COMPARISON OF INTUBATION DIFFICULTY SCORE BETWEEN MACINTOSH LARYNGOSCOPY AND AIRTRAQ OPTICAL LARYNGOSCOPY

Dissertation submitted

in partial fulfilment of the requirements

for award of the Degree

M.D. (Anaesthesiology)

BranchX

GOVT. KILPAUK MEDICAL COLLEGE

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI, TAMILNADU

APRIL 2015

CERTIFICATE

This is to certify that this dissertation entitled **"COMPARISON OF INTUBATION DIFFICULTY SCORE BETWEEN MACINTOSH LARYNGOSCOPY AND AIRTRAQ OPTICAL LARYNGOSCOPY "** submitted by **Dr.DINESH.D** in partial fulfillment for the award of the Degree Doctor of Medicine in Anaesthesiology by The TamilnaduDr.M.G.R. Medical University, Chennai is a bona fide work done by him at GOVERNMENT KILPAUK MEDICAL COLLEGE, CHENNAI, during the academic year 2012-2015.

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DECLARATION

I, **Dr.DINESH.D**, solemnly declare that this dissertation, entitled **"COMPARISON OF INTUBATION DIFFICULTY SCORE BETWEEN MACINTOSH LARYNGOSCOPY AND AIRTRAQ OPTICAL LARYNGOSCOPY "** has been prepared by me, under the expert guidance and supervision of **Prof.Dr.N.Bhavani, M.D.,** Professor of Anaesthesiology, Government Kilpauk Medical College Hospital, Chennai and submitted in partial fulfilment of the regulations for the award of the degree M.D.(Anaesthesiology) by The Tamil Nadu Dr. M.G.R. Medical University and the examination to be held in April 2015.

This study was conducted at Government Kilpauk Medical College, Chennai. I have not submitted this dissertation previously to any university for the award of any degree or diploma.

Place: Chennai

(Dr.DINESH.D)

Date:

INSTITUTIONAL ETHICAL COMMITTEE
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Ref.No.1589/ME-1/Ethics/2014 Dt:06.03.2014.
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Comparison of intubation difficulty score between macintosh laryngoscopy and airtraq optical laryngoscopy" – For Dissertation Work submitted by Dr.D.Dinesh, MD (Anaes), PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

29/5/14.

CHAIRMAN,
Ethical Committee
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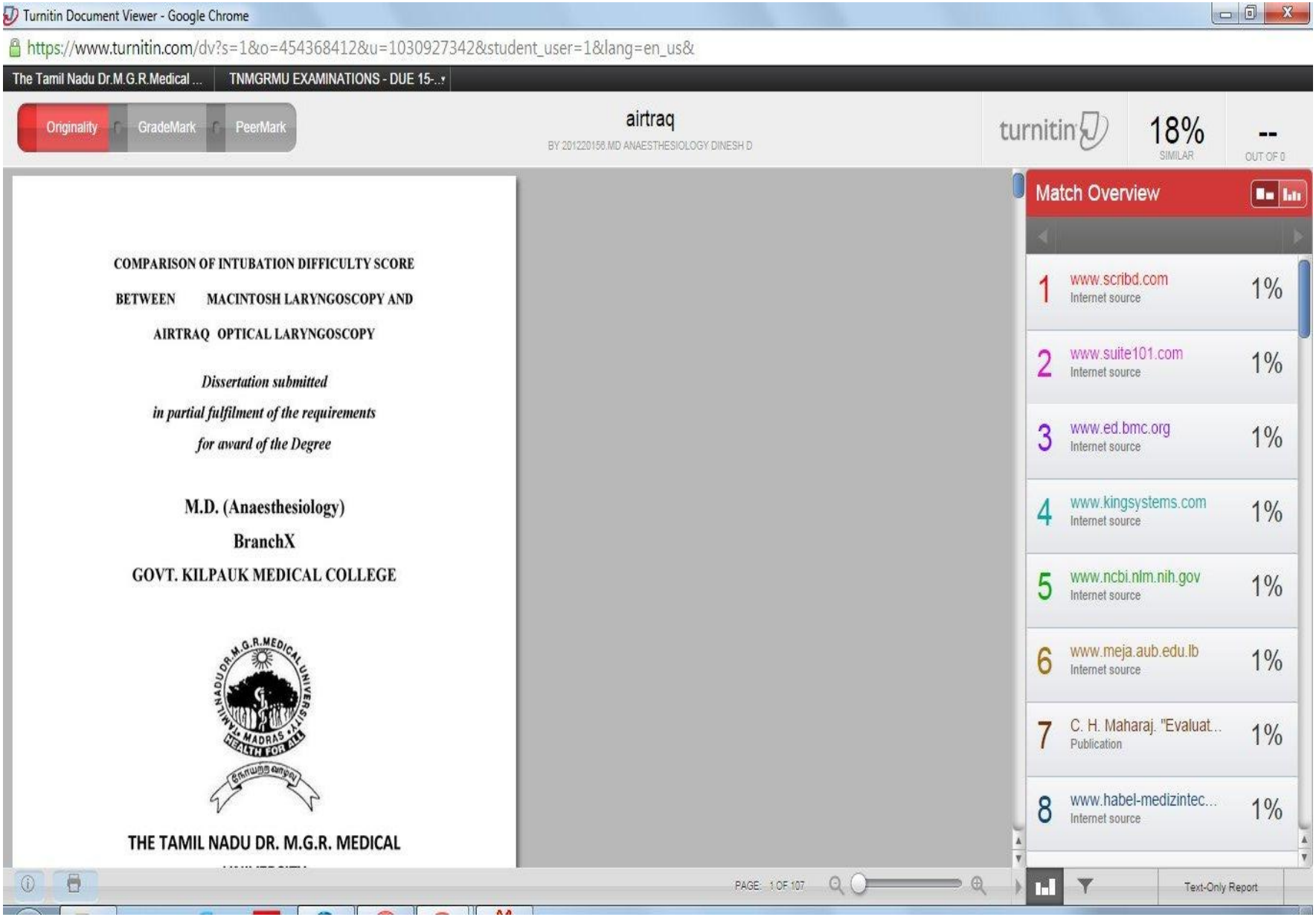
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ABSTRACT

Study title: comparison of intubation difficulty score between macintosh laryngoscopy and airtraq optical laryngoscopy

Background: Intubation Difficulty Score is one of the best parameter to evaluate the factors related to difficult intubation. Which having 7 variable including glottic exposure as defined by Cormack .This score assessed during laryngoscopy. Purpose of this study is to evaluate efficacy by comparing Intubation Difficulty Score.

Objectives: To compare the efficacy of Airtraq optical laryngoscopes to conventional Macintosh laryngoscopes for ease of intubation by comparing the Intubation Difficulty Scores of both laryngoscopes .

Methodology: Total of 60 patients were selected, 30 patients belonged to group-1 for macintosh laryngoscopy, other 30 patients belonged to thegroup-2 for Airtraq intubation. Excluding the patients with difficult airway, compromised airway,Morbid obesity ,Mallampatti grade 3&4**,**American Society of Anesthesiologist physical status III& IV **,**Patient with airway sharing surgery such as Tonsil, Thyriod surgery**,**Patient with emergency surgery**,**Pregnant patients**,** Healthy volunteers not satisfying inclusion criteria**,**Severe cardiovascular, hepatic or renal disease, mental illness**,**Need for nasal intubation**,** Prolonged surgery > 2 hrs. IDS scoreswere estimated for all and compare both groups.

Results: When compare both groups,IDS score is lower in Airtraq group,intubation time is shorter in Airtraq group, hemodynamic parameters during intubation is more acceptable in Airtraq group ,post op complication also less in airtraq group than macintosh group.

Conclusion: Airtraq laryngoscopy can be used as an effective alternate to Macintosh laryngoscopy in patient undergoing elective surgery.

INTRODUCTION

Laryngoscopy is a medical technique used to facilitate tracheal intubation during general anesthesia. Endotracheal intubation by direct laryngoscopy is a ‘gold standard technique ’for airway management in general anaesthesia and critical care settings. It has several advantages including

- Isolation and separation of respiratory system from GI system to minimize the risk of aspiration.
- Allows delivery of oxygen and anesthetic gases to the lungs without inflation of stomach
- To access tracheobronchial tree for drug administration(e.g. inhaled bronchodilators)

Airway management is important in anaesthesia because 75% of adverse respiratory events are responsible for Anaesthesia related complications during surgery. Of these

1. Inadequate ventilation (38%),
2. Difficult intubation (18%)
3. Oesophageal placement of tracheal tube (17%).

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There are at least ten different types of laryngoscope used for this airway management, like conventional, fibreoptic and video

laryngoscopes. Endo tracheal intubation and airway management is a major challenge of a routine Anesthesia practice. Even though we had come a long way from Conventional laryngoscopes to Glide scopes, the conventional Macintosh laryngoscope still remains the most frequently used device for orotracheal intubation since 1943. It's considered as the "gold standard" for airway management. The technique using Macintosh laryngoscopy has the following limitations.

1. Difficulty in acquiring the skill which requires long period of training to achieve expertise[2,]
2. Occasional difficulty encountered in aligning the oral, pharyngeal and laryngeal axis[3]
3. Limitations in predicting difficulties by routine bedside screening tests[4]

Because of above reasons, difficulty encountered even by experienced persons in using Macintosh laryngoscopy technique (Cormack-Lehane grade 3 / 4 laryngeal view) is 1.5 – 8.5% of cases [5]. Unanticipated difficult intubation and failed intubation and mortality [6,7,8].

The incidence of difficult intubation is 1.15-3.8% and the incidence of failed intubation is 0.13-0.3% in the general

population [9]. Failed intubations using Macintosh laryngoscopes were reported in 30% intubations by paramedics [10].

The Airtraq Optical Laryngoscope is an intubation device having magnifying wide-angle mirrors, with light source, and a tracheal tube guide channel which aid in rapid visualization and helps in passage of an endotracheal tube through trachea. It provides glottis clear view without any alignment of the oral, pharyngeal the tracheal axis.

The exaggerated curvature of the blade and the combination of the lens with the prism ensure the transmission of the image to the proximal field. A battery-powered light source is located on the edge of the blade. The purpose of this arrangement is to easy intubation with minimal movement of the cervical spine [11]. With the help of the display lens, the glottis and the surrounding structures are visualized under direct view of its tip, the tracheal tube is introduced between the vocal cords. The endotracheal tube does not obstruct the endoscopic view of the vocal cords during tracheal intubation.

Purpose of this study is To compare the efficacy of Airtraq laryngoscopes to conventional Macintosh laryngoscopes for ease of intubation by intubation difficulty scores.

ANATOMY

Upper airways:

Anatomically airway is the passage through which the air passes during respiration. It may be divided into upper and lower airway. The upper airway comprises Nasal cavity, oral cavity, nasopharynx, oropharynx, pharynx and larynx.

Nasal cavity:

Nasal cavity extends from nares to end of the turbinate's consisting mainly of bone and cartilage. Olfactory receptors in the uppermost part of the nasal cavities of the respiratory tract. They are elongated wedge-shaped spaces with a large inferior base and a narrow superior apex and are held open by a skeletal framework. The anterior apertures of the nasal cavities called nares, which open onto the inferior surface of the nose. The posterior apertures are the choanae, which open into the nasopharynx.

The nasal cavities are separated:

1. Midline by nasal septum;
2. From the oral cavity below, by the hard palate;

3. From the cranial cavity above, by parts of the frontal, ethmoid, and sphenoid bones.
4. Laterally, by the orbits.

Each nasal cavity has a floor, roof, medial wall, and lateral wall

Lateral wall:

The lateral wall is characterized by three curved shelves of bone (conchae), which are one above the other and project medially and inferiorly across the nasal cavity .The medial, anterior and posterior margins of the conchae are free.

The conchae divide each nasal cavity into four air channels.

1. Inferior nasal meatus between the inferior concha and the nasal floor;
2. A middle nasal meatus between the inferior and middle concha;
3. A superior nasal meatus between the middle and superior concha.
4. A spheno-ethmoidal recess between the superior concha and the nasal roof.

These conchae increase the surface area of contact between tissues of the lateral wall and the respired air. The openings of the Para nasal sinuses to the lateral wall of nasal cavity .In addition, the lateral wall also contains the opening of the nasolacrimal duct, which drains tears from the eye into the nasal cavity.

Regions:

Each nasal cavity consists of three general regions—the nasal vestibule, the respiratory region, and the olfactory region,

1. The nasal vestibule is a small dilated space just internal to the nares that is lined by skin and contains hair follicles;

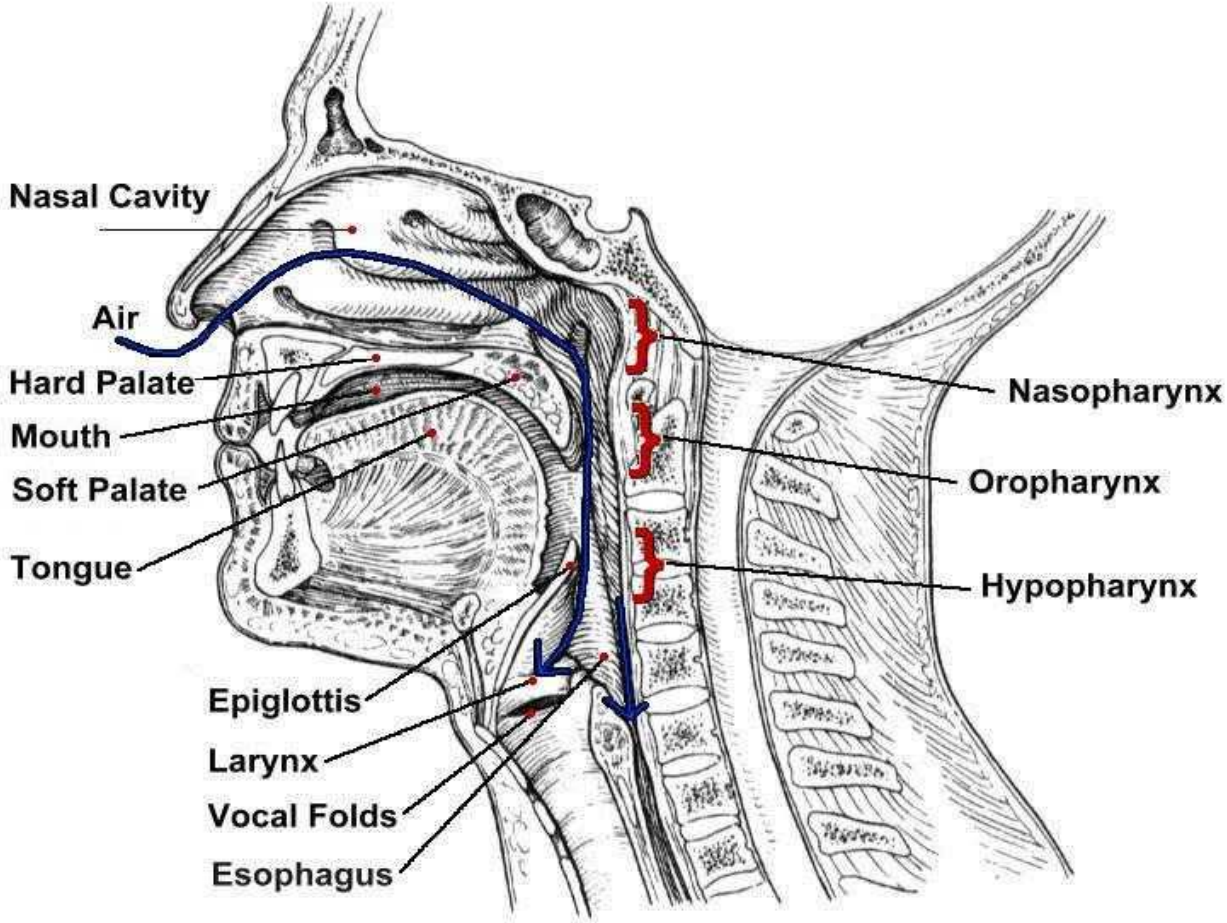
2. The respiratory region is the largest part of the nasal cavity, has a rich neurovascular supply, and is lined by respiratory epithelium composed mainly of ciliated and mucous cells;

3. The olfactory region is small, is at the apex of each nasal cavity, is lined by olfactory epithelium, and contains the olfactory receptors.

In addition to housing receptors for the sense of smell (olfaction), the nasal cavities adjust the temperature and humidity of respired air by the action of a rich blood supply, and trap and remove particulate matter from the airway by filtering the air through hair in the vestibule and by capturing foreign material in abundant mucus. The mucus normally is

moved posteriorly by cilia on epithelial cells in the nasal cavities and is swallowed.[12].

ANATOMY OF UPPER AIRWAY



Oral cavity:

The oral cavity begins at the border between the skin and the lips (vermillion border). The roof of the mouth is formed by the hard palate. The oral cavity leads into the oropharynx, which includes the soft palate, the back of the tongue and the tonsils. The inner surface of the cheeks

forms the sides of the oral cavity. The lowest part of the oral cavity is the floor of the mouth, which is covered by the tongue[13]

The oral cavity can be divided into specific areas, including:

- lips
- labial mucosa (inner lining of the lips)
- commissars of lips (where the upper and lower lips meet at the corner of the mouth)
- vestibule (a space bounded by the teeth and gums on the inside and the mucosal surface of the lips and cheeks on the outside)
- oral tongue (the front two-thirds of the tongue)
- floor of the mouth
- buccal mucosa (the inner lining of cheeks)
- gingiva (gums)
- retro molar trigone (the area just behind the back molars in the lower jaw)
- hard palate (the bony part at the front of the roof of the mouth)
- teeth
- lower jaw (mandible)
- upper jaw (maxilla)

Contracture of mouth and lips can lead to difficult laryngoscopy. The tongue makes up most of the mouth, which is bounded by the mandible

and teeth. The ability to achieve good mouth opening is important for many airway procedures. Initial mouth opening is achieved by rotation within the temperomandibular joint and subsequent opening by sliding of the condyle of the mandible within the joint.

Pharynx:

The pharynx is a fibro muscular tube that extends from the base of the skull to the lower border of cricoid cartilage. It joins the nasal and oral cavities above, with larynx and esophagus below. It is divided into nasopharynx and oropharynx.

Nasopharynx:

Nasopharynx – upper part of the Pharynx

The nasopharynx is located behind the nose. Inhaled air passes via the nose and nasopharynx on its way it enter into the trachea.

Nasopharynx Structure are following

- Eustachian tubes Openings – which is connecting the middle ear cavities and pharynx for the purpose of this is to maintain equilibrium to atmospheric pressure for optimal better hearing.
- Fossa of Rosen Muller – small deep cavity, it is a common region involved in cancer.

- Adenoids – a lymphoid tissue collection at the roof of the nasopharynx which protects the body from infective organisms. Adenoids are normally present in children.

- Tubal tonsils – another collection of lymphoid tissue around the Eustachian tube openings called Tubal tonsils.

Oropharynx:

Oropharynx – between nasopharynx and laryngopharynx

Inhaled Air enter via the nose or the mouth passes through the oropharynx to reach the trachea. Swallowed food passes via the oropharynx to reach the esophagus.

Structures in the oropharynx include following

- Soft palate – situated between the nasopharynx and oropharynx. It completely seals the oropharynx from the nasopharynx and prevents regurgitation of swallowed food.

- Tonsils – lymphoid structures located between the tonsillar pillars.

- Base of the tongue –posterior part of the tongue that fixed to the oropharynx.

Hypo pharynx:

This is the lowest part of the pharynx, continuous part of nasopharynx, oropharynx where there is divided in to esophagus and trachea .

Anatomically, the hypo pharynx is divided into three parts namely pyriform fossae, postcricoid region and posterior pharyngeal wall. Pyriform fossae are smooth depressions on either side of the larynx, acting as passages that guide swallowed food into the esophagus avoiding the larynx.

Functions of the Pharynx during laryngoscopy:

Laryngoscope blade tip is positioned in vallecula during conventional laryngoscopy. Gentle upward pressure on the vallecula with laryngoscope blade tensions hyoepiglottic ligament and indirectly elevates the larynx and helps in the alignment of laryngeal and pharyngeal axes[14.]

Larynx:

The larynx other wise called voice box which situated at the level of the cervical vertebrae(C_3 toC_6) , act as a organ of phonation and as a valve to protect the lower respiratory tract from the contents of the alimentary tract. It extends from the epiglottis to the lower level of the

cricoid cartilage. The larynx bulges posteriorly into the laryngopharynx, with the pyriform fossa lying on each side. It is suspended from the hyoid bone by the thyrohyoid membrane.

The laryngeal structures consist of framework of cartilages ligaments, muscles. These cartilages include the thyroid, cricoid, arytenoids, corniculate cartilages and the epiglottis. The epiglottis is a fibrous cartilage, covered by mucous membrane that reflects as the glossoepiglottic fold onto the pharyngeal surface of the tongue. The epiglottis overhangs the laryngeal inlet and projects into the pharynx. However, it is not absolutely essential for sealing off the airway during swallowing.

The inlet is made by the epiglottis, which joins to the arytenoids cartilages apex on each side by the aryepiglottic folds. Inside the laryngeal cavity narrow bands of fibrous tissue on each side called vestibular folds referred to as the false vocal cords and are separated from the true vocal cords by the laryngeal sinus or ventricle. These extend from the anterolateral surface of each arytenoid to the angle of the thyroid where the latter attaches to the epiglottis.

The pale white ligamentous structures that attach to the angles of the thyroid anteriorly and to the arytenoids posteriorly called true vocal cord. The triangular fissure between these vocal cords is termed the

glottis opening, which represents the narrowest segment of the laryngeal opening in adults.

Cricoid cartilage is a complete ring shaped cartilage and continues with trachea. In young children (<10 years old), the narrowest segment lies just below the cords at the level of the cricoid ring.

The mean length of the relaxed open glottis is 23 mm in males & 17 mm in females.

Conventional laryngoscopy:

Conventional laryngoscopy is performed in the supine position. In this position oral, pharyngeal and laryngeal axes of the patient are offset, making it difficult to obtain a good view of glottis by the conventional laryngoscope. A slight neck flexion of 25 – 35 degrees and head extension of approximately 85 degrees at Atlanto-occipital joint helps to align the axes called Magill's (sniffing) position [15.] proper airway assessment requires for successful direct laryngoscopy and intubation.

AIRWAY ASSESSMENT[16]

Intubation is often complicated by anatomical abnormalities of the upper airway, comorbid illness, position of the patient. To achieve successful direct laryngoscopy and intubation requires proper airway assessment .It consists of following important components.

History: Previous anesthesia records, H/O snoring, H/O voice change, H/O previous surgery, Trauma, Burns, Tumors in and around the oral cavity, neck or cervical spine were asked in the history. H/O systemic illness like Diabetes, Hypertension, Ankylosing spondylitis, Rheumatoid arthritis were asked and recorded.

General examination :

General examination included examination for facial anomalies, temperomandibular joint pathology,anomalies of the mouth and tongue, pathology of nose, pathology of palate were done. height in centimeters and weight in kilograms were recorded and body mass index was calculated. Individual airway indices were measured as follows.

A-O joint movement[17,18]: It assesses feasibility to make sniffing or Magill position for intubation . Measurement done by simple visual estimate or more accurately with a goniometer. To measure this patient is asked to hold head erect, facing directly to the front, then they were asked

to extend the head maximally and the examiner estimates the angle traversed by the occlusal surface of upper teeth. Normal angle of extension is 35° or more, for this examination ask patients to look at the ceiling without raising the eyebrow.

Reduced movement expressed in grades:

Grade I : >35°

Grade II: 22°-34°

Grade III : 12°-21°

Grade IV: < 12°

Neck flexion: Patient was asked to touch the manubrium sterni with chin and the range of movements measured with gonioscope.

TMJ function: The patient was asked to open his mouth wide open and the inter incisor distance measured. Examiner's index finger was placed in front of the tragus and thumb over the mastoid process and the patient was asked to open the mouth and sliding movement of the mandiblar condyle was assessed.

Thyro-mental (T-M) distance [19]: It is the distance from the mentum to the thyroid notch when the patient's neck is fully extended. > 6.5 cm is normal, < 6 cm is difficult; 6-6.5 cm is less difficult, this measurement helps to determining the laryngeal axis will fall in line with the pharyngeal axis when the Atlanto-occipital joint is extended.

Sterno-mental distance[20]: its estimated Distance between the supra sternal notch and mental symphysis when the neck was fully extended and mouth closed. A value of less than 12 cm is found to predict a difficult intubation.

Mento-hyoid distance[21] : Measurement of mandibular length from chin (mental) to hyoid should be at least 4 cm or three finger breadths. Laryngoscopy became more difficult when distance between the mandible and hyoid bone increased.

Neck circumference: Measured in cm at the level of thyroid notch. Normally <40cm. Difficulty to scopy when increased circumference.

Inter-incisor distance [22,23]: It is the distance between the upper and lower incisors. Normal is 4.6 cm or more; while < 3.8 cm predicts difficult airway. Abnormalities like cracking, buck tooth, loose, artificial and absence of incisors were examined and recorded.

Samson and Young modification of Mallampatti Grading[,24,25,26]:

The patient kept in sitting position with maximal mouth opening, protruding tongue, without phonation and the observer's eye in level with patient's mouth, the degree to which the faucial pillars, uvula, soft palate, and hard palate were visible were recorded and classified as follows:

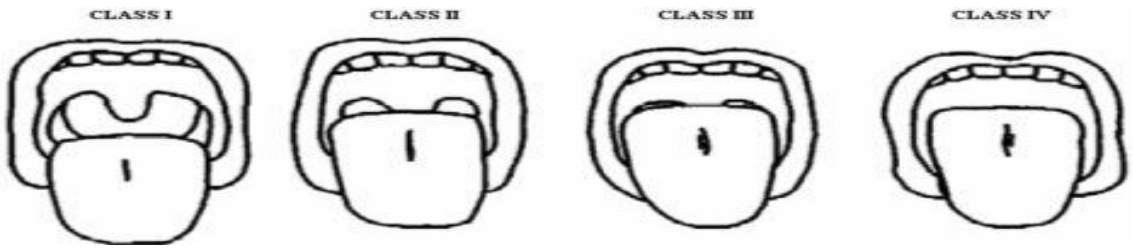
Grade I : Faucial pillars, uvula, soft palate and hard palate visible

Grade II : Uvula, soft palate and hard palate visible

Grade III : Base of uvula or none, soft palate and hard palate visible

Grade IV: Only hard palate visible.

Modified Mallampatti classification



Modified Cormack and Lehane Grading system[27,28,29]:

Entire vocal cord visualized - Grade I

Posterior part of vocal cords seen - Grade IIa

Arytenoids only seen - Grade IIb

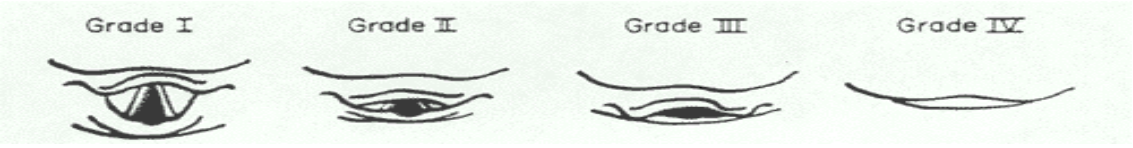
Epiglottis only seen (liftable) - Grade IIIa

Tip of epiglottis only seen (adherent)- Grade IIIb

No glottis structure seen - Grade IV

As described by Yentis and Lee

Cormack and Lehane grading of Laryngeal view



INTUBATION DIFFICULTY SCORE[30]:

Adnet et al in1997 developed an Intubation Difficulty Score based on parameters known to be associated with difficult intubation.

Seven variables are used.

N1 - Number of supplementary attempts. An attempt is defined as one advancement of tracheal tube in the direction of the glottis during direct laryngoscopy.

N2 - Number of supplementary operators directly operating (not assisting)

N3 - Number of supplementary techniques used.

N4 - Cormack Lehane grade minus one; grade I(N4=0)=complete visualization of vocal cords, grade II(N4=1)=visualization of inferior portion of glottis, grade III(N4=2)=visualization of only epiglottis, grade IV(N4=3)=even epiglottis is not visible.

N5 - Subjectively increased lifting force applied during larynoscopy;N5=0 if little effort is necessary,N5=1 increased lifting force is necessary .

N6 - Need for external laryngeal manipulation; N6=0 no external laryngeal pressure is applied,N6=1 external laryngeal pressure is applied. Applying Sellicks maneuver does not alter the score.

N7 - Position of vocal cords.N7= 0-abduction, N7=1-adduction.

An increased score which means increased difficulty. An IDS is a criteria which permit a qualitative and quantitative approach to the progressive nature of the intubation difficuty.

LARYNGOSCOPES

History of Laryngoscopes:

The history of the origin of laryngoscopes can be traced back to the middle of the eighteenth century. The importance of direct visualization of the vocal cords was realized only in the early part of the twentieth century.

YEAR	EVENT
1543	Vesalius - first tracheal intubation in an animal
1854	Manuel Patricio Rodriguez Garcia -First laryngoscope
1870	Trendelenburg - Endotracheal anaesthesia in man
1913	Jackson – first anesthetic laryngoscope
1929	Benjamin Guy Babington - use of a device to view the larynx
1940	Modern day laryngoscope systems began
1941	Wisconsin blade used a straight blade design with one light source.
1941	Robert Miller - curve on the bottom and a curved distal tip.
1942	Curare - Endotracheal intubation became routine in major abdominal and other surgeries
1943	Robert Macintosh - blade with a continuous curvature.

1991	Gorback MS - Bullard scope
1994	Wu TL, Chou HC – WuScope
1996	Pearce AC, Shaw S, Macklin S – UpsherScope
2006	Dr.Pedro Acha - Airtraq laryngoscope

- Modifications over the years have been made to both the blades for the purpose of providing more optimal intubating conditions.

In recent decades, video techniques using fibreoptic technology and Airtraq laryngoscopes based on reflecting mirrors are being commonly employed. The blade is inserted into the mouth in the centre of mouth over the tongue. The blade is then advanced over the contour of the tongue. Once the device has passed over the base of the tongue the operator should view the tip through the eyepiece. The manufacturers recommend the tip of the Airtraq should be placed in the vallecula (Macintosh technique). However, a technique whereby the blade is passed posterior to the epiglottis has also been described[18],thus improving laryngeal view even in patients who can't be kept in ideal sniffing position.

Overview of Laryngoscope design: Commonly used laryngoscopes can be classified as

Conventional Light Laryngoscopes: The light source is at the distal end of the blade, powered by batteries at the handle and electrical connections to illuminate the lamp.

Examples include:

- Macintosh type laryngoscopes (curved blades)
- Miller type laryngoscopes and other straight blade designs
- McCoy laryngoscope and variants (articulating tip)

Fibreoptic Light Laryngoscopes: Advancement in newer lighting technologies eliminated electric wire, lamps and contacts from blade thus producing a very dependable, cold and brighter illumination. Now LED/ XENON lamps that produce excellent light, which follows a quartz glass fiberoptic bundle or plastic bundle along the blade to illuminate a patient's oral cavity are used[31] .

Laryngoscopes using fibreoptic principle include:

- Rigid fibreoptic Laryngoscopes
    1. Bullard laryngoscope [32]
    2. Upsher laryngoscope [33]
    3. Wu laryngoscope (Wuscope) [34]
- Video laryngoscope (with micro miniature TV camera)
- Airtraq laryngoscope
- Flexible Fibreoptic laryngoscope (Bronchoscopes)

MACINTOSH LARYNGOSCOPE

Description of Macintosh Laryngoscope:

Macintosh laryngoscope consists of a handle and detachable blade. The light source is energized when the blade and handle are locked in the working position. A hook-on (hinged, folding) connection between the handle and blade is most commonly used. Standards covering rigid laryngoscopes include the American Society for Testing and Materials (ASTM) and the International Standards Organization (ISO)[35,36].

Handle:

The handle provides the power source for light. A hook on hinge folding connection between the handle and the blade is most commonly used. The handle is fitted with a hinge pin that fits a slot on the base of the blade. This allows quick and easy attachment and detachment[37.] Handles have a metallic contact, which completes an electrical circuit when handle and blade are in working position.

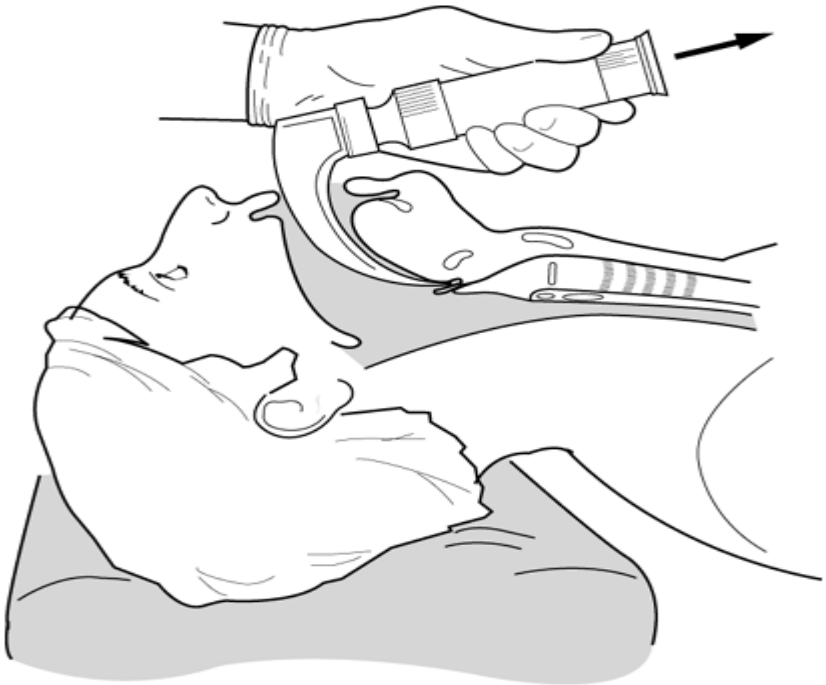
Blade:

The blade is the rigid component that is inserted into the mouth. The blade is composed of a base, heel, tongue, flange, web, tip and light source. The tongue or spatula is the main shaft. It has smooth, gentle curve that extends to the tip. It serves to compress and manipulate the soft tissues especially the tongue and lower jaw. The flange projects off the

side of the tongue and is connected to it by the web. It serves to guide instrumentation and deflect tissues out of the line of vision. The flange determines the cross sectional shape. In Macintosh blade the cross sections form a reverse Z[38.] The tip or beak contacts vallecula and helps to elevate the epiglottis. It is usually blunt to decrease trauma.

MACINTOSH LARYNGOSCOPE

INTUBATION WITH MACINTOSH LARYNGOSCOPE



Intubation with Macintosh Laryngoscope:

Proper preparation should include airway assessment, assembling and checking airway equipments and finally achieving sniffing position. Positioning the height of the table at the level of laryngoscopist's naval helps to achieve a straight line between the operator's eye and the patient's upper airway.

The Macintosh blade should be held with the left hand while the right thumb and index finger open the mouth. Laryngoscope blade should be introduced from the right side of the patient's mouth without engaging the lips and teeth. When half of the blade is introduced tongue should be swept to the left as laryngoscope blade is moved to the centre.

On deeper entry into the oral cavity, the blade tip is positioned between the base of the tongue and the pharyngeal surface of the epiglottis(vallecula). At that stage the tongue and pharyngeal soft tissues are lifted to expose the glottis opening. It is important that the end of the handle opposite the blade is not pulled backward. This will cause the tip to push the larynx upward and out of sight and could cause damage to the teeth or gums. [39,40] The left-molar approach is may be especially helpful and may spare the incisor teeth .

Cleaning

The cleaning of laryngoscopes important because blades are inserted into the mouth , cause cross infection. The handle contaminated with secretions and blood .Recommended cleaning procedures, including washing the blade and liquid chemical sterilization, steam autoclaved. Disposable laryngoscope blades and handles are also available [41,42.]

AIRTRAQ LARYNGOSCOPE

Description of Airtraq Laryngoscope:

Airtraq is a single use laryngoscope designed to facilitate intubation for routine endotracheal intubation as well as patients with difficult airways .Airtraq was developed patented by Dr. Pedro Acha in the year of 2006. It allows full visualization of airway during the intubation. Airtraq laryngoscope design is to better visualization of the glottis without alignment of the oral, pharyngeal and tracheal axes, it does not require hyperextension of neck and permits intubating the patients in virtually any position. The device is made of medical grade plastic material.

Airtraq laryngoscope with two parallel channels. One optical conduit channel for visualization and other opened channel to guide the Endo Tracheal Tube .A low temperature battery operated light is present at the tip of blade which act as an antifogging. The battery life is approximately one hour. Its available in adult and pediatric sizes, and size to accommodate Double Lumen Tube.

Optical conduit channel consist of the viewing lens allows visualization of the glottis and surrounding structures and the tip of the tracheal tube. The image is transmitted to a proximal viewfinder using a

combination of lenses and prisms. The maximum thickness of the blade is 1.8cm. The Airtraq is anatomically shaped for oropharyngeal axes and standard EndoTrachealTubes of all sizes can be used.

To use the Airtraq, a well lubricated EndoTrachealTube is preloaded in a channel next to optical channel, and device is inserted in oropharynx in midline over centre of the tongue for that minimum mouth opening required while using blue Airtaq is 18mm while that for green Airtraq is 16mm[43].The blade is introduced till its tip positioned in the vallecula when the glottis is visualized, the ETT is advanced in to trachea. The Airtraq is then removed, disengaging the ETT with lateral movement. If the vocal cords are not visible, it usually means that either the laryngoscope is not in the midline or placed too posteriorly in the vallecula . In case laryngeal structures are not recognized, withdraw the Airtraq slightly.

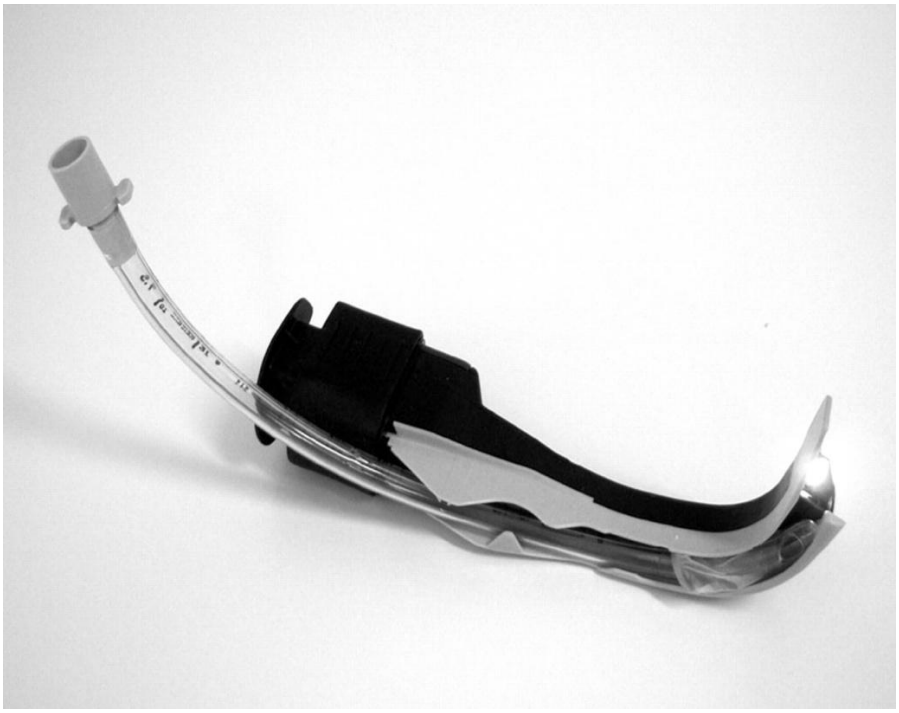
Advantages: It has an anti-fog system built in to optical channel which requires 30-45 sec warm-up time prior to use. It can be converted in to video laryngoscope by attaching optional wireless or wired video system; which should be mounted on top of Airtraq; after removing the original rubber viewfinder.

Disadvantages: The view through the Airtraq is less panoramic when compared with Macintosh and other video laryngoscopes .The oral injuries may be unnoticed if they are outside the optical field of Airtraq.

Size, and Types of blade of Airtraq;

- Regular type- blue -Size-3 used for oral intubation , which require 7-8.5 Size cuffed Endo Tracheal Tube ,18mm mouth opening.
- Small type- green -Size-2 used for oral intubation , which require 6-7.5 Size cuffed Endo Tracheal Tube ,16mm mouth opening.
- Paediatric type- purple -Size-1 used for oral intubation , which require 3.5-5.5 Size cuffed or uncuffed Endo Tracheal Tube ,12.5mm mouth opening.
- Infant type- gray -Size-0 used for oral intubation , which require 2.5-3.5 Size cuffed or uncuffed Endo Tracheal Tube ,12.5mm mouth opening.
- Infant type- white used for nasal intubation , uncuffed Endo Tracheal Tube size not applicable , which require 18mm mouth opening .

AIRTRAQ LARYNGOSCOPE



INTUBATION WITH AIRTRAQ LARYNGOSCOPE

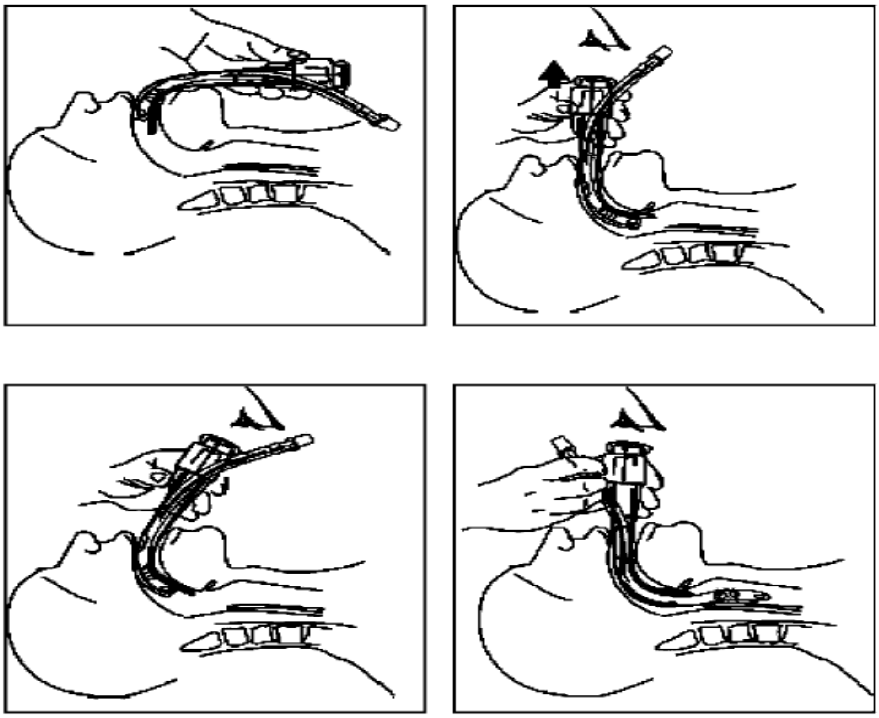


Figura 3. Pasos en la inserción del Airtraq®.

AIM AND OBJECTIVES

To compare the efficacy of Airtraq optical laryngoscopes to conventional Macintosh laryngoscopes for ease of intubation by comparing the Intubation Difficulty Scores of both laryngoscopes .

In addition, we compare the following parameters of both laryngoscopes

- Hemodynamic parameter heart rate ,blood pressure(systolic, diastolic),Oxygen saturation during intubation.
- Complications associated with intubation like throat pain and hoarseness of voice .
- Rate of successful intubation
- The time taken for intubation

REVIEW OF LITERATURE

Study titled, "Comparison of Intubation Difficulty Scores between Macintosh Laryngoscopy and Airtraq Optical Laryngoscopy" conducted in our Govt.Kilpauk Medical College Hospital, to find the intubation difficulty score of Airtraq laryngoscope over Macintosh laryngoscope. The search in to the literature revealed the following.

C.H. Maharaj et al[44] in their study titled, "A comparison of tracheal intubation using the Airtraq or the Macintosh laryngoscope in routine airway management: a Randomized, controlled clinical trial" had included 60 patients with a Male: Female ratio of 11:19 in each group. The Mean Age of Airtraq laryngoscope group (41.1 ± 16.9) was less than the Macintosh laryngoscope (43.8 ± 16.8). Airtraq Group (0.2 ± 0.5) had low Intubation difficulty score as against the Macintosh group (1.4 ± 2.2). 83.4% of patients among Airtraq group had an intubation difficulty score of '0' where as only 46.7% of the Macintosh group scored '0' indicating that Intubation with Airtraq laryngoscope was easy than Macintosh group. All the patients in the Airtraq group were successfully intubated in the first attempt itself whilst 96.7% of the patients in the Macintosh group met with successful intubation when attempted the first time. The glottis exposure on the basis of Cormack and Lehane score was much better in the Airtraq group (95%) as against (70%). No optimization of maneuvers

was used in Airtraq group while such maneuvers were tried in 23.3% of Macintosh group. The ease of instrument use as denoted by the patient's subjective feeling of pain measured by Visual Analog Score was less in the Airtraq group (1.2 ± 1.4) than the Macintosh group (2.0 ± 1.5). **Yoshihiro Hirabayashietal**[45] study on 20 patients where nasotracheal intubation was performed by a non-anaesthesia physician to compare the intubating conditions between Macintosh and Airtraq laryngoscopes. Results observed from the study that nasotracheal intubation was achieved by using Airtraq laryngoscopy is shorter time(65 seconds) than using Macintosh laryngoscopy(123 seconds) with Magill forceps. No esophageal intubation experienced in the Airtraq group, while one resident performed an esophageal intubation in the Macintosh group. It was concluded from the study that in comparison with the Macintosh laryngoscope, the Airtraq laryngoscope provides superior intubation conditions for personnel who are training in airway management, resulting in less time to secure the airway .

Geeta Bhandari et al[46], in their study titled, "Airtraq versus Macintosh laryngoscope: A comparative study in tracheal intubation" studied 24 Males and 56 Females with more males in the Airtraq group and females in the Macintosh group (Males 14 and 10 and Females 26 and 30 respectively). They had stated that the time to intubation was less in the

Airtraq group (18 ± 2.6) than the Macintosh group (29 ± 5.06). They too had obtained significant association between the tracheal intubation using intubation difficulty score. Less optimization maneuver score, greater percentage of Glottic opening as measured by the POGO score and greater ease of intubation of was seen in the Airtraq group than the Macintosh group (97.5% > 35%, 100% > 67.5% and 97.5% > 42.5%) respectively. There isn't much difference between the post operative complications like throat pain and hoarseness of voice between the Airtraq and Macintosh group.

Durga et al[47] in their study comparing Airtraq laryngoscope and Mc Coy laryngoscope in patients simulating traumatic cervical spine injury had observed that the Intubation Difficulty scores of Airtraq group (median 2) was lesser than the Mc Coy laryngoscope group (median 4). The mean intubation time was lesser in the Airtraq group (28.95 ± 18.53 s). Lesser proportion of patients in the Airtraq group (3.3%) had difficulty during laryngoscope insertion. Airway trauma was reported in only 1.7% of Airtraq group patients. Failed intubation was observed in greater proportion of patients among Airtraq group. Successful intubation in the first time was noted to be more in the Airtraq group (93.3%) patients. None in both the study group required more than one operator during intubation. Number of alternative intubation techniques was adopted in

the Mc Coy group where in only 11.7% of the Airtraq group required one alternative technique. The visibility of the Glottis was better in the Airtraq group (81.7&). Only 5% in the Airtraq group required increased lifting force. No external laryngeal pressure was needed in the Airtraq group patients.

Osama El Sharkawy et al[48] in their study in morbidly obese patients comparing Airtraq and Macintosh laryngoscopes had found that the visual analog score of difficulty 'from the operator' was lesser in the Airtraq group (32.6 ± 8.58) than the Macintosh group (46.75 ± 8.28). Lesser attempts at intubation (patients 0/20 < patients 2/20), lesser requirement of more than one operator (patients 0/20 < patients 1/20), lesser need of alternative intubation techniques (patients 1/20 < patients 7/20), lesser need for increased lifting pressure (patients 5/20 < patients 18/20), lesser need for external laryngeal pressure (patients 4/20 < patients 12/20) and low Intubation Difficulty score (1.02 ± 1.303 < 4.25 ± 1.2) was noted among patients in the Airtraq group than the Macintosh group. Highly difficult or impossible score was observed in one among the twenty patients in the Airtraq group where as 4 among the twenty Macintosh group patients experienced highly difficult intubation.

Marwa A. Tolon et al[49] in their study in patients with cervical spine immobilization had observed lower duration in intubation of 34.3 ± 12.27

s in the Airtraq group compared to 48.7 ± 21.57 s in the Macintosh group. The mean intubation attempt in Airtraq group was lesser 1.1 ± 0.31 than the Macintosh group 1.2 ± 0.41. Lesser optimization maneuvers was seen in the Airtraq group 0.1 ± 0.031 than the Macintosh group (0.85 ± 0.081). The rate of cervical spine immobility and successful endo-tracheal tube placement achieved in both the groups were the same. Complications like Lip Bruising (5%), Teeth clicking (5%) and Tongue bruising (5%) were observed in only Macintosh group.

C.H. Maharaj et al[50] in their study on Manikin to evaluate the ease of intubation by anesthetists in 8 different scenario had stated that in scenario 1 (Normal airway) the duration of intubation at 1st attempt was lower (9.5 ± 6.7s) in the Airtraq group as against the Macintosh group (14.2 ± 7.4 s). He further stated that both the Airtraq group and Macintosh group experienced successful intubation at first attempt. But the need for more optimization maneuvers and severity of dental trauma was experienced in higher number by the Macintosh group over their Airtraq counterpart. Intubation maneuver in the left lateral position scenario in Laerdal Airway trainer (Scenario 2 – normal airway with head in left lateral position) exhibited results in direct contrast to those observed in usual position with ease of intubation in favors of Macintosh group. In Scenario 3 – normal airway with cervical immobilization

Airtraq group had a lower mean duration of intubation 918 ± 14.2 s) than the Macintosh group (18.5 ± 10.5s). Dental trauma was seen in more patients in the Airtraq group in the same scenario. In Scenario 4 (Difficult airway due to tongue edema in SimMan Manikin), the overall success rate of intubation was higher in the Airtraq group (92%) than the Macintosh group (44%). Also the mean duration of intubation is better in the Airtraq group (40.6 ± 39.4) than the Macintosh group (74.3 ± 37 s). Airtraq group exhibited better results like higher proportion of successful intubation at first attempt and lesser need for optimization maneuvers. Severity of dental trauma and teeth compression was experienced by lesser patients in the Airtraq group than the Macintosh group. But in Scenario 5 – difficult airway with cervical spine rigidity, observations were in favor of Macintosh group with overall success rate of 100% against 92% of Airtraq group. In other parameters like Mean duration of intubation on 1st attempt, proportion of successful intubation with one attempt, lesser optimization maneuver requirement and lesser severity of dental trauma Airtraq group performed better than Macintosh group. In difficult airway with pharyngeal obstruction (Scenario 6), the overall rate of successful intubation on 1st attempt and proportion of patients requiring single intubation attempt were equal in both the groups. Although the Airtraq group excelled in its performance with regards to lesser optimization maneuver requirement and low dental trauma. In

scenario 7 (Difficult airway with cervical rigidity and pharyngeal obstruction) and Scenario 8 (Difficult airway with jaw trismus), Airtraq group performed better than Macintosh group in all the parameters assessed. They had concluded that the performance of Airtraq laryngoscope was equal to that of Macintosh laryngoscope for tracheal intubation under normal airway situations where as Airtraq performed superiorly than Macintosh in difficult airway scenarios.

Di Marco et al[51] in their study had observed that the duration of intubation with Airtraq laryngoscope was less (40 ± 23s) than the Macintosh laryngoscope (59 ± 26). First attempt success rate was higher in the Airtraq group (47/54 patients) than the Macintosh group (43/ 54 patients). No esophageal intubation was reported and both the groups exhibited similar complications profile.

Koh et al[52], had observed a small change in the mean duration of intubation in the Airtraq group than the Macintosh group with lower duration in the Airtraq group. But the proportion of successful intubation with the Macintosh group is greater than the Airtraq group. Esophageal intubation was not reported in any patients and none showed any complications during intubation and after extubation.

Park et al[53], stated from their study that Airtraq was better than Macintosh with lesser duration of intubation, higher proportion of 1st

attempt success rate and lower complications associated with intubation. Esophageal intubation was reported in both the groups with lower incidence in Airtraq intubation.

Chalkeidis et al[54], gave a different observation in contrast to others stating that the duration of intubation in the Macintosh group (24 ± 6s) to be lesser than the Airtraq group (30 ± 9s). Overall success rate and fewer complications were observed in Macintosh group in a higher proportion than the Airtraq group.

Dhonneur et al.[55], in their study on morbidly obese patients had claimed that the Airtraq group to be better than Macintosh group with less mean duration of intubation and greater overall success rate, where as both showed similar features with regards to oesophageal intubation and complications during intubation and after extubation.

Gaszynski et al.[56], too obtained a result similar to Dhonneur et al.

Wang et al.[57], stated that Macintosh laryngoscope (25 ± 3) had a mean duration of intubation lesser than the Airtraq group (26 ± 3). Both the group exhibited similar results in other parameters.

Ndoko et al.[58], observed that lesser times was required for intubation in the Airtraq group (24 ± 16) than the Macintosh group (56 ± 23). But the

overall success rate of intubation at 1st attempt was higher in the Macintosh group (100%) than the Airtraq group (92%).

Christen et al.[59], in their study observed the Airtraq group to be better performing than the Macintosh group with a lesser duration of intubation (13 ± 5s against 20 ± 12), higher overall success rate (20/20 patients against 19/20) and no complications (0/20 against 2/20).

Y. Lu et al.[60], in their systematic review and meta analysis study had discussed Airtraq laryngoscopes significantly decreased intubation time in both novice and experienced anesthetists. But higher overall first attempt success rate was observed in Airtraq group only among novice users. They also claimed that there was less chance of esophageal intubation with Airtraq laryngoscopes. They also stated that Airtraq laryngoscopes produced less hemodynamic changes than the Macintosh laryngoscopes.

METHODOLOGY

After obtaining the Insitutional Ethical Committee clearance, study was carried out in Govt, Kilpauk Medical College Hospital.

Sample frame consists of patients under going elective surgical procedure under General Anesthesia in Govt. Kilpauk Medical College Hospital.

Study Design: A Prospective study , Randomized controlled Study .

Sample size: Consists of 60 patients. They were randomly allocated into 2 groups of consisting 30 patients for each group.

Group-I- Macintosh laryngoscope was used for intubation of 30 patients

Group-II- Airtraq laryngoscope was used for intubation of 30 patients

Inclusion criteria:

- Elective surgical patients requiring Oral Endotracheal General Anaesthesia, and short duration surgery(<2 hours)
- American Society of Anesthesiologist physical status I & II
- Patients aged between 18 years to 60 years of age of either sex
- Body mass index (BMI) < 35 Kg m^{-2}

- Who had given valid informed consent

Exclusion criteria:

- Patient with difficult airway, compromised airway.
- Morbid obesity
- Mallampatti grade 3&4
- American Society of Anesthesiologist physical status III& IV
- Patient with airway sharing surgery such as Tonsil, Thyriod surgery
- Patient with emergency surgery
- Pregnant patients
- Healthy volunteers not satisfying inclusion criteria
- Severe cardiovascular, hepatic or renal disease, mental illness
- Need for nasal intubation
- Prolonged surgery > 2 hrs

60 adult patients satisfying inclusion criteria were enrolled in the study after obtaining informed consent.

Pre op assessment:

Patients who are admitted to the surgical wards and posted for elective surgery requiring oral endotracheal intubation and satisfying the inclusion criteria were included in the study and data collected from them. Baseline characteristics like general information of the patient, physical examination including height, weight, Blood Pressure, anatomic parameters like Mentohyoid distance (MHD), Thyromental distance (TMD), Sternomental distance (SMD), Neck circumference were measured and recorded.

After explaining the nature of study and getting informed consent, the patients are divided into two groups viz; The Macintosh laryngoscope group, The Airtraq laryngoscope group.

Premedication:

Base line hemodynamic parameters including (heart rate and mean arterial blood pressure) and oxygen saturation were recorded before Anesthesia . After establishing an intravenous route ,Inj. Glycopyrrolate 10 μg/kg i.v , Inj.Midazolam 1mg i.v, Inj.Ranitidine-50mg i.v and Inj.Ondensetran-4 mg i.v was given 30 min before the surgery for all patients who were satisfying the inclusion criteria .

Operating room: Before shifting the patients to the theatre following check lists were done

For laryngoscopy- Airtraq laryngoscopy, Macintosh laryngoscopy.

For Anesthesia- Anesthesia machine with circuit, Suction apparatus, Anesthetic drugs .

For intubation- Endotracheal tube varying size

For emergency management-All emergency drugs,

For monitoring- ECG, pulsoximeter and ETCO2,NIBP,

Others-Difficult airway cart include flexible fibroptic scope, Tracheostomy kit

In the operation theatre all the patients received a standardized general anesthesia protocol. All patients were monitored by standard monitoring included ECG, non-invasive arterial pressure, SpO_2 and measurement of end-tidal carbon dioxide. All patients were preoxygenated with 100% oxygen for 3 minutes. Before induction of anesthesia base line hemodynamic parameters including heart rate, blood pressure and SpO2 were recorded. All patients were induced with , Inj.Pentothal Sodium 5 mg/kg ,Inj. Fentanyl 1.5 μg/kg i.v. After induction of Anaesthesia, all patients were manually ventilated with Sevoflurane 2.0-2.5% in oxygen, and , Inj. Vecuronium 0.1 mg/kg was administered

as a muscle relaxation. Intubation was done after 3 min of optimal intubating conditions. Thereafter Anaesthesia maintained by conventional general anaesthesia by using Sevoflurane (1.25–1.75%) in a mixture of nitrous oxide and oxygen in a 2 : 1 ratio(66:33).

Methods of intubation and recording of vital parameters:

Every patient tracheal intubation was performed by the Airtraq or Macintosh laryngoscopy according to randomization sequence .

Before intubation :After induction of Anesthesia before intubation hemodynamic parameters including heart rate, blood pressure and SpO2 were measured and recorded for all patients.

During attempt of intubation : Cook's modification of Cormack and Lehane grading and Intubation Difficulty Score were noted during intubation. Intubation Difficulty Score having Seven variables.

N1 - Number of supplementary attempts.

N2 - Number of supplementary operators directly operating (not assisting)

N3 - Number of supplementary techniques used.

N4 - Cormack Lehane grade minus one.

N5 - Subjectively increased lifting force applied during larynoscopy.

N6 - Need for external laryngeal manipulation.

N7 - Position of vocal cords.N7= 0-abduction, N7=1-adduction.

An increased score which means increased difficulty. Time duration of intubation was recorded.

After intubation: After intubation hemodynamic parameters including heart rate, blood pressure and SpO2 were measured and recorded at 1min,3min,5min interval for all patients.

Duration of intubation attempt was defined as the time elapsed from insertion of the blade tip between the dental arches until the endo tracheal tube was passed through the vocal cords . Failed intubation was defined as an attempt in which user could not intubate the trachea even with optimization maneuvers or which required >120 seconds to perform the procedure. In the case of failed intubation, intubation with other laryngoscope was allowed.

Post op period:

In postoperative period, the investigator asked patients about signs of sore throat (throat pain) and for hoarseness of voice.

Throat pain was assessed on a score of 0 to 3:

0 – No pain

1 – Mild pain/discomfort only

2 – Moderate pain

3 – Severe pain

If intubation with Airtraq failed and saturation maintained, Macintosh blade was used for intubation. And if the saturation decreased, mask ventilation with 100% oxygen followed by intubation with Macintosh laryngoscope .

OBSERVATION& RESULTS

Data analysis:

Data was entered in Microsoft Excel 2007 and analyzed using IBM SPSS 21.0 software .Descriptive statistics like mean and standard deviation for continuous variables, mode and inter quartile range for ordinal data and frequency and percentage for nominal categorical variables was used.Independent sample student's' test, Mann Whitney U test and Chi square test was employed to test the significant association between the two groups for continuous, ordinal and nominal variables respectively.

Two groups:

Group-I- Macintosh laryngoscope was used for intubation of 30 patients

Group-II- Airtraq laryngoscope was used for intubation of 30 patients

The study titled, "Comparison of Intubation Difficulty Scores between Macintosh Laryngoscopy and Airtraq Optical Laryngoscopy" conducted in Govt. Kilpauk Medical College Hospital showed the following results.

Sample Size Calculation:

Samle size were calculated from a study by Geeta Bhandari et al (18) shows that the overall duration of successful tracheal intubation was 18.15 (±2.74) seconds for Airtraq group versus 29.23 (±5.04) for Macintosh group.

Sample size is calculated using the formula,

$$m \text{ (size per group)} = \frac{2c}{\delta^2} + 1$$

$$\delta = \frac{|\mu 1 - \mu 2|}{\sigma}$$

c = 7.9 for 80% power; 10.5 for 90% power

δ = standardized effect size

μ1 and μ2 = means of the two groups

σ = common standard deviation

Using the following from Di Marco et al [61] study,

Group	**Mean**	**Std dev**	**Sample size**
Macintosh group	59	26	54
Airtraq Group	40	23	54

The common standerd deviation is calculated from [62]

Step 1: Find variance(Var) of individual group

, $Var_{(Macintosh\ group)} = S.D^2_{(Macintosh\ group)} = (26)^2 = 676$

$Var_{(Airtraq\ group)} = S.D^2_{(Airtraq\ group)} = (23)^2 = 529$

Step 2: Error sum of squares (ESS),

$ESS_{(Macintosh\ group)} = [Var\ X\ (n-1)] = [676\ x\ (54-1)] = 35828$

$ESS_{(Airtraq\ group)} = [Var\ X\ (n-1)] = [529x\ (54-1)] = 28037$

Step 3: Overall error of sum of groups (ESS) ,

$ESS_{(Macintosh\ group)} + ESS_{(Airtraq\ group)} = 63865$

Step 4: Deviation Group sum of squares,

$GSS_{(Macintosh\ group)} = (Mean – Group\ mean)^2\ X\ n = (59 – 49.5)^2$ x 54 = 4873.5

$GSS_{(Airtraq\ group)} = (Mean – Group\ mean)^2\ X\ n = (40 – 49.5)^2$ x 54 = 4873.5

Step 5: Total Group sum of squares (TGSS) :

$GSS_{(Macintosh\ group)} + GSS_{(Airtraq\ group)} = 9747$

Step 6: Total sum of squares:

ESS + TGSS = 63865 + 9747 = 73612

Step 7: Grand variance:

TSS/ N-1 = 73612/ (108-1) = 687.96262

Step 8: Common standard deviation = √G.V = √687.96262 = 26.229

$$\text{m (sample size per group)} = \frac{2c}{\delta^2} + 1$$

$$\delta = \frac{\mu 1 - \mu 2}{\sigma} \quad : \quad \delta = \frac{19}{26.229} \quad : \quad \delta = 0.72439$$

$$\text{m (sample size per group)} = \frac{2 \times 7.9}{0.72439^2} + 1$$

m (sample size per group) = 31.1 or 32 approx

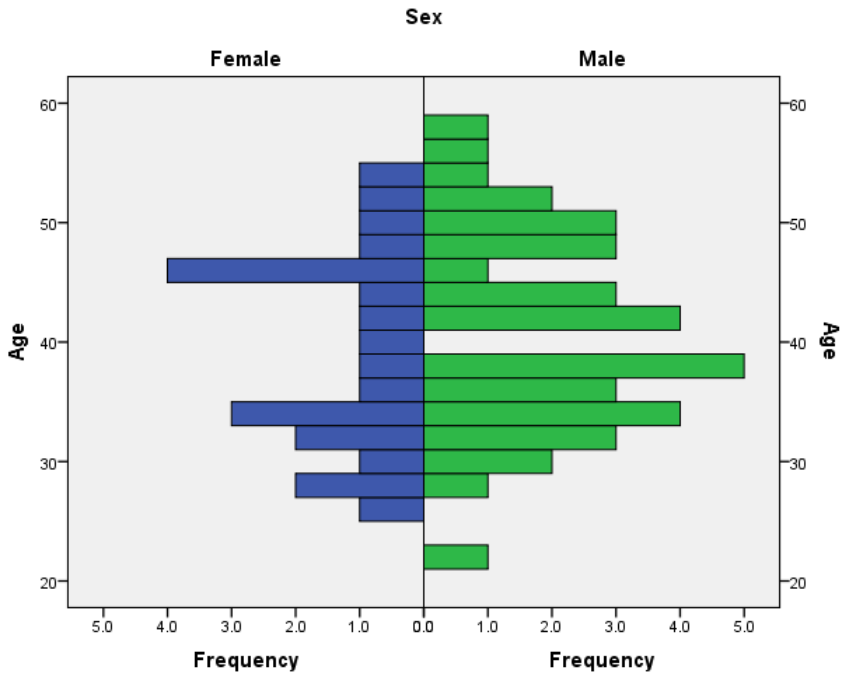
hence the total sample size will be N = 2 X 32 = 64 . For ease of calculation 60 patients are included in the study.

Age and Gender distribution

Variable		Number	Percent
Gender	**Female**	22	36.7
	Male	38	63.3
	Total	60	100.0
	20-30	6	10.0

The study was conducted among 60 patients which included 22 females (36.7%) and 38 males (63.3%). Nearly three fourths (73.3%) of the patients belonged to age group 30 years and 50 years.

The Following figure depicts the age pyramid of the study groups.



Age, Anthropometric and Anatomic Measurements

Variable	Age	Height (cm)	Weight (kg)	BMI	Neck Circumference	Thromental Distance	Hyomental Distance
Mean	40.03	165.28	69.00	25.163	34.35	6.820	6.420
Std. Dev	8.497	7.709	9.998	2.5019	1.981	0.1938	0.1938
Minimum	22	150	50	20.8	30	6.6	6.2
Maximum	58	184	90	34.7	39	7.4	7.0

From the above table it can be seen that the mean age, height, weight and BMI of the study population were 40.03 ± 8.497, 165.28 ± 7.709, 69 ± 9.998 and 25.163 ± 2.5019 respectively. The mean neck circumference was 34.35 ± 1.981 with minimum and maximum being 30 and 39 respectively. The mean thyromental and hyomental distance are 6.820 ± 0.1938 and 6.420 ± 0.1938 respectively.

Age and Anthropometric and Baseline Hemodynamic measurements between the study groups.

Variable	Group	Mean	Std. Deviation	p-value *	95% Confidence Interval	
					Lower	Upper
Age	Macintosh Group	38.37	8.307	0.130	-7.675	1.009
	Airtraq Group	41.70	8.494			
Height(cm)	Macintosh Group	165.93	7.606	0.518	-2.704	5.304
	Airtraq Group	164.63	7.885			
Weight(kg)	Macintosh Group	70.30	8.979	0.318	-2.567	7.767
	Airtraq Group	67.70	10.920			
BMI	Macintosh Group	25.470	2.4272	0.347	-.6809	1.9075

	Airtraq Group	24.857	2.5787			
PR	**Macintosh Group**	79.47	9.468	0.658	-3.968	6.235
	Airtraq Group	78.33	10.256			
SYS BP	**Macintosh Group**	120.80	10.486	0.981	-5.413	5.547
	Airtraq Group	120.73	10.719			
Dias BP	**Macintosh Group**	76.50	7.606	0.986	-3.788	3.855
	Airtraq Group	76.47	7.176			
Mean Arterial Pressure	**Macintosh Group**	91.33	7.858	0.974	-3.941	4.074
	Airtraq Group	91.27	7.647			

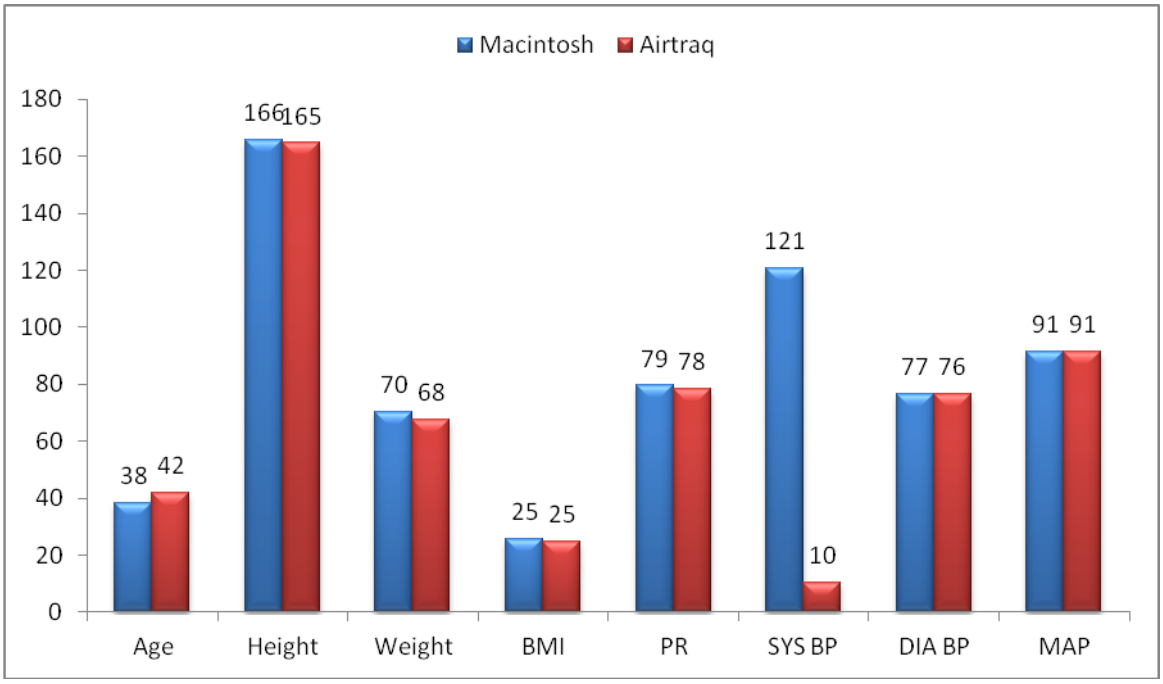
*-Independent sample ‘t’ test

The mean Age of Airtraq group patients was higher (41.7 ± 8.494) than the Macintosh group (38.37 ± 8.307). The mean height, weight and BMI was higher in the Macintosh group [(165.93 ± 7.606), (70.3 ± 8.979)

and (25.47 ± 2.427)] than the Airtraq group [(164.63 ± 7.885), (67.7 ± 10.92) and (24.85 ± 2.57)] respectively. There is no much difference between the Age and Anthropometric measurements between the study groups and their association with the study groups was not statistically significant.

The mean baseline haemodynamic parameters like Pulse Rate, Systolic BP, Diastolic BP and Mean Arterial Pressure was a little higher in the Macintosh group [(79.47 ± 9.468), (120.8 ± 10.48), (76.5 ± 7.6) and (91.3 ± 7.858)] than the Airtraq group [(78.3 ± 10.2),(120.7 ± 10.7),(76.4 ± 7.1) and (91.2 ± 7.6)]. Statistical significant association was not observed among the study groups and the baseline haemodynamic measurements.

Age, Anthropometric and Baseline Haemodynamic Measurements



Neck Anatomic Measurements of the Study Groups.

Variables	Group	Mean	Std. Deviation	p-value	95% Confidence Interval	
					Lower	Upper
Neck Circumference	Macintosh Group	34.73	1.413	0.135	-.246	1.780
	Airtraq Group	33.97	2.385			

Thyromental Distance	**Macintosh Group**	6.830	.1932	0.693	-.0809	.1209
	Airtraq Group	6.810	.1971			
Hyomental Distance	**Macintosh Group**	6.430	.1932	0.693	-.0809	.1209
	Airtraq Group	6.410	.1971			

The average anatomic parameters like neck circumference, thyromental distance and hyomental distance of the Macintosh group is greater than the Airtraq group but their association was not statistically significant.

Gender Distribution of the Study Groups.

Group	Sex		Total	p-value
	Female	Male		
Macintosh Group	14 (46.7) {63.6}	16 (53.3) {42.1}	30 (100) {50}	0.180
Airtraq Group	8 (26.7) {36.4}	22 (73.3) {57.9}	30 (100) {50}	
Total	22 (36.7) {100}	38 (63.3) {100}	60 (100) {100}	

The above table shows the gender distribution of the patients among the study groups. The proportion of males was higher in both the study groups. Among the females most (63.6%) of them belonged to the Macintosh group where in among the males the majority (57.9%) of them belonged to the Airtraq group. There was no significant association between the gender and the study groups. (p-value = 0.180).

American Society of Anesthesiologists classification Distribution

ASA Class	Number	Percent
1	46	76.7

According to American Society of Anesthesiologists Classification most (46) of the patients belonged to ASA Class I.

American Society of Anesthesiologist Classification of the Study Groups .

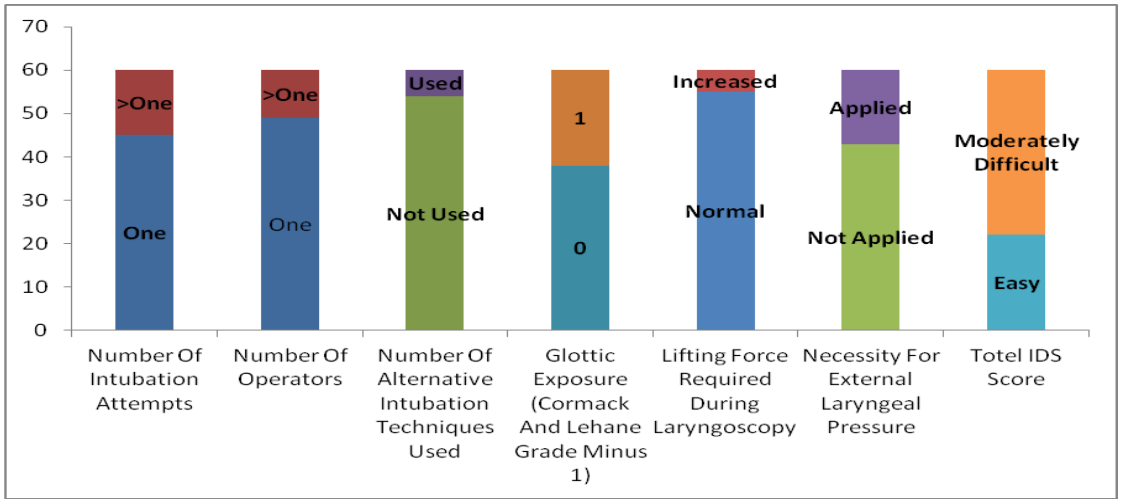
Group	ASA		Total	p-value
	1	2		
Macintosh Group	24 (80) {52.2}	6 (20) {42.9}	30 (100) {50}	0.761
Airtraq Group	22 (73.3) {47.8}	8 (26.7) {57.1}	30 (100) {50}	
Total	46 (76.7) {100}	14 (23.3) {100}	60 (100) {100}	

The ASA classification shows that more than three fourths (76.7%) of the patients belonged to the ASA class 1. Amongst the ASA Class 1 patients, more number (24) of patients belonged to the Macintosh group where in Airtraq group proportion of ASA Class 2 patients were higher (57.1). There was no significant association between the study groups and the ASA Class patients. (p-value = 0.761).

Distribution of patients based on Intubation Difficulty Score

Intubation Difficulty Score		Number	Percent
Number Of Intubation Attempts	**One**	45	75.0
	> One	15	25.0
	Total	60	100.0
Number Of Operators	**One**	49	81.7
	> One	11	18.3
	Total	60	100.0
Number Of Alternative Intubation Techniques Used	**Not Used**	54	90.0
	Used	6	10.0
	Total	60	100.0
Glottic Exposure (Cormack And Lehane Grade Minus 1)	**0**	38	63.3
	1	22	36.7
	Total	60	100.0
Lifting Force Required During Laryngoscopy	**Normal**	55	91.7
	Increased	5	8.3
	Total	60	100.0
Necessity For External Laryngeal Pressure	**Not Applied**	43	71.7
	Applied	17	28.3
	Total	60	100.0
Total IDS Score	**Easy**	22	36.7
	Moderately Difficult	38	63.3
	Total	60	100.0

The above table elaborates the distribution of the patients on the basis of Intubation Difficulty score. It can be seen that only one fourth (25%) of the patients required more than one attempts at intubation, less than one fifth (18.7%) required more than one anesthetist for intubation. Alternative intubation techniques was used in 10 % of the patients, 8.3% required increased lifting force during Laryngoscopy and 28.3% needed the application of external laryngeal pressure during Laryngoscopy. On the basis of Intubation Difficulty Scoring, intubation was easy only in one third (33.7%) of the patients where in the remaining two third (66.3%) had moderately difficult intubation.



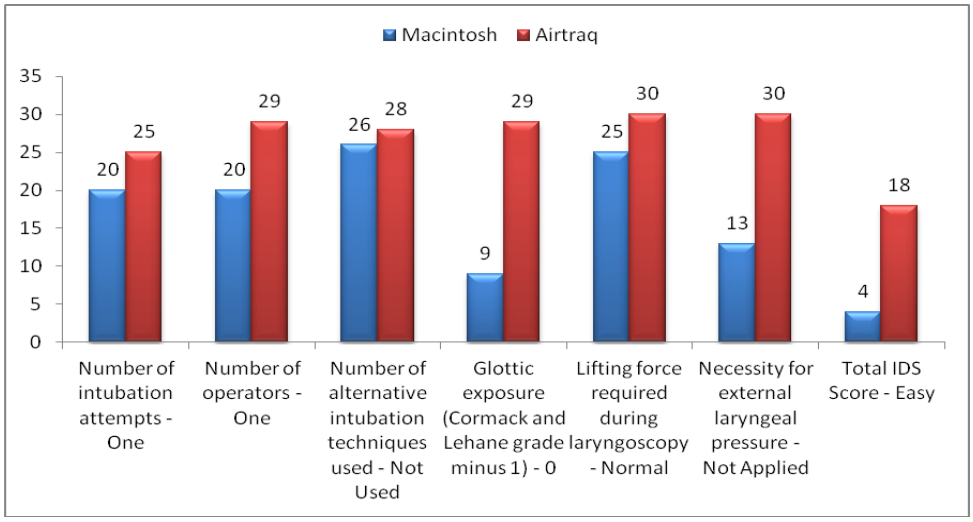
Intubation Difficulty Scores of the Study Groups

IDS Score		Group		p-value
		Macintosh Group	Airtraq Group	
Number of intubation attempts	One	20 (44.4) {66.7}	25 (55.6) {83.3}	0.233
	> one	10 (66.7) {33.3}	5 (33.3) {16.7}	
Number of operators	One	20 (35.6) {66.7}	29 (64.4) {96.7}	0.06
	> one	10 (93.3) {33.3}	1 (6.7) {3.3}	
Number of alternative intubation techniques used	Not Used	26 (48.1) {86.7}	28 (51.9) {93.3}	0.671*
	Used	4 (66.7) {13.3}	2 (33.3) {6.7}	
Glottic exposure (Cormack and Lehane grade minus 1)	0	9 (23.7) {30}	29 (76.3) {96.7}	0.00
	1	21 (95.5) {70}	1 (4.5) {3.3}	
Lifting force required during laryngoscopy	Normal	25 (45.5) {83.3}	30 (54.5) {100}	0.052*
	Increased	5 (100) {16.7}	0 (0) {0}	
Necessity for external laryngeal pressure	Not applied	13 (30.2) {43.3}	30 (69.8) {100}	0.00
	Applied	17 (100) {56.7}	0 (0) {0}	
Total IDS Score	Easy	4 (18.2) {13.3}	18 (81.8) {60}	0.00
	moderately difficult	26 (68.4) {86.7}	12 (31.6) {40}	

* - Fisher's Exact test of significance used

From this table elaborating the Intubation Difficulty Scores, it is evident that the proportion of patients in whom intubation was accomplished successfully with one attempt was greater in the Airtraq group (83.3%) compared with Macintosh group (66.7%). Similarly one operator was required for intubation in 96.7% of the Airtraq group patients against 66.7% of Macintosh group patients. Patients requiring alternative intubation techniques was less (6.7%) in the Airtraq group compared with (13.3%) of patients in the Macintosh group. Most (96.7%) of the Airtraq group of patients had '0' degree of glottis exposure whilst only 30% of the Macintosh group showing that visualization of the glottis is better in the Airtraq group patients. The association of glottis exposure with the study groups was significant (p-value = 0.00). None of the patients required increased force during laryngoscopy procedure in the Airtraq group where as 16.7% of the patients among Macintosh group required more pressure during laryngoscopy. The need for applying external pressure over larynx was felt in 56.7% of the Macintosh group patients while none of the patients in the Airtraq group required external pressure. On the basis of IDS scores, moderate difficulty was seen in 86.7% of the patients in the Macintosh group against 40% in the Airtraq group. Significant association was seen among the necessity of external laryngeal pressure and IDS score and the study groups.

Intubation Difficulty Scores



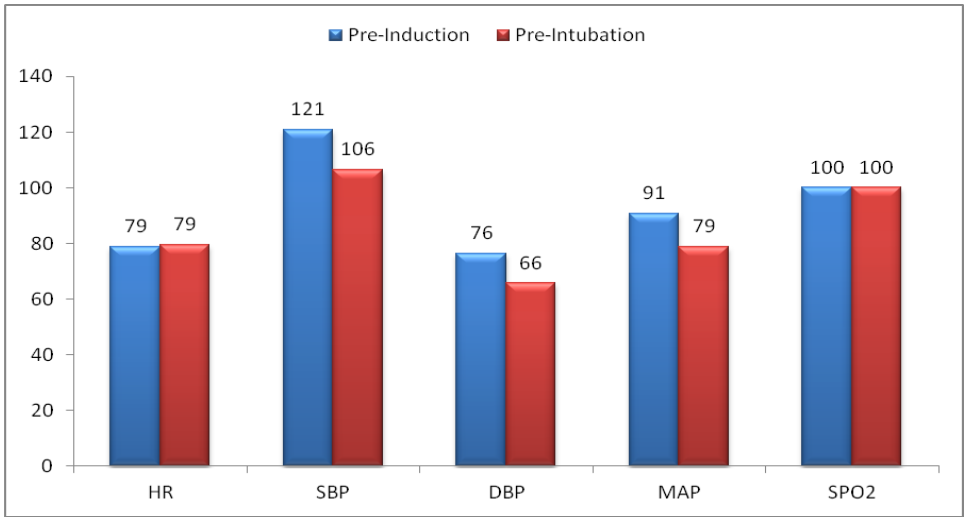
Baseline Hemodynamic measurements

Variable	Pulse Rate	Blood Pressure		Mean Arterial Pressure
		Systolic	Diastolic	
Mean	78.90	120.77	76.48	91.30
Std. Deviation	9.803	10.513	7.331	7.687
Minimum	58	100	60	73
Maximum	98	140	88	105

Hemodynamic measurements before Intubation

Variable	Pre Induction					Pre Intubation				
	HR	**SBP**	**DBP**	**MAP**	**SPO_2**	**HR**	**SBP**	**DBP**	**MAP**	**SPO_2**
Mean	78.90	120.77	76.48	90.85	100.00	79.38	106.47	65.70	78.90	100.00
Std. Deviation	9.803	10.513	7.331	7.699	0.000	7.288	6.539	5.738	5.695	0.000
Minimum	58	100	60	73	100	63	96	52	66	100
Maximum	98	140	88	105	100	92	122	78	92	100

The above table shows the haemodynamic measurements before induction of anaesthesia and before intubation were attempted. The heart rate increased in the pre intubation time where as the Systolic, Diastolic and Mean Arterial Pressure decreased in the same period when compared with the Pre induction period. There is no difference in the oxygen saturation between the two periods.



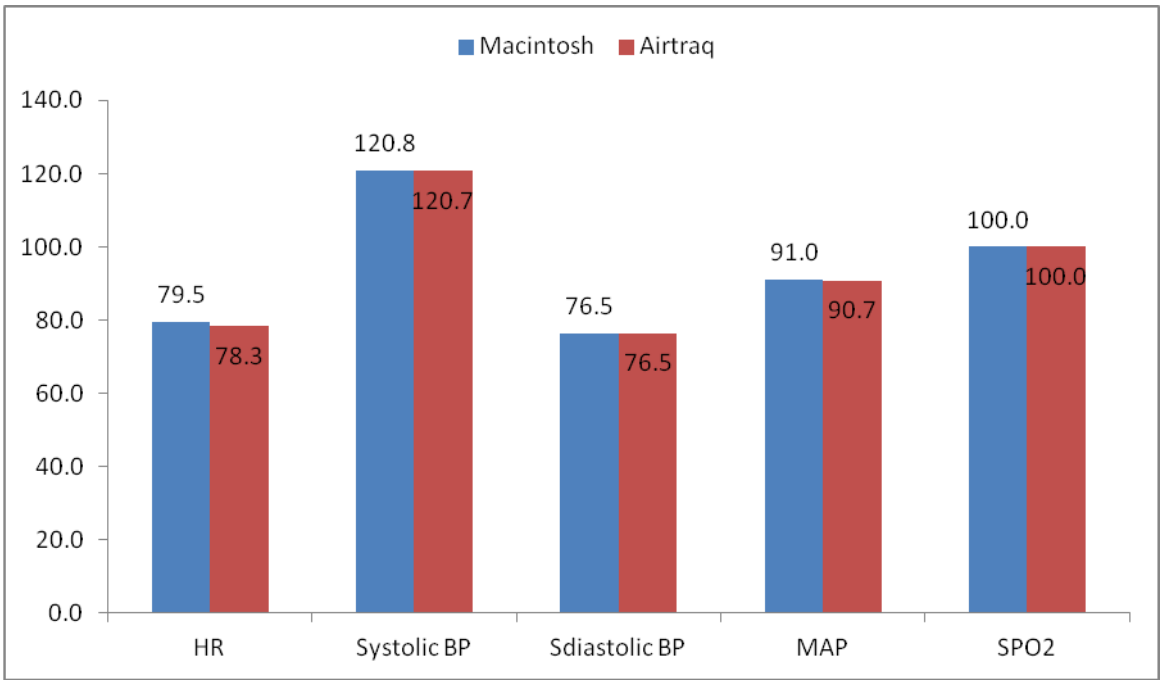
Hemodynamic Variables before Induction of Anesthesia among study groups

Variable	Group	Mean	Std. Deviation	p-value	95% Confidence Interval	
					Lower	Upper
HR	Macintosh Group	79.47	9.468	0.658	-3.968	6.235
	Airtraq Group	78.33	10.256			
SBP	Macintosh Group	120.80	10.486	0.981	-5.413	5.547
	Airtraq Group	120.73	10.719			
DBP	Macintosh Group	76.50	7.606	0.986	-3.788	3.855
	Airtraq Group	76.47	7.176			
MAP	Macintosh Group	90.97	7.832	0.908	-3.780	4.246
	Airtraq Group	90.73	7.697			

SPO2	**Macintosh Group**	100.00	.000[a]			
	Airtraq Group	100.00	.000[a]			

From the above table comparing the haemodynamic variables before induction of anaesthesia, it is evident that the two study groups didn't differ much in their haemodynamic measurements and none of the parameters were statistically significantly associated with the study groups.

Hemodynamic Variables before Induction of Anesthesia among study groups.



Hemodynamic Variables of the Study Groups before Intubation

Variable	Group	Mean	Std. Deviation	p-value	95% Confidence Interval	
					Lower	Upper
HR	Macintosh Group	80.20	5.886	0.390	-2.142	5.408
	Airtraq Group	78.57	8.488			
SBP	Macintosh Group	104.87	6.208	0.057	-6.503	.103
	Airtraq Group	108.07	6.570			
DBP	Macintosh Group	64.27	5.058	0.052	-5.761	.028
	Airtraq Group	67.13	6.095			
MAP	Macintosh Group	77.33	5.095	0.032	-5.985	-.281
	Airtraq Group	80.47	5.912			

SPO2	**Macintosh Group**	100.00	.000[a]			
	Airtraq Group	100.00	.000[a]			

Anova-t test not applicable as Std Dev of both Groups are 0

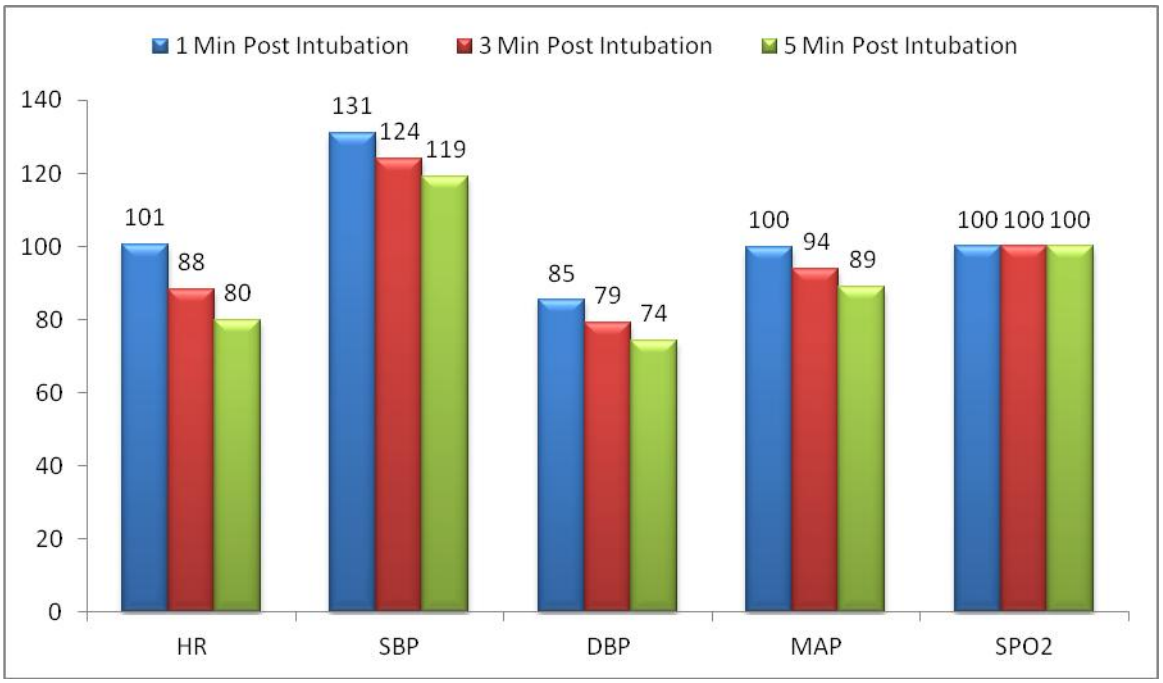
The patients in the Macintosh group showed lower mean pulse rate but higher Systolic, Diastolic and Mean Arterial Pressure than the Airtraq group. There was no difference in means of the oxygen saturation between the two groups. The Mean arterial pressure difference between the two groups was statistically significant.

Haemodynamic measurements after Intubation.

Variable	1 Min Post Intubation					3 Min Post Intubation					5 Min Post Intubation				
	HR	SBP	DBP	MAP	SPO_2	HR	SBP	DBP	MAP	SPO_2	HR	SBP	DBP	MAP	SPO_2
Mean	100.5	130.9	85.3	99.9	100.0	88.4	123.9	79.2	93.8	100.0	79.9	119.0	74.3	88.9	100.0
Std. Dev	9.9	9.1	6.5	6.9	0.0	7.5	7.2	6.2	6.1	0.0	8.6	7.6	8.0	7.2	0.0
Min	74.0	110.0	70.0	86.0	100.0	70.0	108.0	68.0	81.0	100.0	60.0	102.0	58.0	74.0	100.0
Max	118.0	148.0	98.0	114.0	100.0	102.0	140.0	92.0	108.0	100.0	94.0	136.0	88.0	104.0	100.0

The above table shows the change in haemodynamic measurements in the post intubation period measured at 1st, 3rd and 5th minute. It can be seen that as the time increased all the haemodynamic variables decreased from their initial values. However there is no change in the oxygen saturation of the patients.

Haemo dynamic measurements after Intubation.



Hemodynamic Variables among the Study Groups after Intubation.

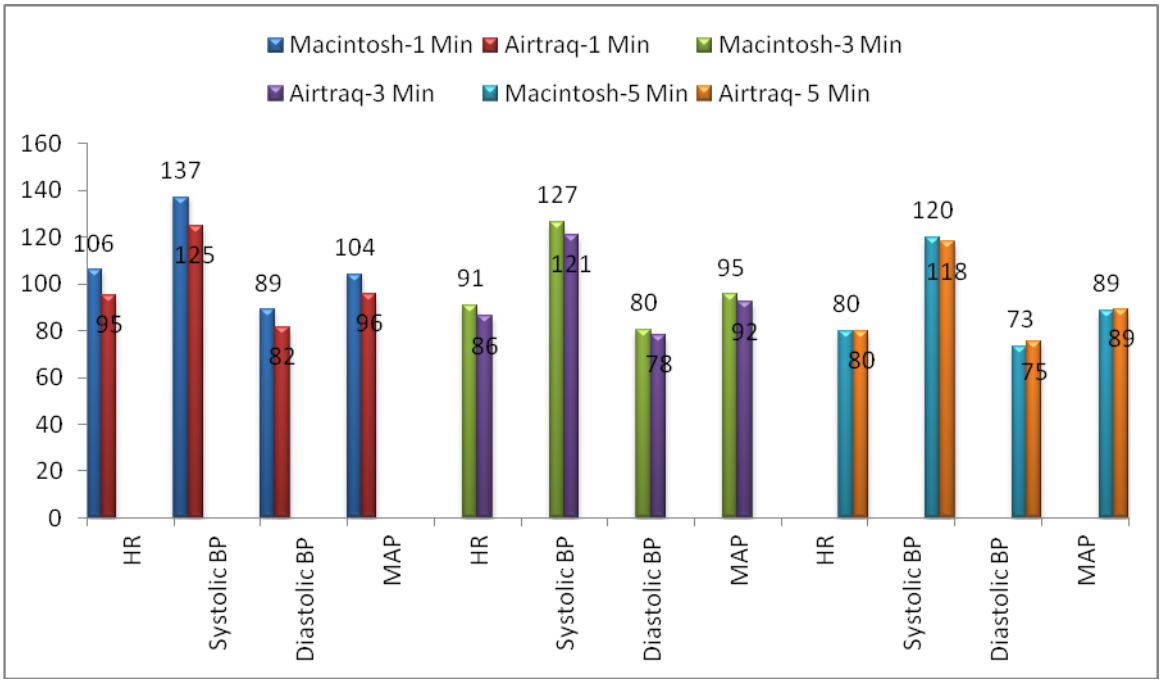
Variable	Group	Mean	Std. Deviation	p-value	95% Confidence Interval	
					Lower	Upper
1 Minute						
HR	**Macintosh Group**	105.87	6.766	0.000	6.334	15.000
	Airtraq Group	95.20	9.736			
SBP	**Macintosh Group**	137.03	7.384	0.000	8.740	15.727
	Airtraq Group	124.80	6.071			
DBP	**Macintosh Group**	88.90	6.272	0.000	4.538	10.062
	Airtraq Group	81.60	4.215			
MAP	**Macintosh Group**	104.00	6.406	0.000	5.467	11.133
	Airtraq Group	95.70	4.364			
SPO2	**Macintosh Group**	100.00	.000[a]			
	Airtraq Group	100.00	.000[a]			

3 Minutes						
HR	**Macintosh Group**	90.60	5.661	0.023	.617	8.050
	Airtraq Group	86.27	8.448			
SBP	**Macintosh Group**	126.67	7.265	0.002	2.094	8.972
	Airtraq Group	121.13	5.981			
DBP	**Macintosh Group**	80.33	6.910	0.170	-.966	5.366
	Airtraq Group	78.13	5.224			
MAP	**Macintosh Group**	95.47	6.653	0.034	.253	6.347
	Airtraq Group	92.17	5.025			
SPO 2	**Macintosh Group**	100.00	.000[a]			
	Airtraq Group	100.00	.000[a]			
5 Minutes						
HR	**Macintosh Group**	79.87	7.964	0.976	-4.541	4.408

	Airtraq Group	79.93	9.299			
SBP	**Macintosh Group**	120.07	8.921	0.289	-1.827	6.027
	Airtraq Group	117.97	5.991			
DBP	**Macintosh Group**	73.40	9.069	0.406	-5.881	2.414
	Airtraq Group	75.13	6.822			
MAP	**Macintosh Group**	88.60	8.177	0.776	-4.273	3.206
	Airtraq Group	89.13	6.152			
SPO 2	**Macintosh Group**	100.00	.000[a]			
	Airtraq Group	100.00	.000[a]			

Anova-t test not applicable as Std Dev of both Groups are 0

Hemodynamic Variables among study group after Intubation.



The above figure illustrates the difference in the mean haemodynamic parameters of the study groups 1 minute, 3 minute and 5 minute post intubation period. It can be seen that the average haemodynamic variables at 1st minute, 3rd minute and 5th minute post intubation was always a little higher in the Macintosh group than the Airtraq group except the Diastolic BP in the 5th minute post intubation where in the Airtraq group has a little higher value than the Macintosh group. Statistical Significant association was seen between the Pulse rate, Systolic BP. Diastolic BP and Mean Arterial Pressure in the 1st minute and the 3rd minute with the exception of Diastolic BP in the 3rd minute.

Mean duration of intubation

Variable	Duration of Intubation	Pulse Rate	Blood Pressure		Mean Arterial Pressure
			Systolic	Diastolic	
Mean	16.83	78.90	120.77	76.48	91.30
Std. Deviation	8.326	9.803	10.513	7.331	7.687
Minimum	10	58	100	60	73
Maximum	50	98	140	88	105

The mean duration of intubation was 16.83 ± 8.326 seconds with 10 seconds and 50 seconds being the shortest and longest time taken for intubating the patients. The baseline mean pulse rate was 78.9 ± 9.803 with a minimum and maximum rate being 58 and 98 respectively. The baseline mean Systolic blood pressure was 120.77 ± 10.513 with a minimum and maximum pressure being 100 and 140 mm Hg respectively. 76.48 ± 7.331 was the mean Diastolic blood pressure with 60 mm Hg being the minimum and 88 mm Hg the maximum. The average Mean Arterial Pressure was 91.30 ± 7.687 with minimum and maximum 73 and 105 mm Hg respectively.

Difference In Duration Of Intubation Between The Macintosh And The Airtraq Groups.

Group	N	Mean	Std. Deviation	p-value	95% Confidence Interval	
					Lower	Upper
Macintosh Group	30	18.17	9.010	0.218	-1.617	6.950
Airtraq Group	30	15.50	7.496			

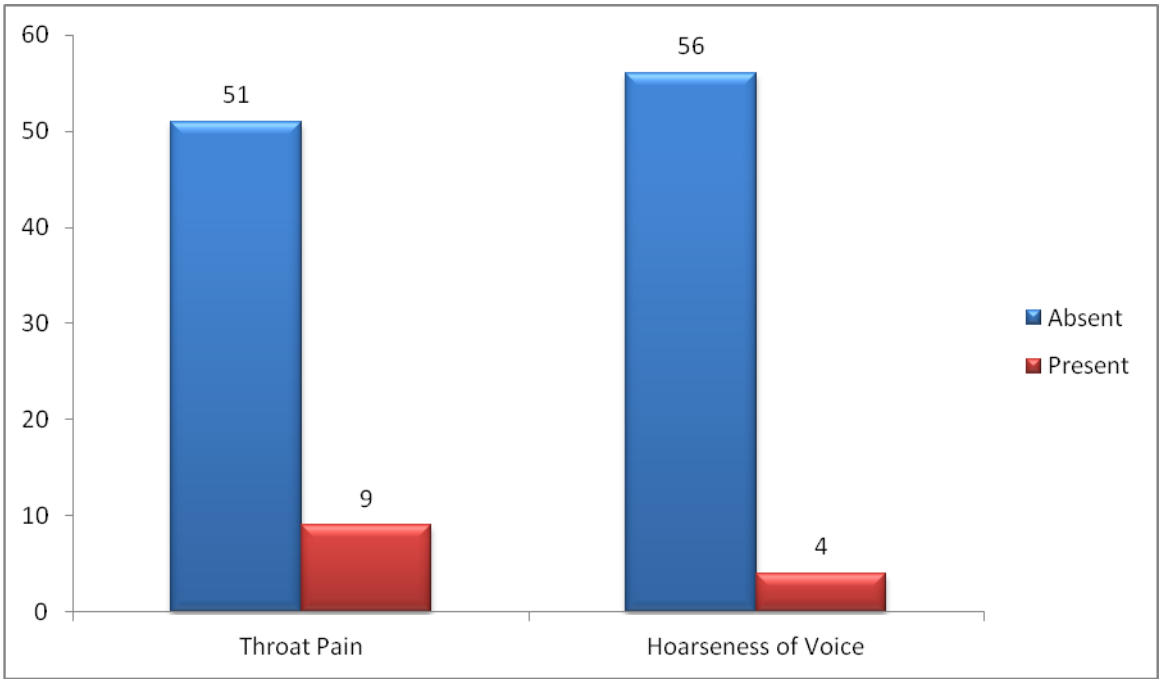
From the above table it is evident that the mean duration taken for intubation in the Airtraq group is lesser (15.50 ± 7.496) than the Macintosh group (18.17 ± 9.01) even though their association is not statistically significant.

Complications Associated with intubation techniques

Complications		Number	Percent
Throat pain	**No Pain**	51	85.0
	Mild Pain/ Discomfort	9	15.0
	Total	60	100.0
Hoarseness of voice	**Absent**	56	93.3
	Present	4	6.7
	Total	60	100.0

From the above table showing the common complication encountered in the post operative period associated with the intubation technique, it can be seen that throat pain was reported in 9 patients (15%) and hoarseness of voice reported among 4 patients (6.7%). Overall 9 patients (15%) complained of one or more complications associated with the intubation technique.

Complications Associated with intubation techniques



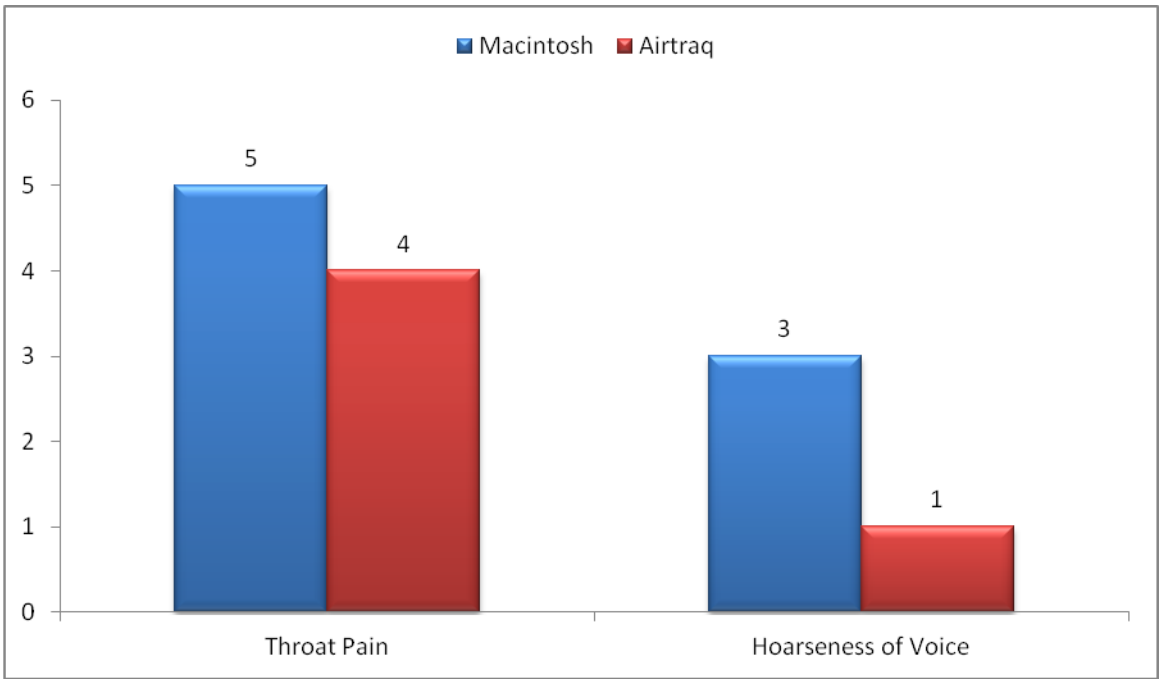
Complications of Intubation Techniques among study groups

Complications		**Macintosh Group**	**Airtraq Group**	**p-value**
Throat Pain	**No Pain**	25 (49) {83.3}	26 (51) {86.7}	1.000*
	Mild Pain/ Discomfort	5 (55.6) {16.7}	4 (44.4) {13.3}	
Hoarseness of Voice	**Absent**	27 (48.2) {90}	29 (51.8) {96.7}	0.612*
	Present	3 (75) {10}	1 (25) {3.3}	

* - Fisher's Exact test of significance used

From the above table it is evident that the proportion of patients with throat pain was greater in the Macintosh group (16.7%) when compared to the Airtraq group (13.3%). Less number (3.3%) of patients complained of hoarseness of voice in the Airtraq group than the Macintosh group (10%). Overall complications associated with the intubation technique were higher in the Macintosh group (16.7%) than the Airtraq group (13.3%).

Complications associated with Intubation Techniques seen among the Study Groups



Mean Ranks Of Intubation Difficulty Scores Between The Macintosh And The Airtraq Groups.

Group	**N**	**Mean Rank**	**Sum of Ranks**	**Mann-Whitney U**	**p-value**
Macintosh Group	30	37.50	1125.00	240	0.00
Airtraq Group	30	23.50	705.00		

On comparing the Intubation Difficulty Score between the two groups , it can be seen that Airtraq group has a mean rank of 23.50 as against Macintosh group which has 37.50. This difference in mean ranks was also statistically significant with a Mann Whitney U test value of 240 and p-value 0.00 inferring that patients in the Airtraq group experienced less Intubation Difficulty than the patients in Macintosh group.

Discussion

The study titled, “Comparison of Intubation Difficulty Scores between Macintosh Laryngoscopy and Airtraq Optical Laryngoscopy” conducted in the tertiary medical college Hospital, was done to evaluate the efficacy of Airtraq laryngoscope over conventional Macintosh laryngoscopes in patients with endotracheal intubation for elective surgery.

The study was done in 60 patients with each group consisting of 30 patients. **Maharaj C.H et al**, **Durga P et al**, too included 60 patients in their study group. Study involving more number of patients was done by **Dhonneur et al** and **Hirbayashi et al**, who included 200 and 212 patients with 100 and 106 in each group respectively

Baseline Characteristics:

The study was conducted among 60 patients including 22 females (36.7%) and 38 males (63.3%). Nearly three fourths (73.3%) of the patients belonged to age group 30 years and 50 years.

Age, Height, Weight and BMI

The mean age, height, weight and BMI of the study population were 40.03 ± 8.497, 165.28 ± 7.709, 69 ± 9.998 and 25.163 ± 2.5019 respectively. We observed that the mean age of Macintosh group (38.37 ±

8.3) was less than the Airtraq group (41.7 ± 8.49). But **Maharaj C.H et al**, had observed that the Mean Age of Airtraq laryngoscope group (41.1 ± 16.9) was less than the Macintosh laryngoscope (43.8 ± 16.8). There is no much difference of Age, Height, Weight and BMI between the study groups and their association with the study groups was not statistically significant.

Neck Anatomic Measurements

The mean neck circumference was 34.35 ± 1.981 with minimum and maximum being 30 and 39 respectively. The mean thyromental and hyomental distance are 6.820 ± 0.1938 and 6.420 ± 0.1938 respectively. The average anatomic parameters like neck circumference, thyromental distance and hyomental distance of the Macintosh group is greater than the Airtraq group but this variation was not statistically significant. **Durga P et al**., study also showed the mean age, weight, thyromental, hyomental and neck circumference as 44.78 ± 10.21, 62.53 ± 11.45, 5.35 ± 0.84, 3.77 ± 0.87 and 36.81 ± 4.41 respectively. There is no much difference of Anthropometric measurements between the study groups and their association with the study groups was not statistically significant.

Gender distribution

The proportion of males was higher in both the study groups. Among the females most (63.6%) of them belonged to the Macintosh group where in among the males, the majority (57.9%) of them belonged to the Airtraq group. There was no significant association between the gender and the study groups. Similar distribution was also observed by **Osama El Sharkawy et al**.

ASA Classification

According to American Society of Anesthesiologists Classification most (46) of the patients belonged to ASA Class I. Amongst the American Society of Anesthesiologists (ASA Classification) Class 1 patients, more number (24) of patients belonged to the Macintosh group where in Airtraq group proportion of ASA Class 2 patients were higher (57.1). There was no significant association between the study groups and the ASA Class patients. In studies performed by **Osama El Sharkawy et al**, and **Geeta Bhandari et al**, similar findings were observed.

Intubation Difficulty Scores

According to the Intubation Difficult Score, only one fourth (25%) of the patients required more than one attempt at intubation, less than one fifth (18.7%) required more than one anesthetist for intubation. Alternative intubation techniques was used in 10 % of the patients, 8.3% required increased lifting force during Laryngoscopy and 28.3% needed the application of external laryngeal pressure during Laryngoscopy. On the basis of Intubation Difficulty Scoring, intubation was easy only in one third (33.7%) of the patients where in the remaining two third (66.3%) had moderately difficult intubation.

The Intubation Difficulty Scores, elaborated that the proportion of patients in whom intubation was accomplished successfully with one attempt was greater in the Airtraq group (83.3%) compared with Macintosh group (66.7%). Similarly one operator was required for intubation in 96.7% of the Airtraq group patients against 66.7% of Macintosh group patients. Patients requiring alternative intubation techniques was less (6.7%) in the Airtraq group compared with (13.3%) of patients in the Macintosh group. Most (96.7%) of the Airtraq group of patients had ‘0’ degree of glottis exposure whilst only 30% of the Macintosh group showing that visualization of the glottis is better in the Airtraq group patients. The association of glottis exposure with the study

groups was significant . None of the patients required increased force during laryngoscopy procedure in the Airtraq group where as 16.7% of the patients among Macintosh group required more pressure during laryngoscopy. The need for applying external pressure over larynx was felt in 56.7% of the Macintosh group patients while none of the patients in the Airtraq group required external pressure. On the basis of IDS scores, moderate difficulty was seen in 86.7% of the patients in the Macintosh group against 40% in the Airtraq group. Statistically significant association was seen among the necessity of external laryngeal pressure and IDS score and the study groups. Similar results were inferred by Maharaj et al, with low Intubation difficulty score in Airtraq Group (0.2 ± 0.5) as against the Macintosh group (1.4 ± 2.2).**Durga et al,** had observed that the Intubation Difficulty scores of Airtraq group (median 2) was lesser than the Mc Coy laryngoscope group (median 4). The mean intubation time was lesser in the Airtraq group (28.95 ± 18.53 s). Lesser proportion of patients in the Airtraq group (3.3%) had difficulty during laryngoscope insertion. Similar results were obtained by **Osama El Sharkawy et al, Marwa A. Tolon et al, Di Marco et al, Koh et al**, **Park et al** and **Dhonneur et al.**

Duration of intubation

The mean duration of intubation was 16.83 ± 8.326 seconds with 10 seconds and 50 seconds being the shortest and longest time taken for intubating the patients respectively.

The mean duration taken for intubation in the Airtraq group is lesser (15.50 ± 7.496) than the Macintosh group (18.17 ± 9.01) even though their association was not statistically significant.). **Geeta Bhandari et al,** had stated that the time to Intubation was less in the Airtraq group (18 ± 2.6) than the Macintosh group (29 ± 5.06).

Base line hemodynamic parameters

The baseline mean pulse rate was 78.9 ± 9.803 with a minimum and maximum rate being 58 and 98 respectively. The baseline mean Systolic blood pressure was 120.77 ± 10.513 with a minimum and maximum pressure being 100 and 140 mm Hg respectively. 76.48 ± 7.331 was the mean Diastolic blood pressure with 60 mm Hg being the minimum and 88 mm Hg the maximum. The average Mean Arterial Pressure was 91.30 ± 7.687 with minimum and maximum 73 and 105 mm Hg respectively. The mean baseline haemodynamic parameters like Pulse Rate, Systolic BP, Diastolic BP and Mean Arterial Pressure was a little higher in the Macintosh group [(79.47 ± 9.468), (120.8 ± 10.48), (76.5 ± 7.6) and (91.3 ± 7.858)] than the Airtraq group [(78.3 ± 10.2),(120.7 ± 10.7),(76.4 ± 7.1) and (91.2 ± 7.6)]. Statistical significant association was

not observed among the study groups and the baseline hemodynamic measurements

Hemodynamic parameters after induction

The haemodynamic measurements after induction of anaesthesia and before intubation were attempted were measured and it showed that the heart rate increased in the pre intubation time where as the Systolic, Diastolic and Mean Arterial Pressure decreased in the same period when compared with the Pre induction period. There is no difference in the oxygen saturation between the two periods. The patients in the Macintosh group showed lower mean pulse rate but higher Systolic, Diastolic and Mean Arterial Pressure than the Airtraq group. There was no difference in means of the oxygen saturation between the two groups. The Mean arterial pressure difference between the two groups was statistically significant.

Hemodynamic parameters post intubation period

From the measured change in haemodynamic measurements in the post intubation period measured at 1^{st}, 3^{rd} and 5^{th} minute, it can be seen that as the time increased all the haemodynamic variables decreased from their Initial values. However there is no change in the oxygen

saturation of the patients. The difference in the mean hemodynamic parameters of the study groups in the 1st minute, 3rd minute and 5th minute post intubation period was always a little higher in the Macintosh group than the Airtraq group except the Diastolic BP in the 5th minute post intubation where in the Airtraq group has a little higher value than the Macintosh group. Statistical Significant association was seen between the Pulse rate, Systolic BP. Diastolic BP and Mean Arterial Pressure in the 1st minute and the 3rd minute with the exception of Diastolic BP in the 3rd minute. This signifies the employability of Airtraq laryngoscopes in haemo dynamically compromised patients and also in the elderly.

Post op complications

Complications seen in the post operative period shows that throat pain was reported in 9 patients (15%) and hoarseness of voice reported among 4 patients (6.7%). Overall 9 patients (15%) complained of one or more complications associated with the intubation technique.

The proportion of patients with throat pain was greater in the Macintosh group (16.7%) when compared to the Airtraq group (13.3%). Less number (3.3%) of patients complained of hoarseness of voice in the Airtraq group than the Macintosh group (10%). Overall complications associated with the intubation technique were higher in the Macintosh group (16.7%) than the Airtraq group (13.3%).

Park et al, Maharaj et al, Christen et al reported more complication in Macintosh group (30%, 45%, 10%) than the Airtraq group (11%, 0%,0%) respectively. No difference in complications were observed in the two groups among the study done by **Koh et al, Di Marco et al, Wang et al, Dhonneur et al, Gaszynski et al and Hirbayashi et al.** Increased complications among the Airtraq group were observed by both **Chalkeidis et al and Ndoko et al**. **C.H. Maharaj et al** in their study titled, "A comparison of tracheal intubation using the Airtraq or the Macintosh laryngoscope in routine airway management: a Randomised, controlled clinical trial" described the ease of instrument use as denoted by the patient's subjective feeling of pain measured by Visual Analog Score was less in the Airtraq group (1.2 ± 1.4) than the Macintosh group (2.0 ± 1.5).

Geeta Bhandari et al, in their study titled, "Airtraq versus Macintosh laryngoscope: A comparative study in tracheal intubation" observed greater ease of intubation to be present in the Airtraq group than the Macintosh group (97.5% > 42.5%). There isn't much difference between the post operative complications like throat pain and hoarseness of voice between the Airtraq and Macintosh group.

Marwa A. Tolon et al in their study showed that complications like Lip Bruising (5%), Teeth clicking (5%) and Tongue bruising (5%) were observed in only Macintosh group. . **Chalkeidis et al** also stating that

fewer complications were observed in Macintosh group than the Airtraq group. **Gaszynski et al**, too obtained a result similar to Dhonneur et al. **Y. Lu et al** in their systematic review and meta analysis study had discussed Airtraq laryngoscopes had less complications than the Macintosh groups.

Mean Ranks Of Intubation Difficulty Scores

On comparing the Intubation Difficulty Score between the two groups, it can be seen that Airtraq group has a mean rank of 23.50 as against Macintosh group which has 37.50. This difference in mean ranks was also statistically significant with a Mann Whitney U test value of 240 and p-value 0.00 inferring that patients in the Airtraq group experienced less Intubation Difficulty than the patients in Macintosh group .

Conclusion

From the study titled, "Comparison of Intubation Difficulty Scores between Macintosh Laryngoscopy and Airtraq Optical Laryngoscopy" to evaluate the efficacy of Airtraq laryngoscope over conventional Macintosh laryngoscopes in endo-tracheal intubation in elective surgical patients, we conclude the following;

- The Intubation Difficulty Scores elaborated that the proportion of patients whom successful intubation with one attempt was greater in the Airtraq group compared to Macintosh group.
- On the basis of the Intubation Difficulty Scores, and The Modified Cormack–Lehane grades, more difficulty was seen in Macintosh group than the Airtraq group . So Airtraq laryngoscopy is a superior laryngoscopy technique than Macintosh laryngoscopy .
- The mean duration taken for intubation in the Airtraq group is lesser than the Macintosh group.
- Similarly one operator was sufficient for almost all patients intubation using Airtraq laryngoscope group.
- Requiring of alternative intubation techniques were less in the Airtraq group compared with the Macintosh group indicating that Airtraq laryngoscope was easy to use.

- Visualization of the glottis was better and statistically significant in the Airtraq group than the Macintosh group without manipulating airway.

- None of the patients required increased force during laryngoscopy procedure in the Airtraq group where as 16.7% of the patients among Macintosh group required more pressure during laryngoscopy.

- The need for applying external pressure over larynx was felt in 56.7% of the Macintosh group patients while none of the patients in the Airtraq group required external pressure.

- The hemodynamic parameters like Pulse Rate, Systolic BP, Diastolic BP and Mean Arterial Pressure was higher in the Macintosh group than the Airtraq group.

- There wasn't much difference between the hemodynamic variables of the study groups before induction of anesthesia

- The proportion of patients with throat pain during post op period was greater in the Macintosh group than the Airtraq group. Less number of patients complained of hoarseness of voice in the Airtraq group than the Macintosh group. Overall complications

associated with the intubation technique were higher in the Macintosh group than the Airtraq group.

- Tachycardia during post op period was higher (20% among the patients)in Macintosh group then (10% among the patient) Airtraq group.

- Even though the mean Age of Airtraq group patients was higher than the Macintosh group and the mean height, weight and BMI was higher in the Macintosh group there was no statistical significant difference between the Age and Anthropometric measurements between the study groups. Thus we infer that that age and anthropometric measurements don't influence the use of either of the two laryngoscopes.

- As there was no significant association between the mean anatomic parameters like neck circumference, thyromental distance and hyomental distance of the Macintosh group and the Airtraq group, it can be concluded that both laryngoscopes can be used in any patients.

SUMMARY

We conclude from our study that Airtraq laryngoscopy can be used as an effective alternate to Macintosh laryngoscopy in patient undergoing elective surgery. Its use in emergency surgery needs further study.

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ABBREVIATION

- MBP-Mean arterial blood pressure in millimetre of mercury
- SBP- Systolic blood pressure in millimetre of mercury
- DBP- Diastolic blood pressure in millimetre of mercury
- HR-Heart rate per minute
- SpO2- Oxygen saturation in percent
- Std.dev- Standard deviation
- ASA- American Society of Anaesthesia
- BMI- Body Mass Index
- IDS – Intubation Difficulty Score

MASTER CHART

S.No	Name	Age	Sex	Group	Height(cm)	Weight(kg)	BMI	ASA	PR	SYS BP	Dias BP	Inter incisc	Mallampati	Jaw protru	neck flexio	Neck AA e	Neck Circu	teeth	thyromenta	Hyomental I	Palate	Pre Inducti	Pre Inducti	Pre Inducti	Pre Inducti	Pre Inducti
1	meenatchi	33	female	Mac	150	50	22.2	2	74	112	68	2	1	1	1	1	2	1	1	1	1	74	112	68	82	100%
2	arun	32	male	Mac	172	69	23.3	1	88	128	84	2	1	1	1	1	2	1	1	1	1	88	128	84	98	100%
3	rukmani	46	female	Mac	184	90	26.5	1	64	110	72	2	1	1	1	1	2	1	1	1	1	64	110	72	84	100%
4	devarajan	53	male	Mac	150	78	34.6	2	84	138	78	2	1	1	1	1	2	1	1	1	1	84	138	78	98	100%
5	senthil	38	male	Mac	155	50	20.8	1	70	118	68	2	1	1	1	1	2	1	1	1	1	70	118	68	84	100%
6	shanmuga	44	male	Mac	166	62	22.5	1	68	134	76	2	1	1	1	1	2	1	1	1	1	68	134	76	95	100%
7	laxmi	46	female	Mac	172	76	25.6	1	80	128	84	2	1	1	1	1	2	1	1	1	1	80	128	84	98	100%
8	saroja	42	female	Mac	170	75	25.9	1	90	126	72	2	1	1	1	1	2	1	1	1	1	90	126	72	90	100%
9	alamelu	35	female	Mac	168	72	25.5	1	67	112	68	2	1	1	1	1	2	1	1	1	1	67	112	68	82	100%
10	seetha	50	female	Mac	174	84	27.74	1	58	100	60	2	1	1	1	1	2	1	1	1	1	58	100	60	73	100%
11	rajendran	41	male	Mac	172	74	25.01	2	68	108	66	2	1	1	1	1	2	1	1	1	1	68	108	66	80	100%
12	sugumar	28	male	Mac	166	70	25.4	1	78	118	86	2	1	1	1	1	2	1	1	1	1	78	118	86	96	100%
13	saravanan	32	male	Mac	160	64	25	2	89	128	78	2	1	1	1	1	2	1	1	1	1	89	128	78	94	100%
14	rajapondy	36	male	Mac	165	68	24.98	1	84	138	84	2	1	1	1	1	2	1	1	1	1	84	138	84	102	100%
15	sundaram	34	male	Mac	164	68	25.28	1	85	124	82	2	1	1	1	1	2	1	1	1	1	85	124	82	96	100%
16	rajavelu	38	male	Mac	172	78	26.37	1	72	112	76	2	1	1	1	1	2	1	1	1	1	72	112	76	88	100%
17	manjula	54	female	Mac	170	72	24.91	1	76	108	66	2	1	1	1	1	2	1	1	1	1	76	108	66	80	100%
18	kaannan	33	male	Mac	168	75	26.57	2	98	136	76	2	1	1	1	1	2	1	1	1	1	98	136	76	98	100%
19	kartikeyan	36	male	Mac	166	72	26.13	1	92	118	78	2	1	1	1	1	2	1	1	1	1	92	118	78	91	100%
20	kamalakan	42	male	Mac	170	74	25.61	1	84	124	86	2	1	1	1	1	2	1	1	1	1	84	124	86	98	100%
21	madavan	46	male	Mac	178	80	25.25	1	86	108	62	2	1	1	1	1	2	1	1	1	1	86	108	62	77	100%
22	thangaraj	48	male	Mac	171	78	26.67	1	83	134	82	2	1	1	1	1	2	1	1	1	1	83	134	82	99	100%
23	balaji	22	male	Mac	168	76	25.51	1	85	112	78	2	1	1	1	1	2	1	1	1	1	85	112	78	89	100%
24	sathya	32	female	Mac	162	72	27.43	1	81	118	74	2	1	1	1	1	2	1	1	1	1	81	118	74	88	100%
25	tamilarasa	34	female	mac	158	56	22.43	1	87	114	86	2	1	1	1	1	2	1	1	1	1	87	114	86	95	100%
26	rajammal	45	female	mac	162	60	22.86	1	75	122	84	2	1	1	1	1	2	1	1	1	1	75	122	84	96	100%
27	bhairavi	47	female	mac	167	69	24.74	2	76	138	88	2	1	1	1	1	2	1	1	1	1	76	138	88	104	100%
28	keerthana	31	female	mac	159	62	24.52	1	70	124	77	2	1	1	1	1	2	1	1	1	1	70	124	77	92	100%
29	devi	25	female	Mac	157	68	27.59	1	80	122	80	2	1	1	1	1	2	1	1	1	1	80	122	80	94	100%
30	nalini	28	female	mac	162	67	25.53	1	92	112	76	2	1	1	1	1	2	1	1	1	1	92	112	76	88	100%
1	kanchna	38	female	Airtraq	162	70	26.67	1	94	124	78	2	1	1	1	1	2	1	1	1	1	94	124	78	93	100%
2	anand	37	male	Airtraq	161	65	25.08	2	83	140	88	2	1	1	1	1	2	1	1	1	1	83	140	88	105	100%
3	moorthy	29	male	Airtraq	165	59	21.67	2	81	132	76	2	1	1	1	1	2	1	1	1	1	81	132	76	92	100%
4	muthusam	30	male	Airtraq	176	87	28.09	2	73	134	74	2	1	1	1	1	2	1	1	1	1	73	134	74	94	100%
5	periammal	44	male	Airtraq	165	78	28.65	2	79	138	78	2	1	1	1	1	2	1	1	1	1	79	138	78	98	100%
6	mani	56	male	Airtraq	168	67	23.74	1	81	138	86	2	1	1	1	1	2	1	1	1	1	81	138	86	103	100%
7	cinadurai	51	female	Airtraq	163	58	21.83	2	89	112	66	2	1	1	1	1	2	1	1	1	1	89	112	66	81	100%
8	selvaraj	52	male	Airtraq	157	68	27.59	2	92	134	70	2	1	1	1	1	2	1	1	1	1	92	134	70	91	100%
9	marutamut	42	male	Airtraq	152	67	29	2	94	130	82	2	1	1	1	1	2	1	1	1	1	94	130	82	98	100%
10	vinoth	34	male	Airtraq	158	62	24.84	1	87	100	66	2	1	1	1	1	2	1	1	1	1	87	100	66	77	100%
11	vijaya	44	female	Airtraq	150	50	22.22	2	86	112	68	2	1	1	1	1	2	1	1	1	1	86	112	68	82	100%
12	chakravart	38	male	Airtraq	172	69	23.32	1	67	124	80	2	1	1	1	1	2	1	1	1	1	67	124	80	94	100%
13	vivekanan	36	male	Airtraq	184	90	26.58	1	62	116	82	2	1	1	1	1	2	1	1	1	1	62	116	82	93	100%
14	mashudba	48	male	Airtraq	165	78	28.65	1	79	128	84	2	1	1	1	1	2	1	1	1	1	79	128	84	98	100%
15	aarokyaraj	42	male	Airtraq	155	50	20.81	1	74	124	86	2	1	1	1	1	2	1	1	1	1	74	124	86	98	100%
16	kumaravel	52	male	Airtraq	166	62	22.5	1	69	120	78	2	1	1	1	1	2	1	1	1	1	69	120	78	92	100%
17	muthusam	49	male	Airtraq	172	76	25.69	1	79	104	66	2	1	1	1	1	2	1	1	1	1	79	104	66	78	100%
18	ramer	44	male	Airtraq	170	75	25.95	1	73	112	68	2	1	1	1	1	2	1	1	1	1	73	112	68	82	100%
19	palanisam	58	male	Airtraq	165	57	20.94	1	91	108	64	2	1	1	1	1	2	1	1	1	1	91	108	64	78	100%
20	kanagaraj	48	male	Airtraq	152	59	25.54	1	70	116	76	2	1	1	1	1	2	1	1	1	1	70	116	76	89	100%
21	kamala	28	female	Airtraq	157	52	21.1	1	90	114	78	2	1	1	1	1	2	1	1	1	1	90	114	78	90	100%
22	godhavari	30	female	Airtraq	168	68	24.09	1	58	112	74	2	1	1	1	1	2	1	1	1	1	58	112	74	86	100%
23	dhanraj	33	male	Airtraq	169	67	23.46	1	67	116	78	2	1	1	1	1	2	1	1	1	1	67	116	78	90	100%
24	thirupugal	50	male	Airtraq	173	85	28.4	1	69	128	82	2	1	1	1	1	2	1	1	1	1	69	128	82	97	100%
25	ramasamy	50	male	Airtraq	178	89	28.09	1	78	124	86	2	1	1	1	1	2	1	1	1	1	78	124	86	98	100%
26	bhagavati	40	female	Airtraq	165	68	24.98	1	90	106	66	2	1	1	1	1	2	1	1	1	1	90	106	66	79	100%
27	kavitha	45	female	Airtraq	168	70	24.8	1	61	110	72	2	1	1	1	1	2	1	1	1	1	61	110	72	84	100%
28	savitri	33	female	Airtraq	161	56	21.6	1	75	124	76	2	1	1	1	1	2	1	1	1	1	75	124	76	92	100%
29	ganeshan	38	male	Airtraq	163	68	25.59	1	86	118	80	2	1	1	1	1	2	1	1	1	1	86	118	80	92	100%
30	namasivay	32	male	Airtraq	159	61	24.13	1	73	124	86	2	1	1	1	1	2	1	1	1	1	73	124	86	98	100%
																	2									
												<3cm-1		CLass1-1	Normal-1	Normal-1		Normal-1	>6.5-1	>6-1	Normal-1					
												>3cm-2		CLass2-2	Reduced-2	Reduced-2	<40cm-2	Abnormal-	6-6.5-2	4 to 6-2	Highly arched-2					

Pre intubat	Pre intubat	Pre intubat	Pre intubat	Pre intuba	1 mins pos	1 mins pos	1 mins pos	1 mins pos	1 mins pos	3 mins pos	3 mins pos	3 mins pos	3 mins pos	3 mins pos	5 mins pos	5 mins pos	5 mins pos	5 mins pos	5 mins pos	Cormac Le	IDS NI	IDS N2	IDS N3	IDS N4	IDS N5	IDS N6	IDS N7
78	100	58	72	100%	98	132	86	101	100%	88	124	68	86	100%	76	114	62	79	100%	0	0	0	0	0	0	1	0
84	102	64	76	100%	108	136	98	110	100%	96	128	90	102	100%	86	130	80	96	100%	1	0	0	0	1	0	1	0
70	96	62	73	100%	94	126	88	96	100%	80	118	78	91	100%	68	112	68	82	100%	1	0	0	0	1	0	0	0
88	112	68	82	100%	112	146	92	110	100%	92	140	76	97	100%	80	136	60	85	100%	1	0	0	0	1	0	1	0
78	102	60	74	100%	104	136	88	104	100%	88	124	76	92	100%	74	120	64	82	100%	1	1	0	0	1	1	1	0
76	110	64	79	100%	102	145	96	112	100%	86	138	90	106	100%	70	136	86	102	100%	1	0	0	0	1	0	0	0
74	116	70	85	100%	104	148	96	113	100%	92	136	88	104	100%	80	124	78	93	100%	1	0	0	0	1	0	1	0
88	104	62	76	100%	108	138	82	100	100%	94	130	76	94	100%	88	128	70	89	100%	0	0	0	0	0	0	0	0
74	100	60	73	100%	98	128	78	94	100%	82	118	70	86	100%	70	114	60	78	100%	0	0	0	0	0	0	1	0
72	96	52	66	100%	98	124	82	96	100%	78	116	72	86	100%	60	110	62	78	100%	0	0	0	0	0	0	1	0
74	98	60	72	100%	98	128	76	93	100%	78	114	68	83	100%	70	106	58	74	100%	1	0	0	0	1	0	0	0
72	106	72	78	100%	96	140	98	112	100%	88	128	80	96	100%	80	122	86	98	100%	1	0	0	0	1	0	0	0
86	108	64	78	100%	108	142	96	98	100%	96	134	86	102	100%	86	130	76	94	100%	1	0	0	0	1	0	0	0
82	104	68	80	100%	106	144	94	110	100%	94	134	90	104	100%	86	128	88	101	100%	2	1	1	1	2	1	1	0
86	112	72	85	100%	112	134	88	103	100%	94	128	84	98	100%	84	126	82	96	100%	1	0	0	0	1	0	1	0
74	104	62	76	100%	104	138	90	106	100%	88	124	78	93	100%	78	110	70	83	100%	0	0	0	0	0	0	0	0
73	96	58	70	100%	104	122	78	92	100%	88	112	70	84	100%	74	102	62	75	100%	1	0	0	0	1	0	1	0
88	102	62	75	100%	112	130	86	100	100%	96	126	80	95	100%	94	122	76	91	100%	1	0	0	0	1	0	1	0
86	100	64	76	100%	118	132	86	101	100%	94	122	82	95	100%	92	116	78	90	100%	1	0	0	0	1	0	0	0
83	108	72	84	100%	102	138	92	107	100%	94	124	80	94	100%	84	114	70	84	100%	0	1	0	0	0	1	1	0
82	98	58	71	100%	106	128	82	97	100%	92	118	72	87	100%	88	112	62	78	100%	0	0	0	0	0	0	0	0
86	110	66	80	100%	114	138	92	107	100%	94	130	86	100	100%	82	124	82	96	100%	1	0	0	0	1	0	1	0
88	102	66	78	100%	112	142	89	106	100%	94	128	84	98	100%	82	114	78	90	100%	1	0	0	0	1	0	0	0
78	106	62	76	100%	100	148	84	105	100%	90	124	78	93	100%	82	112	74	86	100%	2	0	0	0	2	0	1	0
84	104	70	81	100%	116	146	98	114	100%	102	130	84	100	100%	90	126	78	94	100%	1	1	1	1	1	1	0	0
80	110	68	82	100%	114	138	88	104	100%	92	124	80	94	100%	76	116	70	85	100%	1	0	0	0	1	0	1	0
78	122	74	90	100%	102	144	96	112	100%	92	140	92	108	100%	74	136	88	104	100%	1	0	0	0	1	0	0	0
74	112	64	80	100%	98	146	94	111	100%	86	132	88	102	100%	72	122	78	92	100%	0	0	0	0	0	0	0	0
82	104	64	77	100%	112	138	88	104	100%	96	128	84	98	100%	82	118	80	92	100%	0	0	0	0	0	0	1	0
88	102	62	75	100%	116	136	86	102	100%	94	128	80	96	100%	88	122	76	91	100%	1	1	0	0	1	1	1	0
86	106	64	78	100%	112	126	80	95	100%	98	120	74	89	100%	92	118	68	84	100%	0	1	1	0	0	0	0	0
80	112	74	86	100%	102	132	82	98	100%	92	128	82	97	100%	88	120	80	93	100%	0	0	0	0	0	0	0	0
78	100	60	73	100%	96	122	84	96	100%	90	124	84	97	100%	86	120	80	93	100%	0	0	0	0	0	0	0	0
76	106	62	76	100%	88	124	82	96	100%	80	126	82	96	100%	74	124	84	97	100%	0	0	0	0	0	0	0	0
84	116	64	81	100%	96	130	84	99	100%	86	128	82	97	100%	80	124	82	96	100%	0	1	1	1	0	0	0	0
80	118	76	90	100%	94	132	78	96	100%	88	128	78	94	100%	82	120	78	92	100%	0	1	1	0	0	0	0	0
84	102	68	79	100%	98	118	70	86	100%	94	116	68	84	100%	92	112	64	80	100%	0	0	0	0	0	0	0	0
92	116	62	80	100%	110	120	80	93	100%	96	118	76	90	100%	90	120	70	86	100%	0	0	0	0	0	0	0	0
90	116	76	89	100%	104	122	82	95	100%	92	126	82	96	100%	90	128	80	96	100%	0	0	0	0	0	0	0	0
84	96	60	72	100%	98	110	74	86	100%	90	108	68	81	100%	88	108	62	77	100%	0	0	0	0	0	0	0	0
85	104	60	74	100%	102	122	82	95	100%	94	116	72	86	100%	84	112	66	81	100%	0	1	0	0	0	0	0	0
76	100	66	77	100%	96	118	78	91	100%	82	120	78	92	100%	70	122	78	92	100%	0	0	1	0	0	0	0	0
64	104	68	80	100%	84	122	86	98	100%	76	118	86	96	100%	66	114	86	95	100%	0	0	0	0	0	0	0	0
76	116	76	89	100%	92	130	82	98	100%	86	128	82	97	100%	82	128	80	96	100%	0	1	1	1	0	0	0	0
78	120	78	92	100%	94	136	84	101	100%	82	128	84	98	100%	74	124	84	97	100%	0	0	0	0	0	0	0	0
68	114	70	84	100%	84	132	80	97	100%	78	126	78	94	100%	72	122	78	92	100%	0	0	0	0	0	0	0	0
82	102	60	74	100%	108	118	78	91	100%	96	112	70	84	100%	82	108	66	80	100%	0	0	0	0	0	0	0	0
74	108	62	77	100%	94	124	82	96	100%	84	112	76	88	100%	74	106	68	80	100%	0	0	0	0	0	0	0	0
88	100	56	70	100%	106	122	82	95	100%	98	114	74	87	100%	92	112	64	80	100%	0	0	0	0	0	0	0	0
76	104	68	80	100%	96	122	78	92	100%	82	122	74	90	100%	72	124	76	92	100%	0	0	0	0	0	0	0	0
92	110	70	83	100%	102	128	84	98	100%	96	122	80	94	100%	92	120	78	92	100%	0	1	1	0	0	0	0	0
63	102	64	76	100%	84	126	86	99	100%	72	114	78	90	100%	62	110	74	86	100%	0	0	0	0	0	0	0	0
64	108	66	80	100%	78	128	84	98	100%	74	124	80	94	100%	68	118	78	91	100%	0	1	1	1	0	0	0	0
70	110	70	83	100%	78	126	82	96	100%	72	126	82	96	100%	72	125	82	96	100%	0	1	1	0	0	0	0	0
78	114	74	87	100%	86	128	86	100	100%	82	128	82	97	100%	80	118	78	91	100%	0	0	0	0	0	0	0	0
86	100	60	73	100%	106	116	76	89	100%	98	114	70	84	100%	92	116	66	82	100%	0	0	0	0	0	0	0	0
63	102	64	76	100%	74	118	78	91	100%	70	116	74	88	100%	64	112	72	85	100%	0	0	0	0	0	0	0	0
78	114	68	83	100%	96	128	88	101	100%	84	126	78	94	100%	78	122	76	91	100%	1	0	0	0	1	0	0	0
88	110	72	84	100%	102	136	90	105	100%	92	126	84	98	100%	86	116	80	92	100%	0	1	1	1	0	0	0	0
74	112	76	88	100%	96	128	86	100	100%	84	120	86	97	100%	74	116	76	89	100%	0	1	1	0	0	0	0	0
																				Grade 1-1					min-0	no ext pres	vocal cord
																				grade 2-2					increased-	pressure g	adduction-
																				grade3 -3							
																				grade 4-4							

TOTEL ID	duration of	problem H	problem T	problem ar	problem br	problem hy	problem tr	problem er	problem esophageal intubation
1	16	0	0	0	0	0	0	0	0
2	15	0	0	0	0	0	0	0	0
1	17	0	0	0	0	0	0	0	0
2	14	0	0	0	0	0	0	0	0
4	12	0	0	0	0	0	0	0	0
1	16	0	0	0	0	0	0	0	0
2	16	0	0	0	0	0	0	0	0
0	15	0	0	0	0	0	0	0	0
1	17	0	0	0	0	0	0	0	0
1	15	0	0	0	0	0	0	0	0
1	15	0	0	0	0	0	0	0	0
1	15	0	0	0	0	0	0	0	0
1	12	0	0	0	0	0	0	0	0
7	45	0	0	0	0	0	0	0	0
2	16	0	0	0	0	0	0	0	0
0	17	0	0	0	0	0	0	0	0
2	16	0	0	0	0	0	0	0	0
2	17	0	0	0	0	0	0	0	0
1	16	0	0	0	0	0	0	0	0
3	30	0	0	0	0	0	0	0	0
0	17	0	0	0	0	0	0	0	0
2	15	0	0	0	0	0	0	0	0
1	15	0	0	0	0	0	0	0	0
3	15	0	0	0	0	0	0	0	0
5	50	0	0	0	0	0	0	0	0
2	14	0	0	0	0	0	0	0	0
1	12	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0
1	15	0	0	0	0	0	0	0	0
4	30	0	0	0	0	0	0	0	0
2	12	0	0	0	0	0	0	0	0
0	12	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0
0	12	0	0	0	0	0	0	0	0
3	22	0	0	0	0	0	0	0	0
2	14	0	0	0	0	0	0	0	0
0	12	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0
0	11	0	0	0	0	0	0	0	0
0	11	0	0	0	0	0	0	0	0
1	12	0	0	0	0	0	0	0	0
1	12	0	0	0	0	0	0	0	0
0	12	0	0	0	0	0	0	0	0
3	25	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0
0	14	0	0	0	0	0	0	0	0
0	15	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0
0	15	0	0	0	0	0	0	0	0
2	30	0	0	0	0	0	0	0	0
0	12	0	0	0	0	0	0	0	0
3	30	0	0	0	0	0	0	0	0
2	25	0	0	0	0	0	0	0	0
0	11	0	0	0	0	0	0	0	0
0	10	0	0	0	0	0	0	0	0
0	11	0	0	0	0	0	0	0	0
1	10	0	0	0	0	0	0	0	0
3	35	0	0	0	0	0	0	0	0
2	30	0	0	0	0	0	0	0	0
abduction, or not visua		yes-1	yes-1	yes-1	yes-1	yes-1	yes-1	yes-1	yes-1
1		no-0	no-0	no-0	no-0	no-0	no-0	no-0	no-0

PROFORMA

NAME : AGE/ SEX :

Height : Weight : BMI :

ASA/PS : Comorbid illness:

Pulse - B.P - R.R -

CVS: R.S:

OTHERS:

Airway examination :

INTER INCISOR GAP [CM] : <3CM ☐ >3 CM ☐

Mallampati :

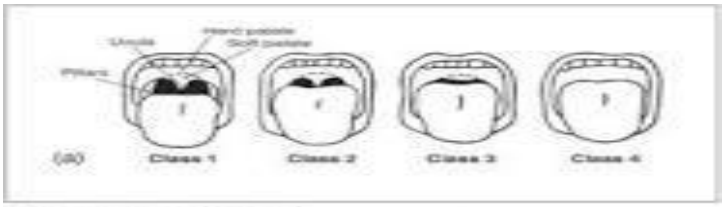


Figure 1. The Mallampati score:
Class 1. Complete visualization of the soft palate
Class 2. Complete visualization of the uvula
Class 3. Visualization of only the base of the uvula
Class 4. Soft palate is not visible at all

Jaw protrusion (upper lip bite test):

Class -1	Class-2	Class- 3

Neck Flexion:

Normal	reduced	fixed

Neck A A extension :

normal	reduced	fixed

Neck Circumference:

>40cm	< 40 cm

Teeth :

Normal	Buck	Missing	Loose	Edentulous	Dentures

Thyromental distance:

>6.5cm	6- 6.5 cm	<6 cm

Hyomental distance:

>6cm	4- 6cm	< 4cm

Palate:

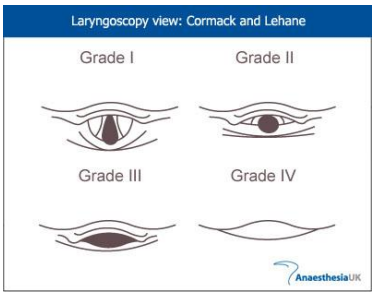
TMJ function:

Normal	Highly arched	Very narrow

Hemodynamic changes :

	H.R	S. BP	D. BP	MAP	SPO2
Pre induction					
Pre intubation					
1,3 mins post intubation					
5 mins post intubation					

CORMAC LEHANE VIEW :



IDS SCORING :

N1	N2	N3	N4	N5	N6	N7

PROBLEM DURING AIRWAY ESTABLISHMENT :

HYPERTENSION		
TACHYCARDIA		
ARRYTHYMIA		
BRONCHOSPASM		
TRAUMA		
HYPOXIA		
ENDOBRONCHIAL INTUBATION		
OESOPHAGEAL iNTUBATION		

PATIENT CONSENT FORM

Study detail : COMPARISON OF INTUBATION DIFFICULTY SCORE

BETWEEN MACINTOSH LARYNGOSCOPY AND AIRTRAQ OPTICAL LARYNGOSCOPY

Study centre : GOVT. KILPAUK MEDICAL COLLEGE HOSPITAL , CHENNAI.

Patients Name :

Patients Age :

Identification Number :

Patient may check ($\surd$) these boxes

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well-being or any unexpected or unusual symptoms. ☐

I hereby consent to participate in this study. ☐

I hereby give permission to undergo complete clinical examination and diagnostic tests including hematological, biochemical, radiological tests. ☐

Signature/thumb impression:

Patients Name and Address:

Signature of investigator：

Study investigator’s Name:

Consent form in reginol language (Tamil)

ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு :

துறை :

கீழ்ப்பாக்கம் மருத்துவ கல்லூரி :

பங்கு பெறுபவரின் பெயர் :

பங்கு பெறுபவரின் வயது :

பங்கு பெறுபவரின் எண் :

மேலே குறிப்பிடப்பட்டுள்ள ஆராய்ச்சியின் விவரங்களும் அதன் நோக்கமும் முழுமையாக எனக்கு தெளிவாக விளக்கப்பட்டது.

எனக்கு விளக்கப்பட்ட விஷயங்களை நான் புரிந்து கொண்டு எனது சம்மதத்தை தெரிவிக்கிறேன்.

இந்த ஆராச்சியில் பிறரின் நிர்ப்பந்தமின்றி என் சொந்த விருப்பத்தின் போில் தான் பங்கு பெறுகின்றேன். இந்த ஆராய்ச்சியில் இருந்து நான் எந்நேரமும் பின்வாங்கலாம் என்பதையும் அதனால் எந்த பாதிப்பும் ஏற்படாது என்பதையும் நான் புரிந்து கொண்டேன்.

நான் என்னுடைய சுய நினைவுடனும் மற்றும் முழு சுதந்திரத்துடனும் இந்த மருத்துவ ஆராய்ச்சில் என்னை சேர்த்துக் கொள்ள சம்மதிக்கிறேன்.

ஆராய்ச்சியாளர் மற்றும் அவரைச் சார்ந்தவர்களோ, நெறிமுறைக்குழு உறுப்பினர்களோ நான் இந்த ஆராய்ச்சியில் இருந்து விலகினாலும் என்னுடைய அனுமதியின்றி என்னுடைய உடல்நிலை குறித்த தகவல்களை இந்த ஆராய்ச்சிக்கோ இது தொடர்பான வேறு ஆராய்ச்சிக்கோ பயன்படுத்திக் கொள்ள முடியும் என்று புரிந்து கொண்டு சம்மதம் அளிக்கிறேன். ஆனாலும் என்னுடைய அடையாளம் வெளியிடப்பட மாட்டாது என்று புரிந்து கொள்கிறேன்.

இந்த ஆராய்ச்சியின் தகவல்களையும் முடிவுகளையும் அறிவியல் நோக்கத்திற்காக பயன்படுவதற்கு நான் அனுமதியளிக்கிறேன். இந்த ஆராய்ச்சியில் பங்கு பெற முழு மனதுடன் சம்மதிக்கிறேன்.

ஆய்வாளர் பெயர்
மற்றும் கையொப்பம்

பங்கேற்பவரின் கையொப்பம்
(அல்லது) கட்டை விரல் ரேகை