A COMPARATIVE STUDY ON ROLE OF GUM ELASTIC BOUGIE WITH AIRTRAQ OPTICAL LARYNGOSCOPE FOR ENDOTRACHEAL INTUBATION: AID OR IMPEDIMENT

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ABSTRACT

AIMS

This study aims to compare endotracheal intubation using the Airtraq with bougie vs. the Airtraq without bougie with respect to: Time for intubation, Ease of intubation, Maneuvers employed to facilitate intubation, Number of attempts.

MATERIALS AND METHODS

This randomised prospective study was done with Seventy five patients undergoing elective surgery under general anaesthesia. 37 patients in group Airtraq (A) and 38 patients in group AB were studied.

RESULTS

All the demographic details of the patients ASA Physical status and airway parameter are insignificant in both groups, i.e. they are similar. There is no significant differences in the mean inter-incisor distance and the mean Thyro-Mental Distance between the study groups. The distribution of patients according to Modified Mallampati Class in the two groups were similar. When the two groups were compared with respect to the number of patients in each group requiring particular maneuvers to optimise glottic view and facilitate intubation, no statistical difference was observed. However, there was a statistically and clinically significant difference when the two groups were compared with respect to the number of patients requiring various maneuvers to optimise the glottic view to facilitate intubation. Four of seven patients in group Airtraq (A) who had trauma had also required additional maneuvers to facilitate intubation. One of these four had a grade 3 Cormack-Lehane view despite maneuvers and a second attempt was needed in two patients. In our study, trauma was observed more frequently in Airtraq (A) group. Its greater frequency in group Airtraq (A) as compared to Airtraq with bougie (AB) was both statistically and clinically significant. Majority of the patients in group Airtraq™ with bougie (AB) were intubated easily, but proportion did not reach statistical significance when compared with group Airtraq.™

CONCLUSION

The Gum Elastic Bougie aids intubation with the Airtraq avoiding the need for repeated attempts. The time required for visualisation of the glottis and intubation when a GEB is used along with the Airtraq is comparable to the time taken when the Airtraq is used alone. Although, the incidence of complications with either technique is not statistically significant, the higher incidence of trauma in group Airtraq (A) is possibly the result of increased manipulation required to obtain optimal intubating conditions as well as additional intubation attempts.

KEYWORDS

Intubation, Endotracheal, Optical laryngoscope, Airtraq, gum elastic bougie.

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INTRODUCTION: The AIRTRAQ™ {PRODOL, SPAIN} is a new intubation device that has been developed for the management of both normal and difficult airways. It is designed to provide a view of the glottis without alignment of the oral, pharyngeal and tracheal axes. The blade of the Airtraq™ consists of two side by side channels. One channel acts as the housing for the placement and insertion of the tracheal tube and the other channel terminates in a distal lens.

A battery operated light is present at the tip of the blade. The images are transmitted to a proximal viewfinder using a combination of lenses and prisms rather than fibreoptics. Use of the Airtraq™ does not however, guarantee smooth intubation even when a grade I Cormack-Lehane view is obtained as the endotracheal tube can hinge against the arytenoid cartilages or vocal cords when it is advanced forward from its channel in the Airtraq TM[1].™ The Eschmann Gum Elastic Bougie (GEB) was first described by Macintosh in 1949 and has proved to be an extremely useful aid for

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intubation in many circumstances. Its angulated distal end facilitates insertion through the vocal cords when only the epiglottis (grade III view) or tip of the arytenoids (grade II view) can be visualised.[2]

This study was designed on the working hypothesis that a bougie being narrower and firmer is more likely to pass unhindered through the glottis when positioned directly in front of it using the Airtraq.™ A preloaded endotracheal tube should then pass easily over it into the trachea without hinging against the vocal cords or arytenoid cartilages. However, addition of a gadget could also result in prolonged intubation times.

MATERIALS AND METHODS: This Randomized prospective study was commenced after obtaining approval of the departmental dissertation committee and hospital ethics committee. Seventy five patients undergoing elective surgery under general anaesthesia were enrolled in the study.

Inclusion Criteria: Patients of either gender aged between 16-65 years scheduled for elective surgical procedures under general anaesthesia requiring endotracheal (ET) intubation, ASA-Physical Status 1 and 2.

Exclusion Criteria: Emergency surgeries requiring rapid sequence induction of anaesthesia and patients with full stomach, Patients with known orofacial or laryngopharyngeal pathology, Patients having known cardio pulmonary disease, Patients with restricted mouth opening/anticipated difficult airway, Body mass index more than 35 kg. Patients were randomly allocated into one of the following two groups using a computer generated random sequence.

- Group A: Use of Airtraq™ alone for endotracheal intubation.
- Group AB: Use of Airtraq™ with bougie for endotracheal intubation.

Preoperative Assessment:

- All Patients were kept nil per oral (6 hours for solids and 2 hours for clear fluids).
- All patients received anxiolytic premedication according to their body weight on the night before and morning of the surgery. Patients ≤50 kg received tablet alprazolam 0.25 mg and patients >50 kg - tablet alprazolam 0.5 mg.
- All patients also received tablet pantoprazole 40 mg with metoclopramide 10 mg on the night before surgery and morning of surgery.

Induction of Anaesthesia: Prior to induction for all patients included in the study:
Following monitors were secured:

- ECG monitoring lead II and V_5.
- NIBP recording at 1 minute intervals.
- SpO_2.
- End-tidal CO_2.
- Baseline vitals were recorded.
- Monitor was set to activate alarms if greater than 25% deviation from baseline in heart rate or blood pressure occurred during the study.
- All patients were administered I.V. glycopyrrolate 0.2 mg and I.V. fentanyl 2 µg/kg.
- Preoxygenation was done with 100% oxygen for 3 minutes.
- Induction was done with Inj. Propofol 2.5-3 mg/kg.
- Loss of verbal response was taken as the end point of anaesthetic induction.
- After checking the adequacy of mask ventilation, neuromuscular blockade was achieved with vecuronium bromide 0.12 mg/kg and anaesthesia was deepened with 1.5%-2% isoflurane in oxygen to achieve an end-tidal MAC of 1.
- Peripheral nerve stimulator was placed over the ulnar aspect of the upper limb opposite to which NIBP cuff was attached.
- Laryngoscopy was commenced only when TOF count equalled 0 and end-tidal MAC ≥1.

Preparation of Airtraq™ Channel: The Airtraq™ was prepared by lubricating its ETT channel and placing an ETT in it as indicated below:

i. ETT alone in group Airtraq™ (A).
ii. ETT with well-lubricated bougie inserted upto the Murphy's eye in group Airtraq™ with Bougie (AB) such that when protruded through the ETT, the bougie curved anteriorly.
   - For groups Airtraq™ alone and Airtraq™ with bougie 7 mm ID ETT loaded in the green Airtraq™ (size 3) was used for all females and 8 mm ID ETT loaded in the blue Airtraq™ (size 4) was used for all males.
   - The ETT channel of the Airtraq™ was generously lubricated and the appropriate ETT was placed in it.
   - Both convex and concave surfaces of the Airtraq™ blade were generously lubricated.

Technique of Inserting the Airtraq™:

- Patient lying supine with head in sniffing position.
- All patients were intubated by observer 2 by inserting the Airtraq™ into the mouth in the midline over the centre of the tongue while providing a jaw lift with the thumb of the observer's nondominant hand hooked over the patient's mandible. This was the primary and preferred technique.
- If insertion of the Airtraq™ was found to be difficult with the primary technique, the following maneuvers were employed in descending order of preference:
  i. Jaw thrust provided by another anaesthesiologist from the patient's foot end.
  ii. Insertion of the Airtraq™ from the side of the mouth.
- Maneuvers employed for Airtraq™ insertion were noted.

- Once insertion was achieved, the Airtraq™ blade was advanced along the posterior wall of the pharynx until its tip was positioned in the vallecula. It was then lifted up to obtain a glottic view.

In order to achieve a central grade I/II view, the following maneuvers were used in decreasing order of preference:

- Lifting the Airtraq™ blade up and outwards with its tip in the vallecula (Standard Procedure).
- Inclusion of epiglottis with the Airtraq™ blade.
- External laryngeal manipulation in combination with the preceding two maneuvers.
- The time (T1) and maneuvers require to obtain a good glottic view were noted. If despite using all three maneuvers, a grade I/II view was not obtained, the patient was not excluded from the study. Time from introduction of the Airtraq™ blade tip through the patient's incisor teeth up to satisfactory visualisation of the glottis was noted-T_1 (seconds).

Once a Good Glottic View was obtained:

IN GROUP AIRTRAQ™ (A): The ETT was advanced into the glottis under vision.

- Once the cuff of the ETT passed between the vocal cords, it was inflated.
- The ETT was displaced laterally from the Airtraq™ and Positive Pressure Ventilation (PPV) initiated while the Airtraq™ was removed.
- The time in seconds taken from the visualisation of the glottis till a capnographic trace was obtained was noted- T_2 (seconds).

IN GROUP AIRTRAQ™ WITH BOUGIE (AB): The bougie was advanced till its tip was just beyond the vocal cords.

- The ETT was railroaded under vision over it into the trachea while the bougie was held by an assistant.
- The bougie was removed after the cuff of the ETT had passed just beyond the vocal cords.
- The ETT cuff was inflated.
- The ETT was displaced laterally from the Airtraq™ and PPV initiated while the Airtraq™ was removed. The time taken from the visualisation of the glottis till a capnographic trace was obtained was noted - T_2.
- Total time 'T' (seconds) - total intubation time for both groups was defined as the time from introduction of the Airtraq™ blade tip through the patient's incisor teeth till confirmation of intubation by capnography ($T = T_1 + T_2$).
- In both groups, the ETT was secured after confirming bilaterally equal normal breath sounds.

Ease of Intubation: Ease of intubation was graded by both observers as easy/not very easy/difficult as follows:

Easy: Smooth insertion of Airtraq™ into position in the vallecula allowing a good glottic view **AND** smooth passage of ETT/GEB into the glottis without hinging against arytenoids.

Not Very Easy: Difficulty in inserting Airtraq™ into position and obtaining good glottic view **OR** hinging of ETT/GEB against arytenoids.

Difficult: Difficulty in inserting Airtraq™ into position **AND** difficulty in inserting ETT/GEB through the vocal cords, **OR** complete inability/failure to intubate using Airtraq.™

- In each group, two attempts with the primary intubation technique were permitted.
- If the primary intubating technique failed, one attempt with the alternative technique was allowed and such a case was recorded as failure in the primary group.
- If both techniques failed, then the patient was intubated using conventional laryngoscopy and the case recorded as a failure.
- Maintenance of anaesthesia and further management of the patient were left to the discretion of the primary anaesthesiologist assigned for the case. Each attempt was allowed for not more than 120 seconds (Total time 'T') or a drop in SpO_2 below 95% whichever occurred earlier.
- Mask ventilation with 1.5 to 2% isoflurane in oxygen was provided between attempts ensuring end-tidal MAC of 1.
- In case of intubation attempts lasting beyond 45 seconds, additional boluses of propofol 0.5 mg/kg were administered as per the discretion of observer 2.

Parameters Observed:

1. Time for intubation (seconds).
   T1 - Time from insertion of scope into mouth to the visualisation of the glottis.
   T2 - Obtaining glottic view to capnographic confirmation.
   T - Total time for intubation = T_1+T_2.
2. Ease of intubation.
3. Maneuvers employed.
4. Number of attempts.

RESULTS: A total of 75 adult patients were studied. 37 patients in group Airtraq (A) and 38 patients in group Airtraq with Bougie (AB).

Parameter	Group Airtraq (A) (n=37)	Group Airtraq with Bougie (AB) (n=38)	P value
Age (Years) Mean±SD	37.35±11.12	34.61±11.52	0.297 (NS)
Gender			
Male	17 (45.9%)	15 (39.4%)	0.24 (S)
Female	20 (54.1%)	23 (60.5%)	
Height (cm) Mean±SD	159.86±8.20	160.39±7.97	0.777 (NS)
Weight (kg) Mean±SD	57.57±9.90	56.71±9.78	0.707 (NS)
BMI (kg/m2) Mean±SD	22.78±3.92	22.02±3.33	0.365 (NS)

Table 1: Demographic Data

All the demographic details of the patients are insignificant.

ASA Physical Status			
ASA I	34	33	0.479 (NS)
ASA II	3	5	
Total	37	38	
Airway Parameter			
IID (cms) (Mean±SD)	4.74±0.89	4.70±0.70	0.838 (NS)
TMD (cms) (Mean±SD)	8.31±0.98	8.16±0.76	0.466 (NS)
Modified Mallampati Class			
Class I	13	17	0.401 (NS)
Class II	22	17	
Class III	2	4	

Table 2: Details of Study Before Intubation

ASA physical status and airway parameter are insignificant in both groups, i.e. they are similar. There is no significant differences in the mean inter-incisor distance and the mean Tyro-mean Distance between the study groups. The distribution of patients according to Modified Mallampati Class in the two groups were similar.

	Group Airtraq™ (A) (n=37)	Group Airtraq™ with Bougie (AB) (n=38)	P value
Cormack & Lehane grade			
GRADE I	33 (89.2%)	33 (86.8%)	0.475 (NS)
GRADE II	3 (8.1%)	5 (13.2%)	
GRADE III	1 (2.7%)	0 (0.0%)	
Maneuvers to view glottis			
No maneuvers	22 (55.5%)	31 (81.6%)	0.475 (NS)
Any maneuvers	15 (40.5%)	7 (18.4%)	
Attempt			
1	33 (89.2%)	38 (100.0%)	0.114 (NS)
2	4 (10.8%)	0 (0.0%)	
Time required for glottic visualisation (T_1) &intubation (T_2) (Seconds			
T_1	6.95±3.66	6.08±2.66	0.244 (NS)
T_2	19.95±11.89	19.92±5.78	0.991 (NS)
(T) $T_{1+}T_2$	26.89±12.19	26.00±6.46	0.7 (NS)

Table 3: Parameters observed during intubation

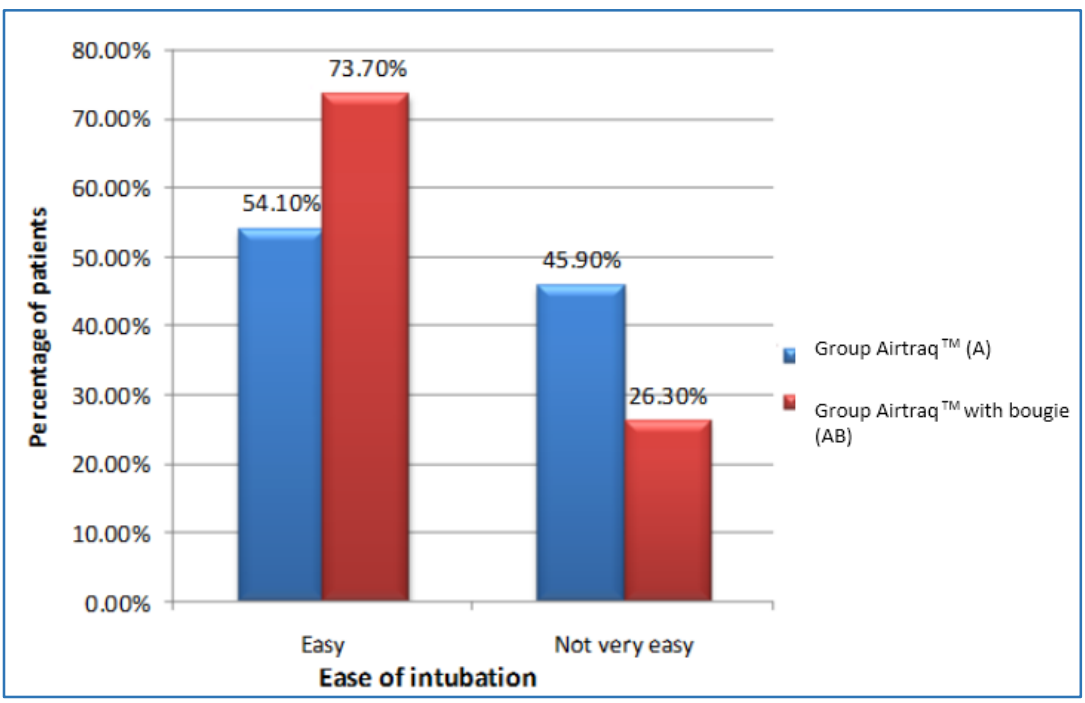
Chi-square test NS - Not statistically significant

When the two groups were compared with respect to the number of patients in each group requiring particular maneuvers to optimise glottic view and facilitate intubation, no statistical difference was observed. However, there was a statistically and clinically significant difference when the two groups were compared with respect to the number of patients requiring various maneuvers to optimise the glottic view to facilitate intubation. Four of seven patients in group Airtraq (A) who had trauma had also required additional maneuvers to facilitate intubation. One of these four had a grade 3 Cormack-Lehane view despite maneuvers and a second attempt was needed in two patients.

Trauma	Group Airtraq™ (n=37)	Group Airtraq™ with Bougie (AB) (n=38)	P-Value
Absent	30 (81.1%)	37 (97.4%)	0.052 (NS)
Present	7 (18.9%)	1 (2.6%)	

Table 4: Complications

In our study, trauma was observed more frequently in Airtraq (A) group. Its greater frequency in group Airtraq (A) as compared to Airtraq with Bougie (AB) was both statistically and clinically significant. The occurrence of complications put together as a whole were not statistically significant between the two groups.



As shown in graph 1 majority of the patients in group Airtraq™ with Bougie (AB) were intubated easily, but proportion did not reach statistical significance when compared with group Airtraq.™

DISCUSSION: Securing the airway is always a priority for anaesthesiologists both in the operating room and in emergency medicine. Endotracheal intubation has been the gold standard for management of the airway. Despite recent developments in airway device technology, the curved laryngoscope blade described by Macintosh in 1943 remains the most popular device used to facilitate orotracheal intubation and constitutes the gold standard. However, tracheal intubation using this laryngoscope has been demonstrated to fail in up to 35% of patients with an unpredicted difficult airway.[3,4] A wide variety of alternatives to the Macintosh laryngoscope have been introduced in the recent past decade to improve airway safety in clinical practice. In the recent past, researchers have started to use the GEB (Gum elastic bougie) with many optical and video laryngoscopes as a useful aid or rescue device. Roland Amathieu et al reported that GEB is a useful aid with modern optical laryngoscopes (Airtraq, LMA CTrach) when intubation with these devices alone was found difficult.[5] Donat et al[6] reported the use of GEB in combination with the Airtraq™ in one patient with previously operated cervical neoplasm who had an anticipated difficult airway. The technique of using GEB with the Airtraq™ described by them is similar to the technique that we used in our study.[6]

We hypothesised that the Airtraq™ allows alignment of ETT/Gum Elastic Bougie (GEB) exactly in front of the glottic opening and the GEB being narrow and curved anteriorly is more likely to pass through the glottis without abutting against arytenoid cartilage/aryepiglottic folds. An ETT can then be railroaded under vision (via Airtraq) over the GEB, with less hindrance from arytenoid cartilage/vocal cords.

Our aim was to evaluate whether the gum elastic bougie aids or impedes endotracheal intubation with the Airtraq.™ The GEB was originally described and introduced into clinical practice in 1949 by Sir Robert Macintosh who used it as an endotracheal tube introducer. The bougie has been proven to be a useful adjunct for endotracheal intubation in conjunction with many conventional direct laryngoscopes and laryngeal mask airways in routine as well as difficult

airway management. Malin et al used the gum elastic bougie with Airtraq™ following failed intubation with Macintosh and Airtraq™ laryngoscope alone.[7] The Airtraq™ was used in 47 patients with predicted or unpredicted difficult intubation after failed orotracheal intubation. Tracheal intubation with Airtraq™ was successful in 36 patients (80%). A gum elastic bougie was used to facilitate tracheal access in one-third (11/36) of the cases where the Airtraq™ alone failed to secure the airway. This study confirmed the findings of previous clinical trials, which reported that the Airtraq™ provides excellent view of the glottis. This is also true in our study results where the majority of patients in both study groups achieved grade 1 glottic view (89.2% in group A and 86.8% in group AB and study groups were comparable). However, in their study, in a few patients with difficult intubating conditions, the Airtraq™ failed to achieve an adequate view of the glottis or failed to facilitate intubation despite adequate view of the glottis. This is reflected in our study results as well where 11 patients in Airtraq™ group and 4 patients in group Airtraq™ with bougie (AB) group required multiple maneuvers to facilitate intubation even though a grade 1 CL view was obtained and the patients had a normal airway. Malin et al's study is the first case series that reports failure to intubate with the Airtraq™ This study included three patients in whom no view of the glottis could be obtained despite use of the Airtraq™ and these patients were intubated only with the help of a bougie.

Intubation was not possible with Airtraq™ in two additional cases where correct visualisation of the glottis was obtained. Despite lifting the Airtraq™ and elevating the blade into the vallecula passing the tube through the side channel resulted either in oesophageal intubation or entrapment/engagement of the tip of the tube against the posterior wall of the glottis. Thus, they mentioned that although the endotracheal tube is guided by a channel acting as a conduit, the lack of alignment of the oral, pharyngeal and tracheal axes does not always guarantee that once the glottis is viewed, the endotracheal tube will pass through the vocal cords without difficulty. This conclusion was in concordance with our hypothesis.[7] Matsuyama et al[8] studied the efficacy of GEB for intubation with the Airtraq.™

Twenty anaesthesiologists were assigned evenly to one-hundred-forty-one patients. The time required for intubation was studied. Among non-board-certified anaesthesiologists, the time needed for successful intubation was significantly shorter with combined use of Airtraq™ and GEB than intubation with Airtraq™ alone. However, among board certified anaesthesiologists, there was no significant advantage on combining the GEB with the Airtraq.™ This finding is echoed in our study as well where consultant anaesthesiologists performed all intubations and no significant difference in total intubation time was observed between the two groups. A. M. Joffe et al have quoted in their retrospective study that manoeuvring the Airtraq™ such that the glottic structures are seen in the lower left quadrant of the operator's view leads to the highest likelihood of first attempt intubation success.

The following three maneuvers were used in their study: a backup manoeuver to bring the glottis down in the view, rotating the Airtraq™ to the right to bring the glottis leftward in the view and a combined backup manoeuver with rotation to the right were used and subjective assessment of ease of intubation was graded as 1 (easy, no difficulties) to 6 (extremely difficult or impossible) using a modified Likert scale.[9] Similar maneuvers (i.e. up and out, inclusion of the epiglottis, external laryngeal manipulation) and subjective grading of ease of intubation (i.e. easy, not very easy, difficult) were used in our study.[10] Dhonneur G et al[10] demonstrated that successful tracheal intubation using the Airtraq™ laryngoscope required the glottic opening to be centered in view with the interarytenoid cleft positioned medially below the horizontal line in the centre of the view.

They described a triple manoeuver (down, back and up manoeuver) to reposition the Airtraq™ following failed tracheal intubation to improve alignment of the Airtraq™ with the glottis and allow successful intubation.[10] We used similar maneuvers in our study as well. Even though, a rotatory manoeuver was not described in the methodology of our study, one patient required rotatory manoeuver alone to bring the glottis into the centre of the visual field. Jaw thrust and lateral insertion of the Airtraq™ were additional insertion techniques that we used in our study. These insertion maneuvers are not reported anywhere in the literature with respect to optical laryngoscopes, but proved quite helpful in our study where one patient had a thick tongue and the Airtraq™ could only be inserted laterally.

In another patient, insertion of the Airtraq™ proved technically difficult despite the patient having an adequate interincisior distance of 3.9 cm and a jaw thrust (provided by another anaesthesiologist) in addition to the midline technique was necessitated. Dhonneur G et al have also noted difficulty in introduction of the Airtraq™ optical laryngoscope in their clinical experience and their study concluded that reverse technique of insertion was useful in morbidly obese patients where standard technique was not satisfactory.[10] Few instances have been reported in literature where the Airtraq™ was associated with unrecognised oral trauma.[11,12,13] The incidence of trauma in our study was found to be significantly different between the two study groups (group A-18.9%, group AB-2.6%), although when analysed as a subset of all complications, results were not statistically significant. Of the 7 patients in group Airtraq™ (A) who developed trauma during intubation 5 had grade 1 CL views and 2 of these required additional maneuvers to aid intubation as did the patients with grade 2 and grade 3 view.

The only patient in group Airtraq™ with Bougie (AB) who developed trauma also had a grade 1 CL view, but required additional maneuvers to aid intubation. Conversely, not all patients who required additional maneuvers to aid intubation developed trauma. Among the patients where blood spots on the Airtraq™ blade were observed, there were three patients in whom the site of trauma could not be identified even on check laryngoscopy. This is similar to the case reported by Holst et al.[13] A significantly larger

proportion of patients (n=15) in group Airtraq™ (A) required additional maneuvers for successful intubation compared to group Airtraq™ with Bougie (AB) where 7 patients required additional maneuvers. The increased amount of manoeuvering required to align the Airtraq™ with the glottis to achieve intubation as compared to the limited amount of manoeuvering required when a GEB was used to guide the ETT into the trachea reflects in the different rates of trauma observed in the two groups. Nevertheless, the assessment of trauma in our study was based only on the visualisation of blood on the Airtraq™ blade and it is possible that subglottic trauma if any was missed.

Evaluation for such trauma would require a fibreoptic evaluation post intubation, which was not included in our study. Since, we included ENT patients undergoing airway surgery in our study, postoperative study of the incidence of sore throat (as a reflection of airway trauma) was not considered reliable or feasible. Also, our study was limited to ASA grade 1 and 2 physical status patients who were scheduled for elective surgery and had a good mouth opening with no anticipation of a difficult airway. Whether the results of this study hold true in patients considered at higher risk of difficult airway for e.g. obese and pregnant ladies, obese individuals and patients scheduled for emergency surgery can only be confirmed by further studies including such patient groups. Fibreoptic evaluation for airway trauma would also refine the study further.

CONCLUSION: The Gum Elastic Bougie aids intubation with the Airtraq avoiding the need for repeated attempts. The time required for visualisation of the glottis and intubation when a GEB is used along with the Airtraq is comparable to the time taken when the Airtraq is used alone. Although, the incidence of complications with either technique is not statistically significant, the higher incidence of trauma in group Airtraq (A) is possibly the result of increased manipulation required to obtain optimal intubating conditions as well as additional intubation attempts.

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