DOES MILLER STRAIGHT BLADE AND PARAGLOSSAL TECHNIQUE PROVIDE BETTER LARYNGOSCOPY THAN TRADITIONAL MACINTOSH BLADE STANDARD TECHNIQUE - A COMPARATIVE STUDY?

Bhanu Pratap Swain[1], Deb Sanjay Nag[2], Devi Prasad Samaddar[2], Amlan Swain[3], Srividhya[2], Binita Panigrahi[4] and Sudhir Kumar Dua[2]

Abstract

Background: Studies in adult populations have shown that the paraglossal technique with Miller blade provides a better glottic view during intubation when compared to traditional Macintosh blade. However, better glottic visualization has not always been shown to translate to easier intubation.

Aims: The purpose of this prospective open labeled randomized study was to compare paraglossal technique with Miller blade and the Macintosh blade in terms of "glottic view" and "ease of intubation" in routine adult tracheal intubations. Settings and Design: One hundred and fifty patients without any predicted difficult airway parameters were randomly assigned to one of two groups (Miller and Macintosh).

Methods and Materials: After induction of anesthesia, laryngoscopy was performed with the study blades and tracheal intubation was achieved. Parameters monitored were: Cormack Lehane grade, ease of intubation, number of intubation attempts, duration of laryngoscopy and complications if any.

Results: Better visualization of the larynx (Grade 1 Cormack and Lehane view) was achieved with the paraglossal technique by the Miller blade (92% patients) as compared to the Macintosh blade (68% of the patients). The difficulty encountered during intubation was similar with both the techniques (Grade 1 intubation difficulty in 72% cases in the Macintosh group compared to 69.3% in Miller group). The time taken for intubation (in seconds) was slightly longer in Miller group (23 ± 7) as compared to the Macintosh blade (20.5 ± 7.7), however the difference was not clinically relevant and no significant complication was noted in either group.

Conclusion: Miller straight blade with paraglossal technique is a better alternative to Macintosh blade as it provides better glottic view with similar ease of intubation.

Keywords: Laryngoscopy, Endotracheal intubation, Anesthesia.

1 DA, DNB Department of Anesthesiology, Tata Main Hospital, Jamshedpur, Jharkhand, India.
2 MD Department of Anesthesiology, Tata Main Hospital, Jamshedpur, Jharkhand, India.
3 DA, DNB, DM, Department of Anesthesiology, Tata Main Hospital, Jamshedpur, Jharkhand, India.
4 DNB, Department of Anesthesiology, Tata Main Hospital, Jamshedpur, Jharkhand, India.
Corresponding Author: Bhanu Pratap Swain, Specialist, Dept. of Anaesthesiology & Critical care Tata Main Hospital. Tel: +916576641166, Fax: +916572224559. E-mail: bhanu_swain@yahoo.co.in

Introduction

Appropriate laryngoscopic view and easy intubation are desirable while intubating a patient. Since the introduction of tracheal intubation in anesthesia practice in 1878 by Macewen, various types of laryngoscope designs and techniques of laryngoscopy have been used for securing the endotracheal tube. The standard curved Macintosh blade is preferred by anesthesiologists in routine intubations. This laryngoscope has the advantage of allowing more room in the oropharynx for manipulation of the endotracheal tube; however poor visualization of the larynx is often an encountered problem with the use of such blades[1]. Miller straight blades using paraglossal technique have been found to be beneficial in such situations[1-5]. To date there are very few studies that have compared the two blades with regard to laryngoscopic view and ease of intubation. Besides, in the few available studies, there are contradictory opinions[6,7]. Hence a prospective comparative study was undertaken to evaluate the laryngoscopic view and ease of intubation with both the aforementioned blades in routine tracheal intubations.

Subjects and Methods

This study was designed as an open labeled randomized control trial after approval of the institutional ethics committee of Tata Main Hospital, Jamshedpur, India. The study was registered with ClinicalTrials.gov, the clinical trial registry of the U.S. National Institutes of Health with an identifier of NCT02664532.

One Hundred and fifty patients of ASA status I and II aged between 18 to 70 years of either gender scheduled for elective surgery requiring general anesthesia with oral endotracheal intubation were included in the study. Patients with anticipated difficult airway (Grade 3 intubation prediction score), cervical spine disorders and anesthesia requiring rapid sequence induction were excluded from the study. Airway assessment was an integral part of the study and was done on the basis of intubation prediction score[6]. The intubation prediction score is an integration of three predictive tests i.e. Mallampati classification[8] (Table 1), atlanto-occipital joint extension[9] (Table 2) and mandibular space[10] (Table 3). Each of the aforesaid airway predictive tests was graded and each grade was given points. Subsequently a nominal score was generated by addition of these points (intubation prediction score) which was further classified into three basic grades according to the total nominal score as; Grade 1: easy intubation (3-4 points); Grade 2: moderately difficult intubation (5-8 points); and Grade 3: difficult intubation (9-12 points). Patients with grade 3 intubation score were not included in the study.

Table 1
*Mallampati's Test (MPC grade)**

MPC grade	Oro-Pharyngeal structures visible	Points
1	soft palate, fauces, uvula, anterior and posterior tonsillar pillars	1
2	soft palate, fauces, uvula	2
3	soft palate, fauces, base of uvula	3
4	soft palate not visible at all	4

* The patient was asked to sit, open the mouth maximally, and protrude the tongue but not phonate. Visibility of the oral and pharyngeal structures is then classified by an observer sitting at the same level as the patient.

Table 2
*Atlanto-occipital Joint Extension (AOJE)**

Grade	AOJE	Points
1	≥ 35°	1
2	22° and < 35	2
3	≥ 13° and < 22°	3
4	< 13°	4

* When the atlanto-occipital joint is extended, the angle between the erect and extended planes of the occlusal surface of the upper teeth quantitates the degree of AOJE (Measured with the help of a goniometer).

All patients were informed about the nature of the study and written informed consent was obtained from all of them. Patients were then allocated to either group (Macintosh vs. Miller) based on computer generated

randomization.

After attachment of standard ASA monitors in the operation theatre, all patients were induced with intravenous Fentanyl 2 µgm/kg, Midazolam 0.03 mg/kg and Thiopentone 5 mg/kg. After conformation of adequate mask ventilation and administration of intravenous Succinylcholine 1.5 mg/kg, laryngoscopy with the randomly assigned blade was attempted after 60 seconds.

Table 3
*Mandibular Space**

Grade	TMD & LM	Points
1	TMD ≥ 6 cm and LM ≥ 9 cm	1
2	TMD ≥ 6 cm and LM < 9 cm	2
3	TMD < 6 cm and LM ≥ 9 cm	3
4	TMD < 6 cm and LM < 9 cm	4

* It includes the measurement of thyromental distance (TMD) and the horizontal length of the mandible (LM).

In the Macintosh group, the curved blade was introduced to lift the base of the epiglottis to visualize the larynx and then trachea was intubated conventionally.

In the Miller group, laryngoscopy by paraglossal technique was employed using a no 3 Miller blade for all intubations. In this technique, an assistant retracted the cheek and a no 3 Miller blade was introduced adjacent to the right lateral border of the tongue along the groove between the tongue and the tonsil. Due care was exercised to keep the laryngoscope blade lateral to the tongue and no attempt was made to bring the blade toward the midline, unlike the technique adopted for the curved blade. The Miller Straight blade was then advanced till the blade passed posterior to the epiglottis. At this stage the blade was lifted anteriorly to visualize the glottis opening followed by intubation. A stylet was used with the endotracheal tube so as to maintain the curved shape before intubation. During the process of intubation, the endotracheal tube was directed underneath the laryngoscope blade taking care such that the endotracheal tube would never be lateral to the blade. The curvature of the endotracheal tube automatically brought the tip towards the vocal cords as it was advanced. After successful endotracheal intubation, the endotracheal tube was attached to the circuit and anesthesia continued according to the discretion of the anesthesia care provider.

The following parameters were monitored during the procedure: laryngeal view obtained by Cormack Lehane grading (Table 4), ease of intubation or degree of difficulty with intubation (Table 5), number of intubation attempts, total laryngoscopy duration in seconds and any complications during the procedure.

Table 4
Cormack and Lehane grade

Grade	Laryngeal view
1	Full view of glottis
2	Only posterior commissure visible
3	Only epiglottis visible
4	No glottic structure visible

An intubation attempt was defined as "any activity aiding intubation during a single continuous laryngoscopy maneuver". Thus, even if several attempts were made to place an endotracheal tube during the course of a single laryngoscopy, it was counted as a single intubation attempt.

The duration of intubation was defined as the time taken from placement of the laryngoscope in the mouth to the time taken to remove the laryngoscope from the mouth following intubation.

Table 5
Degree of Difficulty with Intubation

Grade 1	Intubation easy
Grade 2	Intubation requiring an increased anterior lifting force/optimal external laryngeal manipulation (OELM)/assistance to pull the right corner of the mouth upwards to augment space
Grade 3	Intubation requiring more than one attempt or bougie guided intubation
Grade 4	failure to intubate with the assigned laryngoscope

In all the cases laryngoscopy and intubation were done by a single operator with experience in both laryngoscope blades and techniques.

Statistical Analysis

Ease of intubation as a parameter was used to calculate the sample size. Based on the study by Arino et al[6], we hypothesized that easy intubation (grade 1 intubation difficulty score) is expected in 90% of patients and there will be an approximate decrease of 20% in the ease of intubation while using Miller straight blade with paraglossal technique. We aimed for an alpha error to be 5% and the desired power of the study was 80%. The total no of sample size came out to be 146 with 73 in each group. Subsequently we enrolled a total of 150 patients with 75 patients in each group in this study.

Data is presented as mean with standard deviation or proportions as appropriate. Student's t-test was used as statistical tool to test for significance of observed differences in the mean. Chi-square test was used to test for significance of proportions. A p value < 0.05 was considered to be statistically significant.

Results

The demographic data, preoperative airway assessments and intubation prediction score were comparable between the two groups (Table 6). The group intubated by the Miller blade paraglossal technique exhibited higher incidence of grade 1 Cormack and Lehane view in 69 (92%) patients compared to 51 (68%) cases in the group intubated with the Macintosh blade (P = 0.0002). Grade 2 Cormack and Lehane view was observed in fewer patients in Miller group 6(8%) as compared to patients in the Macintosh group 18 (24%) (P = 0.007). None of the patients in the Miller group had a grade 3 Cormack and Lehane view vs. 6 (8%) patients in Macintosh group (P = 0.012) (Fig. 1).

Table 6
Demographic Profile

	Macintosh Blade (n =75)	**Miller Blade (n =75)**	**P-value**
Age (year)	48.2 ± 14	44.8 ± 13.1	0.126
BMI(kg/m2)	21.9 ± 3.1	22.8 ± 3.0	0.072
Gender (M: F)	28: 47	26: 49	0.733
IPS Grade 1; n (%)	28 (37.3%)	24 (32%)	0.492
IPS Grade 2; n (%)	47 (62.7%)	51 (68%)	0.492

BMI: Body Mass Index IPS: Intubation Prediction Score.No significant complications were encountered during the course of the study in any patient in both groups.

Fig. 1
Cormack Lehane Grades between the two groups

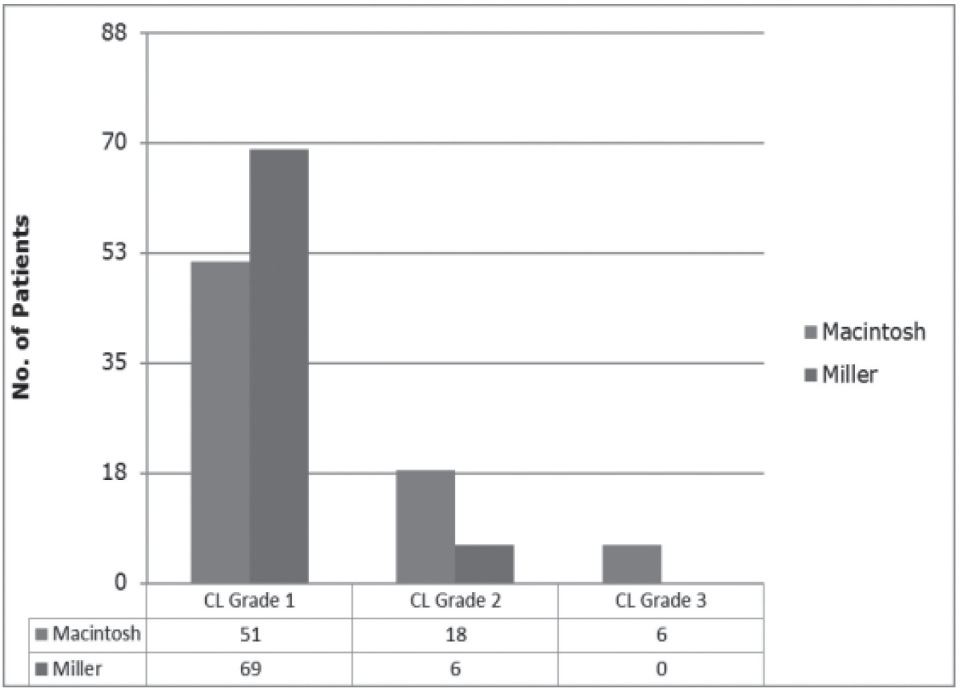
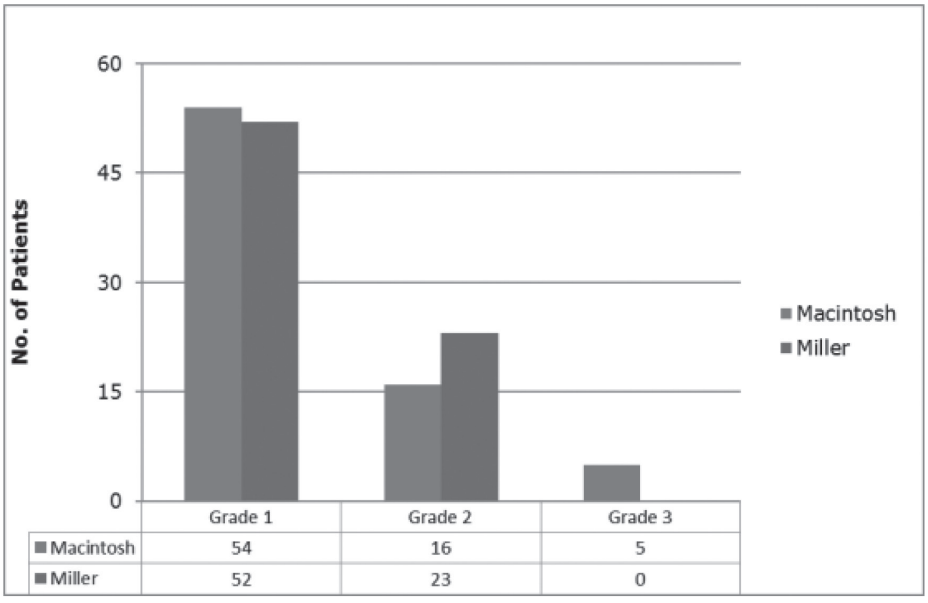


Fig. 2
Degree of difficulty of intubation between the two groups



The Miller group had a grade 1 intubation difficulty in 52 (69.3%) patients compared to 54 (72%) patients in the Macintosh group (P = 0.719) (Fig. 2). Grade 2 intubation difficulty was experienced in 23 (30.7%) patients in the Miller group compared to 16 (21.3%) patients in the Macintosh group (P = 0.192). In the Miller group no patient had grade 3 intubation difficulty as compared to 5 (6.7%) patients in the Macintosh group (P = 0.022). All patients in the Miller group were intubated in a single attempts whereas one patient required a second attempt in the Macintosh group. The time taken for performing intubation (in seconds) was slightly longer in Miller group (23 ± 7) than in Macintosh group (20.5±7.7) (P = 0.039).

Discussion

Securing the airway by direct laryngoscopy and endotracheal intubation under vision is the cornerstone of airway management and is indeed one of the most practiced modalities in anesthesia and intensive care. Over the years, many laryngoscope designs and techniques of laryngoscopy have evolved in search of an intubation modality which would facilitate the best view of the vocal cords and would also be easy to perform. Magill straight blade laryngoscopes were preferred before the introduction of Macintosh curved blades. Despite the popularity and routine use of the Macintosh curved blade in modern anesthesia practices, significant incidences of failure to visualize the larynx have been reported with its use[1]. The failure to achieve a direct line of sight (LOS) of the larynx by a Macintosh laryngoscope can be basically attributed to two reasons. First, the curvature of the Macintosh laryngoscope interferes with the line of sight of larynx especially in subjects with decreased space in oral cavity[11]. Second, in the same group of patients, it is not always possible to displace the entire volume of the tongue to the left of the laryngoscope, leading to distal compression of the base of the tongue and consequent posterior displacement of the epiglottis, thus resulting in a handicapped view of the vocal cords[12]. The aforesaid shortcomings of the popular Macintosh blade hence mandate that anesthesiologists and airway managers should hone their skills with more than one type of laryngoscope[1]. Use of the straight blade has the theoretical premise of avoiding these shortcomings and has also been shown to be beneficial in patients with distorted dentition such as buck teeth and dental malocclusion as well as in patients with a floppy epiglottis[13-15]. A careful perusal of the available literature reveals a scant body of work on the feasibility of use of the straight blade as an effective alternative modality of laryngoscopy and intubation in selected subgroups of anticipated and unanticipated difficult airway[16].

Paraglossal straight blade laryngoscopy was first described by Chevalier Jackson and later by

Magill[17]. However this technique could never become really popular as the majority of operators found it apparently cumbersome and generally failed to adhere to the recommendations suggested by Magill. This old technique has recently been resurrected by Henderson[1] with the recommendation that this technique should be used regularly in cases of difficult laryngoscopy. The paraglossal straight blade technique had also been shown to be an effective alternative in difficult airway scenarios[18-21].

The method of paraglossal straight blade technique used in our study was almost similar to the approach described by Henderson with a slight modification as suggested by Achen et al[22]. In subjects intubated with paraglossal straight blade technique, the endotracheal tube (ETT) was introduced underneath the laryngoscope, not by the side of the blade. A stylet was employed to maintain the curved shape of ETT which enabling it to be brought back up towards the vocal cords as it was advanced under the laryngoscope blade.

Our study demonstrated that the Miller straight blade (with paraglossal technique) provides better laryngoscopic view as compared to the Macintosh blade. Of greater significance was the fact that larynx could not be visualized (Cormack and Lehane grade 3 view) in 6 cases (8%) in the Macintosh group as compared to no case in the Miller group (P = 0.04). Arino et al[6] found that 96% cases of Miller group and 72% cases in Macintosh group had Cormack and Lehane Grade 1 view, which is similar to the results of our study. It is worthwhile to note that as far as the use of a Miller straight blade is concerned use of a paraglossal technique in our study produced nearly the same visualization rates as the classical technique as reported by Arino et al. The visualization rates of our study are also in concordance with the study by Achen et al[22] who reported Cormack and Lehane Grade 1 view in 96.5 % cases with Miller blade paraglossal technique. Henderson[1] had also found similar results in their smaller series of 10 cases, where he obtained Cormack and Lehane grade 1 view in all cases with Miller blade paraglossal technique as compared to Cormack and Lehane grade 3 or 4 view with previously failed Macintosh laryngoscope.

Our study found that the two intubation modalities in question were very similar to each other when compared for ease of intubation. These observations were in contrast to previous studies which reported that intubation using a straight blade was difficult in comparison to the use of a curved blade[6,7]. The reason postulated for such an observation was that curved blade laryngoscopy in contrast to a straight blade allows for more room in the oropharynx to maneuver the endotracheal tube. The results of our study seem to suggest otherwise, as we did not encounter any significant difficulty in using the Miller blade. A plausible explanation for such encouraging results whilst using the Miller straight blade in our study could be the minor procedural modification of inserting the stylet mounted ETT below the laryngoscope blade rather than the side of it hence circumventing the concern regarding the limited space encountered in straight blade paraglossal technique laryngoscopy. The stylet induced curvature, an improved spatial configuration eventually allowed for an easier passage of the endotracheal tube in to a better visualized glottis opening.

Time taken for intubation was slightly longer in the Miller group than in the Macintosh group. This was similar to the observations made by Achen et al[22].

We initially hypothesized, that miller blade paraglossal technique will result in poorer intubating condition (worsening of ease of intubation), however our study demonstrated similar intubating conditions with both blades in question viz. Miller blade and the Macintosh blade. Hence with comparable intubating condition along with significantly better laryngeal view, Miller blade can be a worthy alternative to Macintosh blade in routine endotracheal intubation.

We do have certain limitations in our study. Blinding of the person performing the laryngoscopies was not possible. The study was conducted in predicted non difficult airways and therefore results cannot be extrapolated in difficult airway situations. Also laryngoscopy and intubation was done by an anesthesiologist with considerable experience in both modalities and results may vary with less experienced users especially Miller blade paraglossal technique. These limitations give us a logical future direction for studying feasibility of alternative laryngoscopy techniques in difficult airway situations to ascertain

whether similar benefits can be replicated under more clinically relevant scenarios.

We demonstrated that in subjects without predicted difficult airway parameters Miller straight blade paraglossal technique laryngoscopy offered better laryngeal view and a comparable ease of intubation to that of Macintosh blade.

The authors of this article have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this article.

References

1. Henderson JJ: The use of paraglossal straight blade laryngoscopy in difficult tracheal intubation. *Anaesthesia*; 52:552-60, 1997.
2. Crinquette V, Vilette B, Solanet C, et al: Appraisal of the PCV, a laryngoscope for difficult endotracheal intubation. *Annales Francaises D'Anesthesie et de Re´animation*; 10:589-94, 1991.
3. Phillips OC, Duerksen RL: Endotracheal intubation: a new blade for direct laryngoscopy. *Anesth Analg*; 52:691-8, 1973.
4. Arai T, Nagaro T, Nitta K: Management of the difficult endotracheal intubation; advantages of the Miller blade and a facilitated nasotracheal intubation with a fiberoptic bronchoscope. *Masui*; 36:1112-6, 1987.
5. Bonfils P: Difficult intubation in Pierre-Robin children, a new method: the retromolar route. *Anaesthesist*; 32:363-7, 1983.
6. Arino JJ, Velasco JM, Gasco C, Lopez Timoneda F: Straight blades improve visualization of the larynx while curved blades increase ease of intubation: a comparison of the Macintosh, Miller, McCoy, Belscope and Lee-Fiberview blades. *Can J Anaesth*; 50:501-6, 2003.
7. Kulkarni AP, Tirmanwar AS: Comparison of glottis visualisation and ease of intubation with different laryngoscope blades. *Indian J Anaesth*; 57:170-4, 2013.
8. Mallampati SR: Clinical signs to predict difficult tracheal intubation (hypothesis) (Letter). *Can Anaesth Soc J*; 30:316-7, 1983.
9. Bellhouse CP, Doré C: Criteria for estimating likelihood of difficulty of endotracheal intubation with the Macintosh laryngoscope. *Anaesth Intensive Care*; 16:329-37, 1988.
10. Benumof JL: Management of the difficult adult airway. With special emphasis on awake tracheal intubation. *Anesthesiology*; 75:1087-110, 1991.
11. Bellhouse CP: An angulated laryngoscope for routine and difficult tracheal intubations. *Anesthesiology*; 69:126-9, 1988.
12. Horton WA, Fahy L, Charters P: Factor analysis in difficult tracheal intubation: laryngoscopy-induced airway obstruction. *Br J Anaesth*; 65:801-5, 1990.
13. Benumof JL: Difficult laryngoscopy: obtaining the best view. *Can J Anaesth*; 41:361-5, 1994.
14. Salem MR, Mathrubhutham M, Bennett EJ: Difficult intubation. *N Engl J Med*; 295:879-81, 1976.
15. King TA, Adams AP: Failed tracheal intubation. *Br J Anaesth*; 65:400-14, 1990.
16. McIntyre JW: Laryngoscope design and the difficult adult tracheal intubation. *Can J Anaesth*; 36:94-8, 1989.
17. Magill IW: An improved laryngoscope for anaesthetists. *Lancet*; 1:500, 1926.
18. Brown A, Norton ML: Instrumentation and equipment for management of the difficult airway. In: Atlas of the Difficult Airway. Edited by Norton ML, Brown AC: St Louis, Mosby year Book, pp. 24-32, 1991.
19. Phillips OC, Duerksen RL: Endotracheal intubation: a new blade for direct laryngoscopy. *Anesth Analg*; 52:691-8, 1973.
20. Arai T, Nagaro T, Nitta K: Management of the difficult endotracheal intubation; advantages of the Miller blade and a facilitated nasotracheal intubation with a fiberoptic bronchoscope. *Masui*; 36:1112-6, 1987.
21. Bonfils P: Difficult intubation in Pierre-Robin children, a new method: the retromolar route. *Anaesthesist*; 32:363-7, 1983.
22. Achen B, Terblanche OC, Finucane BT: View of the larynx obtained using the Miller blade and paraglossal approach, compared to that with the Macintosh blade. *Anaesthesia Intensive Care*; 36:717-21, 2008.