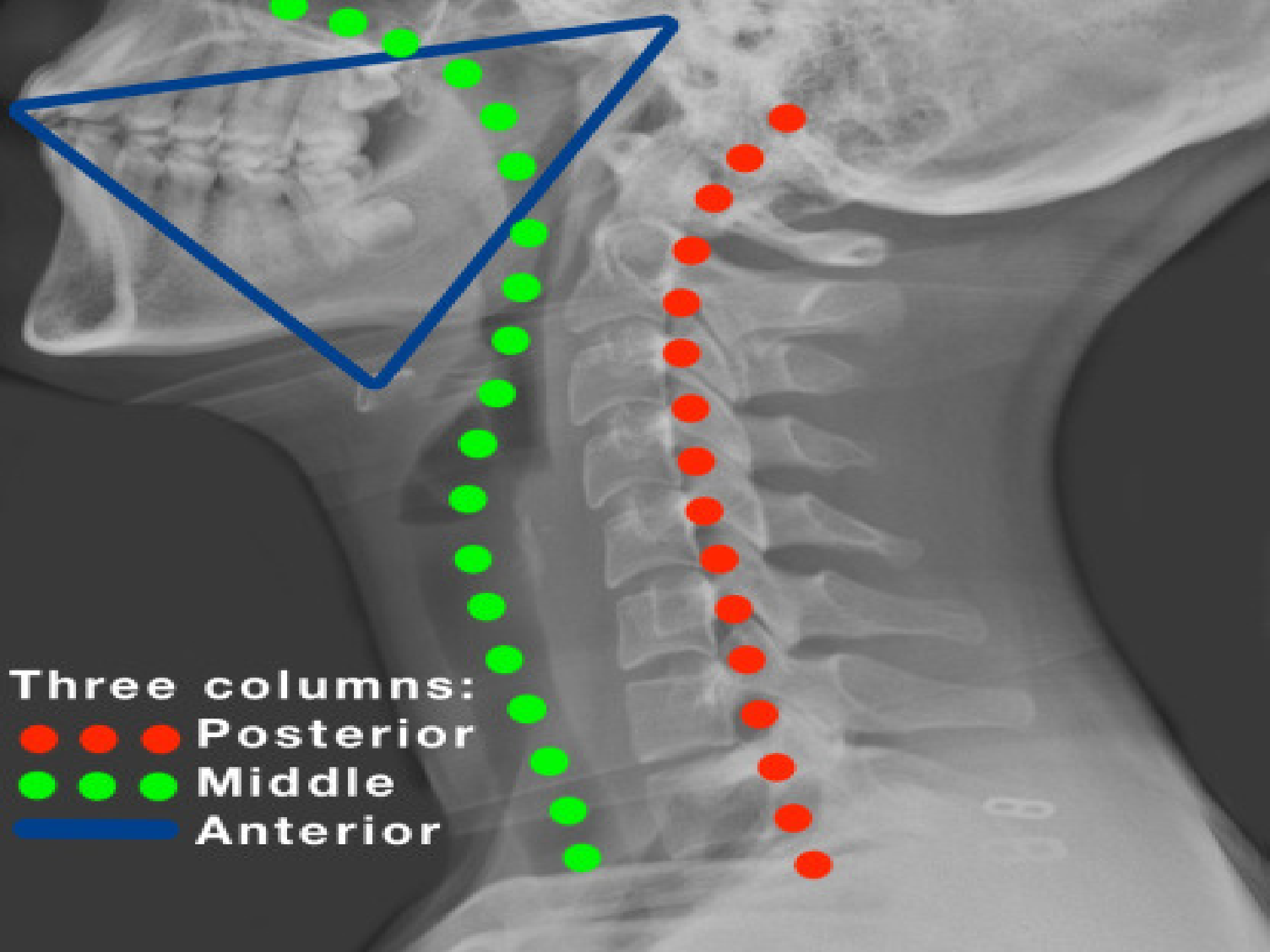
Primary curve
Secondary curve
Inflection point
Vestibule axis
Line of sight

Neutral position

Hyperextended position

THREE COLUMN MODEL

- Developed by Keith Greenland (2008)

- assessing the airway   device selection for intubation

Three columns:
🔴🔴🔴 Posterior
🟢🟢🟢 Middle
▬▬▬ Anterior

Posterior column

- **<u>Examples of pathology</u>**

  Rheumatoid Arthritis Ankylosing Spondylitis   Cervical Spine Fusion   Hard cervical spine collar   Manual in-line Stabilisation (MILS)

- **<u>Assessment-</u>** assess range-of-movement at **atlanto-occipital joint** (flexion-extension)

- **<u>Suggested devices</u>** Hyperangulated blade video laryngoscopy   Direct laryngoscopy with a McCoy blade
  LMA as a conduit with bronchoscope and Aintree catheter
  ILMA

Middle column

- **<u>Examples of pathology</u>**

  Foreign bodies,Tumours , Infections(abscesses or epiglottitis) Obstructive Sleep Apnoea   Laryngeal oedema, Upper airway burns

- **<u>Assessment:</u>**   History and examination (e.g. hoarse voice, stridor)   CT/ MRI   Nasopharyngoscopy   USG

- **<u>Suggested devices</u>**   Standard blade video laryngoscopy   Direct laryngoscopy with a Macintosh blade LMA as a conduit with bronchoscope and Aintree   catheter   (Avoid ILMA)

Anterior column

- **<u>Examples of pathology</u>** Decreased size of the anterior column: Micrognathia, Marfan's Decreased compliance: Ludwig's angina,Haemorrhage, Radiotherapy Forward protruding upper incisors ("relative micrognathia") Macroglossia

- **<u>Assessment</u>** Thyromental distance, TMJ-TMJ distance, TMJ-to-incisor distance Overbite/ Micrognathia Mallampati score

- **<u>Suggested devices:</u>** Hyperangulated blade video laryngoscopy (conforms to primary curve rather than compresses the anterior column) Direct laryngoscopy with a straight blade (directly lifts epiglottis, narrow profile, compresses the anterior column) LMA as a conduit with bronchoscope and Aintree catheter (Avoid McCoy blade) (Avoid ILMA)

Intubation Difficulty Scale - Adnet

PARAMETER	SCORE
NUMBER OF ATTEMPTS > 1 (each additional attempt adds one point)	1
NUMBER OF OPERATORS > 1 (each additional operator adds one point)	1
NUMBER OF ALTERNATIVE TECHNIQUES	1
CORMACK AND LEHANE GRADE	1
LIFTING FORCE REQUIRED NORMAL INCREASED	 0 1
LARYNGEAL PRESSURE NONE APPLIED	 0 1
POSITION OF VOCAL CHORD ABDUCTION ADDUCTION	 0 1
EASY SLIGHT DIFFICULTY MODERATE DIFFICULTY IMPOSSIBLE	0 ≤ 5 > 5 $=7$

Anterior Column Tests –
Dynamic Phase of Laryngoscopy

- Mouth Opening
- Upper Incisor length
- Receding Mandible
- Buck Teeth
- Upper Lip Bite Test
- Mallampatti Class
- Thyro - Mental Distance
- Thyro - Hyoid Distance
- Hyo - Mental Distance
- Subluxation of the Mandible

Posterior Column Tests-
Static Phase of Laryngoscopy

- Head Extension
- Neck Mobility
- Sterno Mental Distance

Mallampatti -Modified by Samsoon & Young
Sit straight & Head erect
## Mouth fully Open
Tongue fully Protruding Out
No Phonation

CLASS	PHARYNGEAL STRUCTURES VISIBLE
1	Soft Palate, Fauces, Entire Uvula. Pillars
2	Soft Palate, Fauces, Portion of Uvula
3	Soft Palate, Base of Uvula
4	Hard Palate only

The test serves to estimate the **relative size of the tongue to the oral cavity** and likely ease or difficulty in **displacing the tongue with a standard laryngoscope** in order to view the glottis
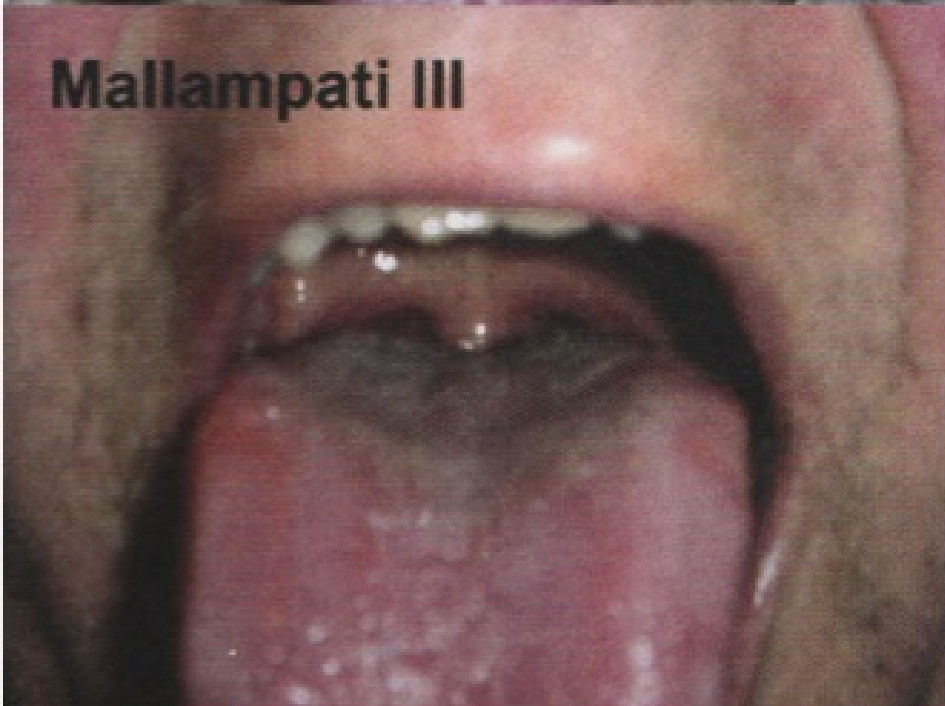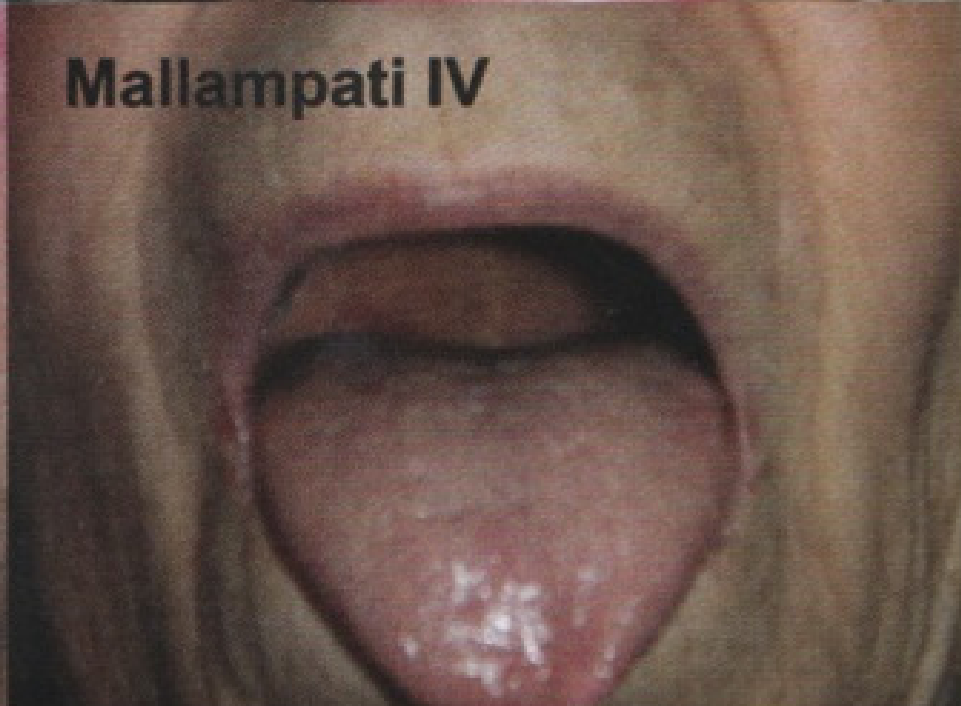
Mallampati I

Mallampati II
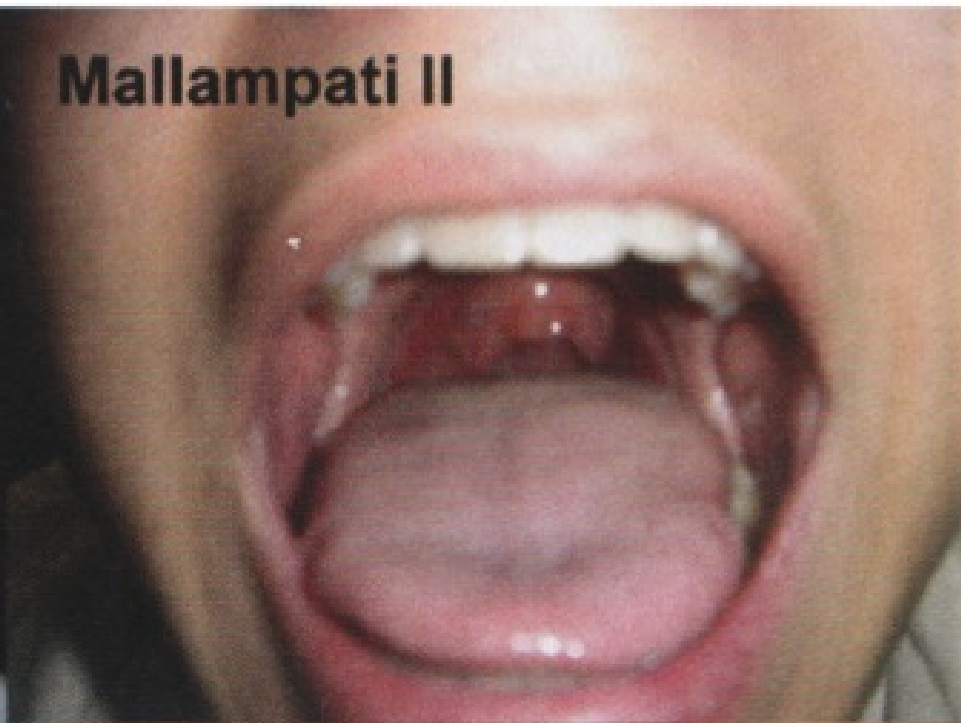
Mallampati III

Mallampati IV

Modified Cormack-Lehane
Cormack-Lehane –Yentis & Lee

Grade	Description	Approximate frequency	Likelihood of difficult intubation
1	Full view of glottis	68-74%	<1%
2a	Partial view of glottis	21-24%	4.3-13.4%
2b	Only posterior extremity of glottis seen or only arytenoid cartilages	3.3-6.5%	65-67.4%
3	Only epiglottis seen, none of glottis seen	1.2-1.6%	80-87.5%
4	Neither glottis nor epiglottis seen	very rare	very likely

Modified Cormack and Lehane classification

Classification	Description	Frequency (%)	Possibility of intubation failure (%)
Grade 1	Full view of the glottis	68	<1
Grade 2a	Partial view of the glottis	24	4.3
Grade 2b	Only posterior portion of glottis or arytenoid cartilages	6.5	67.4
Grade 3a	Epiglottis can be lifted from the posterior pharyngeal wall	1.2	87.5
Grade 3b	Epiglottis cannot be lifted from the posterior pharyngeal wall	Very rare	Very likely
Grade 4	Neither glottis or epiglottis can be seen	Very rare	Very likely

Original Cormack-Lehane system	I Full view of the glottis	II Partial view of the glottis or arytenoids		III Only epiglottis visible	IV Neither glottis nor epiglottis visible
View at laryngoscopy	E LI				
Modified system Cormack-Lehane	I As for original Cormack-Lehane above	IIa Partial view of the glottis	IIb Arytenoids or posterior part of the vocal cords only just visible	III As for original Cormack-Lehane above	IV As for original Cormack-Lehane above

Grade 1

Grade 2
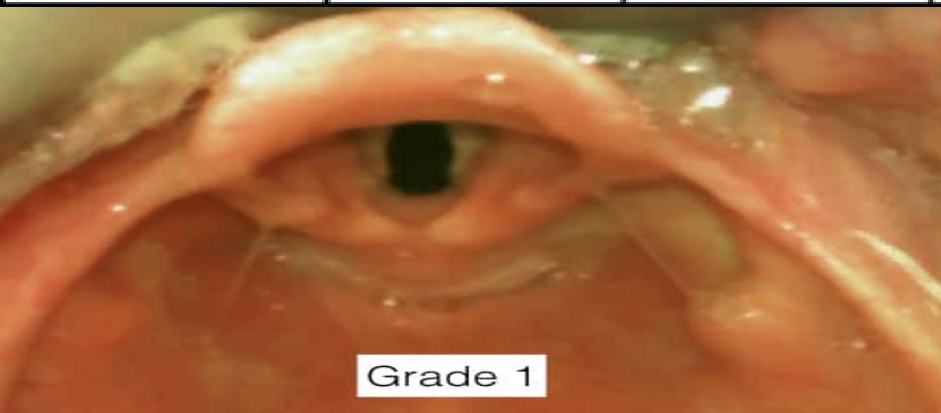
Grade 3

Grade 4

Correlation between MMP score and laryngoscopy grade

MMP class	Cormack and Lehane grade			
	Grade 1	**Grade 2**	**Grade 3**	**Grade 4**
Class I (73%)	59%	14%	-	-
Class II (19%)	5.7%	6.7%	4.7%	1.9%
Class III & IV (8%)	-	0.5%	5%	2.5%

Airway Management, Jonathan Benumof

PERCENTAGE OF VISIBLE GLOTTIC OPENING (POGO)

Levitan devised an alternative description of the laryngeal view in terms of the percentage of visible glottic opening.
This score can be used for direct and indirect laryngoscopy, or techniques where standard positioning is not used.
One disadvantage of this description is that it requires the observer to estimate how much of the glottis is not visualised.
The POGO score has not been widely adopted

100%
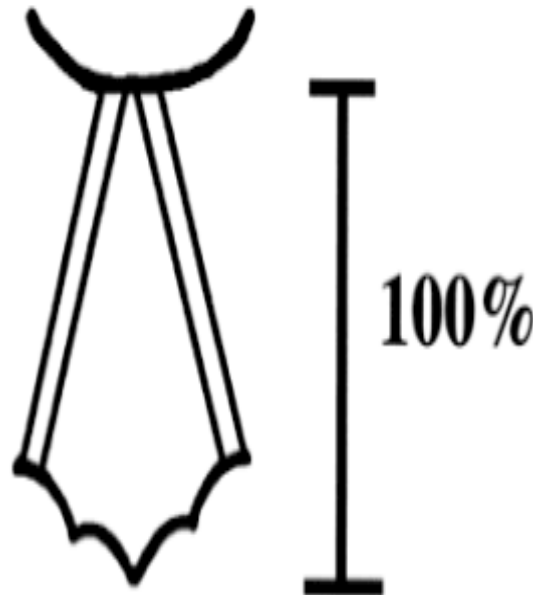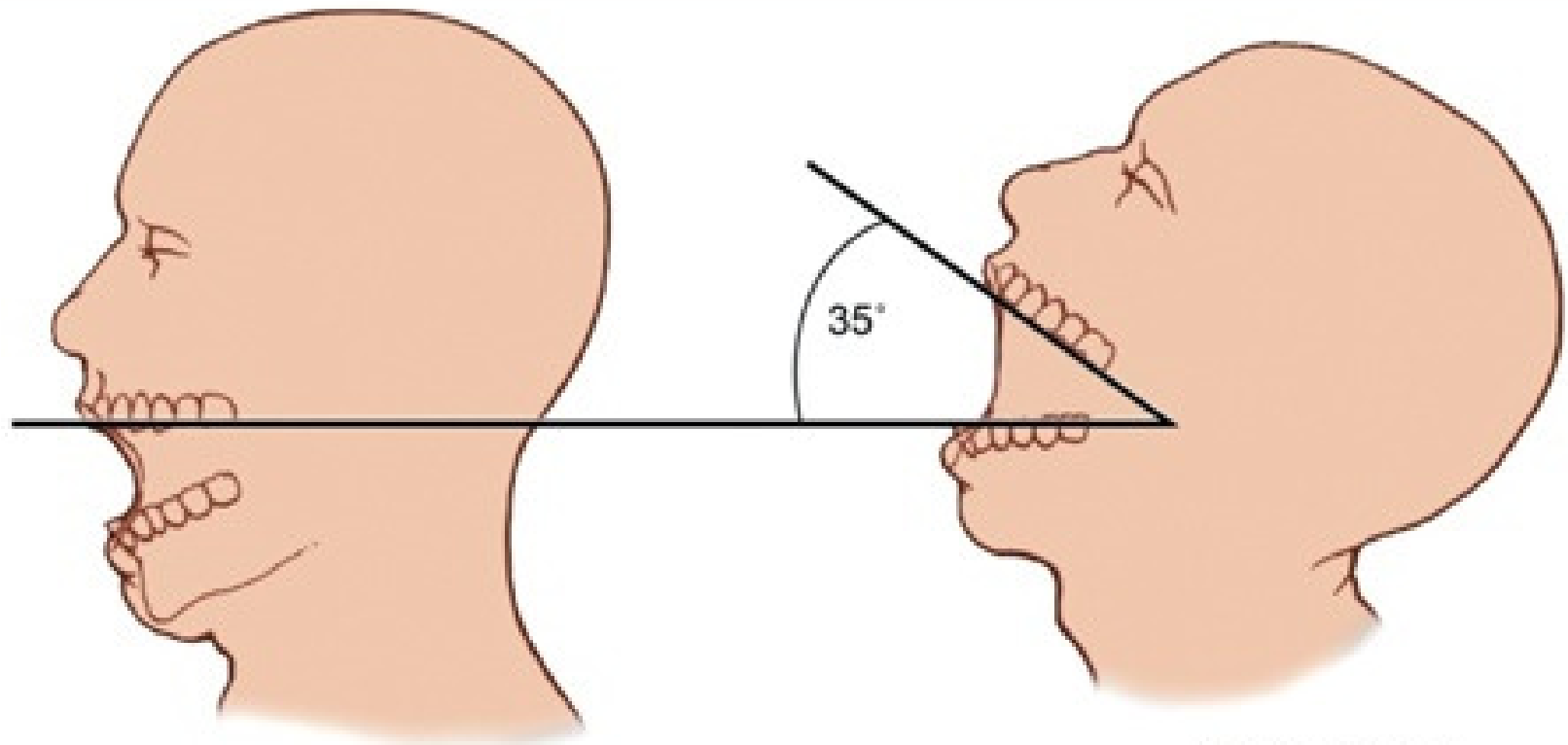
| | | |
Grade		Reduction of Atlantooccipital Joint Extension
1. No appreciable reduction of extension		None
2. Approximately 1/3 reduction		1/3
3. Approximately 2/3 reduction		2/3
4. No appreciable extension		Complete

Clinical method for quantitating atlanto-occipital joint extension. (Bellhouse CP, Doré C. Criteria for estimating likelihood of difficulty of endotracheal intubation with the Macintosh laryngoscope. *Anaesth Intensive Care*. 1988;16:329–337.)

Neck Mobility

- Neck fully flexed – Chin to touch Sternum

- Maximum Extension of Neck

- Angle traversed by the Line tangent to the Forehead

- Normal ≥ 90⁰

ASSESSMENT OF TMJ FUNCTION

TM joint exhibits 2 functions.

  *Rotation of the condyle

  *Forward displacement of the condyle

SUBLUXATION OF THE MANDIBLE

Index finger is placed in front of the tragus & the thumb is placed in front of the the lower part of the mastoid process. patient is asked to open his mouth as wide as possible. Index finger in front of the tragus can be intented in its space and the thumb can feel the sliding movement of the condyle as the condyle of the mandible slides forward.
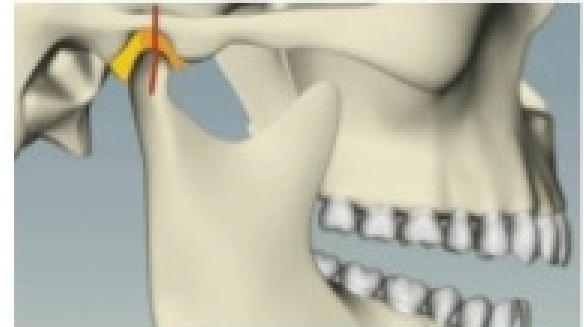
3-3-2

- — 3 fingers of mouth opening

- — 3 fingers mentum to hyoid

- — 2 fingers hyoid to thyroid
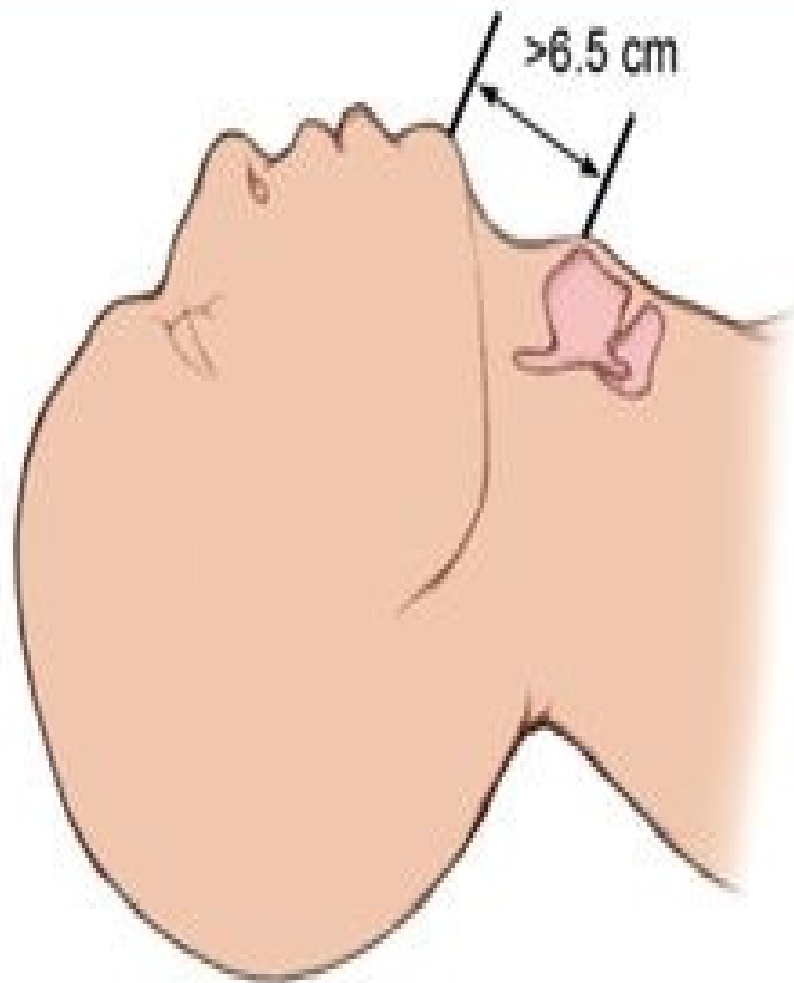
≥6.5 cm - normal, easy intubation

6.0–6.5 cm - laryngoscopy/ intubation difficult but may be possible

<6.0 cm - laryngoscopy/ intubation impossible

Mandibular space. (Patil V. *Fibre-optic Endoscopy in Anaesthesia: Visualizing the Difficult Airway.* Chicago, IL: Year Book Medical; 1983; Bellhouse CP, Doré C. Criteria for estimating likelihood of difficulty of endotracheal intubation with the Macintosh laryngoscope. *Anaesth Intensive Care.* 1988;16:329–337; Frerk CM. Predicting difficult intubation. *Anaesthesia.* 1991;46:1005–1008.)

Patil Distance – Thyromental Distance
Savva Distance – Sternomental Distance
Neck Extended & Mouth Closed
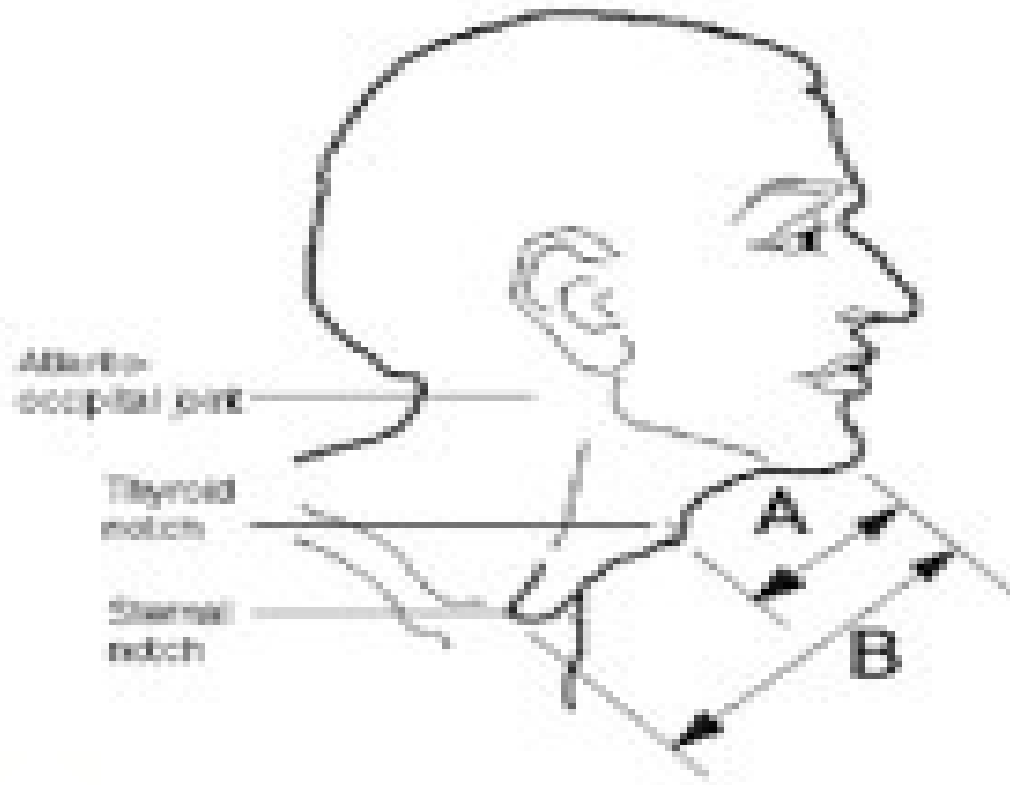
Anatomical distance

A = Thyromental distance (Patel distance)
B = Sterno-mental distance (Savva distance)

Critical distance

6.0 cm
12.5 cm

UPPER LIP BITE TEST

- class I : lower incisors can bite the upper lip above the vermilion line
- class II : lower incisors can bite the upper lip below the vermilion line
- class III : lower incisors cannot bite the upper lip

> 0 $= 0$ < 0

Horizontal Length of Mandible

HLM has little predictive value if used on its own. Measurement is subject to error although a value greater than **9cm** suggests easy intubation

Neck Circumference

- > 17 inches in Men
- > 16 inches in women

	SENSITIVITY %	SPECIFICITY %	POSITIVE PREDICTIVE VALUE %
MALLAMPATTI	42-60	81-89	4-21
MODIFIED MALLAMPATTI	65-81	66-82	8-9
THYROMENTAL DISTANCE	65-91	81-82	8-15
STERNOMENTAL DISTANCE	82	89	27
WILSON	42-55	86-92	6-9
ARNE	80-98	91-94	25-42
MOUTH OPENING	26-47	94-95	7-25
JAW PROTRUSION	17-26	95-96	5-21

COMBINED TESTS

- SIMPLIFIED AIRWAY RISK INDEX
- WILSON RISK SUM SCORE
- EL-GANZOURI RISK INDEX
- ARNE RISK INDEX
- NAGUIB MODEL
- SAGHEI & SAFAVI

SIMPLIFIED AIRWAY RISK INDEX

	Parameter	0 points	1 point	2 points
1	Mouth opening	> 4 cm	<4 cm	
2	Thyromental Distance	>6.5 cm	6 to 6.5 cm	<6 cm
3	Mallampati	I or II	III	IV
4	Neck movement	> 90°	80 to 90°	< 80°
5	Underbite	Can protrude jaw	Cannot protrude jaw	
6	Body weight	< 90 kg	90 to 110 kg	> 110 kg
7	Previous intubation history	No difficulty	Unsure or Unknown	Known difficulty
	Predictor of difficult intubation	**Score ≥ 4**		

WILSON RISK SUM SCORE

WEIGHT	< 90kg 90-110 kg > 110kg	0 1 2
HEAD & NECK MOVEMENT	>90 ± 90 < 90	0 1 2
JAW MOVEMENT	Inter-incisor gap >5cm, SLux >0 Inter-incisor gap 5cm, SLux = 0 Inter-incisor gap < 5cm, SLux <0	0 1 2
RECEDING MANDIBLE	NORMAL MODERATE SEVERE	0 1 2
BUCK TEETH	ABSENT MODERATE SEVERE	0 1 2
PREDICTOR OF DIFFICULT INTUBATION		> 2 (75%)

EL-GANZOURI RISK INDEX		
MOUTH OPENING	> 4cm 4cm < 4cm	0 1 2
THYRO MENTAL DISTANCE	> 6.5cm 6-6.5cm < 6cm	0 1 2
MALLAMPATTI	1 2 3	0 1 2
NECK MOVEMENT	> 90º 80º -90º < 90º	0 1 2
JAW PROTRUSION	Yes No	0 1
WEIGHT	< 90kg 90-110 kg > 110kg	0 1 2
H/O DIFFICULT INTUBATION	NONE QUESTIONABLE DEFINITE	0 1 2
SCORE	> 3 – VIDEO LARYNGOSCOPY > 7 –AWAKE FIBREOPTIC	

ARNE RISK INDEX

PREVIOUS H/O DIFFICULT INTUBATION	NO YES	0 10
PATHOLOGIES ASSOCIATED WITH DIFFICULT INTUBATION	NO YES	0 5
CLINICAL SYMPTOM OF AIRWAY PATHOLOGY	NO YES	0 3
INTER INCISOR GAP AND MANDIBULAR SUBLUXATION	IIG ≥ 5cm or ML > 0 3.5 < IG < 5 and ML = 0 IG < 3.5cm and ML < 0	0 3 13
THYRO MENTAL DISTANCE	≥ 6.5 cm < 6.5cm	0 4
HEAD & NECK MOVEMENT	Above 100° 90° ± 10° Below 80°	0 2 5
MODIFIED MALLAMPATTI TEST	Class 1 Class 2 Class 3 Class 4	0 2 6 8
HIGH PROBABILITY OF DIFFICULT INTUBATION	SCORE > 11	

- Thyromental distance
- Mallampati score
- Inter-incisor gap
- Height

SAGHEI & SAFAVI

WEIGHT	> 80kg
TONGUE PROTRUSION	< 3.2cm
MOUTH OPENING	< 5cm
UPPER INCISOR LENGTH	>1.5cm
MALLAMPATTI CLASS	>1
HEAD EXTENSION	< 70º
> 3 INDICES	DIFFICULT LARYNGOSCOPY

- **Difficulty Endotracheal Intubation- LEMON**
- Look externally
    E   Evaluate 3-3-2
    M Mallampati
    O Obstruction/Obesity
    N Neck Mobility
- **Difficult Bag-Mask-Valve (BMV)- BONES**
- B Beard
    O Obstructed/Obese/OSA
    N Neck Stiffness / Neck Mass
    E Edentulous   S Stridor /
    Snores (OSA)
- **Difficult Laryngeal Mask Airway (LMA)-RODS**
- R Restricted Mouth Opening
    O Obstruction
    D Distorted airway anatomy
    S Stiff Lungs / Neck
- **Difficult Cricothyrotomy -SHORT**
- S Surgery
    H Hematoma, Have Infection (Abscess)
    O Obesity
    R Radiation
    T Trauma, Tumor

- X ray   Occiput- C1 distance $< 5\text{mm}$
                         Posterior mandible depth > 2.5cm

   Ratio of effective mandibular length to its posterior depth <3.6

    Tracheal compression

 CT Scan: Tumors of floor of mouth,
     pharynx, larynx   Cervical spine trauma, inflammation
                              Mediastinal mass   Exact
    location and degree of airway compression

- Nasoendoscopy

Ultrasonogram-

- Anterior airway anatomy
- Tongue thickness
- Pretracheal fat
- Sub glottic airway diameter
- Fasting status
- Successful Extubation
- Post extubation stridor

Airway assessment

- **History**
  - Patient/notes/chart/medic-alert/spam letter
    - Difficulty
    - Surgery/burns
    - Concurrent disease
    - Reflux/recent meals
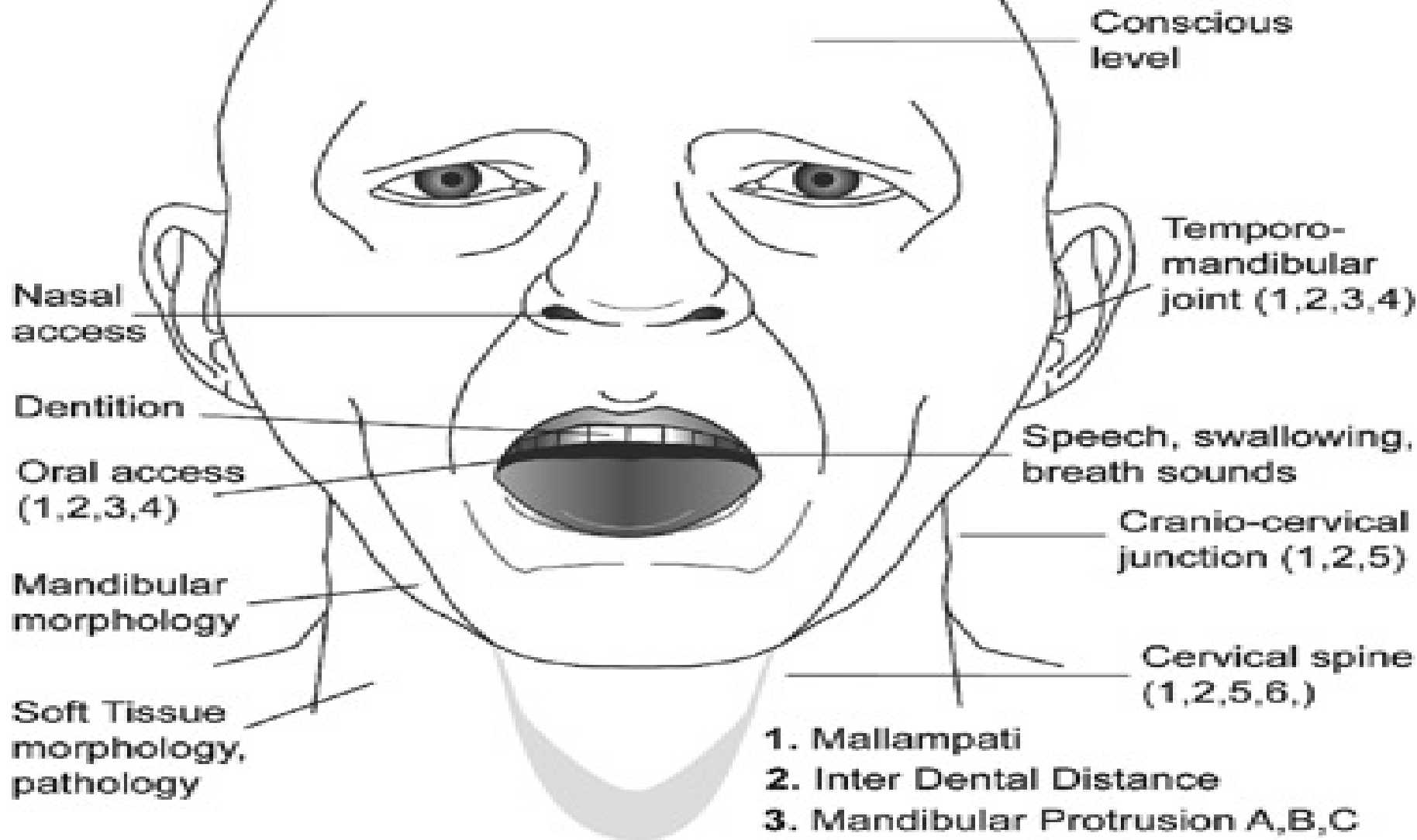- **General examination**
  - Do they just look difficult?
    - Dentition (prominent upper incisors, receding chin)
    - Distortion (edema, blood, vomits, tumor, infection)
    - Disproportion (short chin-to-larynx distance, bull neck, large tongue, small mouth)
    - Dysmobility (TMJ and cervical spine)
  - Massively obese or pregnant
  - Beards +/- tubes
- **Specific tests/indices**
- **Investigations.**
  - Nasoendoscopy
  - X-ray, CT/MRI
  - Flow volume loop

Airway Assessment

Conscious level

Temporo-mandibular joint (1,2,3,4)

Nasal access

Dentition

Oral access (1,2,3,4)

Speech, swallowing, breath sounds

Cranio-cervical junction (1,2,5)

Mandibular morphology

Cervical spine (1,2,5,6,)

Soft Tissue morphology, pathology

1. Mallampati
2. Inter Dental Distance
3. Mandibular Protrusion A,B,C
4. Upper Lip Bite Test
5. Thyro-mental Distance
6. Cervical Spine Movement

Airway assessment is useful only if ideal condition for laryngoscopy is given

- Adequate Depth of Anesthesia
- Good Muscle Relaxation
- Adequate time

BEST WISHES & GOOD LUCK for your EXAMS