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Original Research Article

Comparison of the Modified Tube-First Technique versus the Conventional Technique for Awake Nasal Fibre-optic Intubation in Patients with an Anticipated Difficult Airway: A Randomized Controlled Trial

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Conflict of interest: Nil

Abstract:

Background: Awake nasal fibre-optic intubation is the reference technique for the anticipated difficult airway in oral and maxillofacial surgery. The conventional scope-first approach is limited by soiling of the bronchoscope tip with secretions, which impairs glottic visualization and prolongs the procedure. In the modified tube-first (MTF) technique, the endotracheal tube is first positioned in the nasopharynx and the bronchoscope is then passed through it as a protective conduit. This study compared the MTF technique with the conventional technique.

Methods: In this prospective, randomized, comparative trial, 94 adults (18–55 years, Mallampati grade ≥3) scheduled for elective oral and maxillofacial surgery were allocated to a conventional group (CG, n=47) or an MTF group (n=47). The primary outcomes were total intubation time, vocal-cord visualization (T1) and time to intubation (T2), while the secondary outcomes were ease of visualization and tube placement, number of attempts, need for rescue manoeuvres, patient reaction score, and complications.

Results: The groups were comparable for age, sex and ASA status. Total intubation time was significantly shorter with MTF (104.49 ± 47.81 vs 125.72 ± 41.31 s; p=0.024). T1 was shorter with MTF but did not reach significance (73.06 ± 40.51 vs 86.57 ± 31.07 s; p=0.073, and T2 (31.43 ± 15.69 vs 39.15 ± 16.79 s; p=0.024). First-attempt success was higher with MTF (53.19% vs 23.40%; p=0.010). MTF required fewer bronchoscope reinsertions (46.81% vs 76.60%; p=0.006) and less oxygen insufflation through the bronchoscope (27.66% vs 55.32%; p=0.012). Patient reaction scores were better with MTF (3.09 ± 1.00 vs 3.55 ± 1.10; p=0.048). Epistaxis was less frequent with MTF (42.55% vs 61.70%) but not significantly (p=0.099). No laryngospasm, aspiration or airway injury occurred.

Conclusion: The MTF technique is faster, achieves higher first-attempt success, requires fewer rescue manoeuvres and is better tolerated than the conventional technique, with comparable safety. It is a simple and reliable refinement of awake nasal fibre-optic intubation.

Keywords: Awake Fibre-Optic Intubation; Anticipated Difficult Airway; Modified Tube-First Technique; Nasotracheal Intubation; Oral And Maxillofacial Surgery.

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Introduction

Airway management is one of the most critical competencies in anaesthesiology, and the anticipated difficult airway remains a potentially life-threatening challenge. The reported incidence of the difficult airway ranges from 1% to 18% of surgical patients depending on the population and definition used. Awake tracheal intubation is universally recognized as the gold-standard technique for securing an anticipated difficult airway, because preservation of spontaneous ventilation maintains continuous oxygenation and protective airway reflexes throughout the procedure. [1,2]

The 2022 American Society of Anesthesiologists practice guidelines and contemporary difficult-airway frameworks emphasize awake tracheal intubation built on sedation, topicalization, oxygenation and performance. [1,3] Despite its established safety, awake fibre-optic intubation remains underutilized, accounting for only about

0.2–0.4% of tracheal intubations in clinical practice. [3,4] Nasal fibre-optic intubation is particularly valuable in oral and maxillofacial surgery, where unrestricted surgical access to the oral cavity is essential and patients frequently present with limited mouth opening, mandibular fractures or temporomandibular joint pathology. [2,5]

In the conventional scope-first technique, a flexible bronchoscope pre-loaded with the endotracheal tube is advanced through the nostril, navigated through the vocal cords, and the tube is then railroaded into the trachea. A significant limitation of this approach is contamination of the bronchoscope camera with nasal and oropharyngeal secretions, which impairs visualization, prolongs the procedure, and may necessitate removal, cleaning and reinsertion of the scope. [6] Technical difficulty and failure rates of 1–10% have been reported even among experienced operators, primarily attributed to poor visualization and difficulty railroading the tube across the vocal cords. [7,8] Impingement of the tube most commonly occurs at the arytenoid cartilages, reported in approximately 47% of cases and various manoeuvres such as tube rotation, jaw thrust, head extension and the use of Parker Flex-Tip tubes have been proposed to overcome it, each adding complexity and time. [7,9,10]

To address these limitations, the modified tube-first (MTF) technique advances the endotracheal tube into the nasopharynx to a predetermined depth (typically around 14 cm from the nares) before introducing the bronchoscope through the tube. [9,11] The pre-positioned tube acts as a conduit that protects the scope from secretions, improves glottic visualization, eases subsequent passage of the tube and may shorten procedural time, potentially reducing reliance on advanced fibre-optic expertise. [11,12] Despite these theoretical advantages, comparative data on the MTF technique remain limited.

Given the clinical importance of difficult-airway management in oral and maxillofacial surgery, this study compared the modified tube-first technique with the conventional technique for awake nasal fibre-optic intubation, evaluating procedural time, ease of device placement, number of attempts, patient reaction and complication rates. [12,13]

Material and Methods

This prospective, comparative, randomized controlled study was conducted in the Operating Theatre of the Department of Anaesthesiology, Sawai Man Singh Medical College and Attached Group of Hospitals Jaipur, after approval from the Institutional Ethics Committee and Research Review Board (1196/MC/EC/2024) and registration with the Clinical Trials Registry of India (CTRI/2025/11/097135). The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines, and written informed consent was obtained from all participants.

Sample Size and Eligibility: The sample size was calculated at a 95% confidence interval ($\alpha = 0.05$) based on reported mean total intubation times of 164.8 s (conventional) and 128.8 s (MTF). To detect a mean difference of at least 30 s with a standard deviation of 48 s and 80% power, 42 patients were required per group; this was increased to 47 per group (total N = 94) to allow for 10% attrition. Adults aged 18–55 years of either sex, scheduled for elective oral and maxillofacial surgery, with an anticipated difficult airway (Mallampati grade ≥3) and willing to provide consent were included. Patients with a nasal mass or polyp, bleeding disorder, base-of-skull fracture, prior nasopharyngeal surgery, or those enrolled in another study were excluded.

Randomization and Technique: Patients were randomly allocated using computer-generated random numbers in sealed opaque envelopes to Group A (Conventional, n = 47) or Group B (MTF, n = 47). All patients received preoperative nebulization with 4 mL of 2% lignocaine and nasal preparation with 0.1% xylometazoline drops. After standard monitoring and 3 minutes of preoxygenation, premedication comprised glycopyrrolate 10 µg/kg, midazolam 0.03 mg/kg and fentanyl 1 µg/kg intravenously, with bilateral superior laryngeal nerve blocks using 2% lignocaine.

In Group A, the bronchoscope was inserted first through the prepared nostril, navigated through the vocal cords to the carina, and the pre-loaded endotracheal tube was then railroaded into the trachea. In Group B, the endotracheal tube was first advanced into the nasopharynx to a predetermined depth, the bronchoscope was passed through the tube lumen to the carina under direct vision, and the tube was then advanced over the bronchoscope into the trachea. After confirmation of placement by equal bilateral air entry and capnography, anaesthesia was induced with propofol 2 mg/kg and atracurium 0.5 mg/kg, and maintained with nitrous oxide–oxygen (50:50), sevoflurane 1–2% and atracurium.

Outcomes and Statistical Analysis: The primary outcome was total intubation time. T1 was the time from insertion of the bronchoscope (Group A) or tube (Group B) through the nares to vocal-cord visualization, and T2 the time from visualization to successful placement and cuff inflation; total time was T1 + T2. Secondary outcomes were ease of device placement, number of attempts, patient reaction score, and complications (epistaxis, desaturation [SpO_2 <90%], haemodynamic changes, trauma, failed intubation). Data were analysed with

SPSS v26.0. Continuous variables (mean ± SD) were compared using the independent Student's t-test and categorical variables using the chi-square or Fisher's exact test. A two-tailed p-value < 0.05 was considered significant.

Results

Ninety-four patients were analysed, 47 in each group. The two groups were comparable with respect to age, sex and ASA physical status (Table 1). The overall mean age was 47.21 ± 12.29 years, and males predominated (78.72%); most patients were ASA II (71.28%).

Table 1: Baseline demographic and airway characteristics

Characteristic	Conventional (n=47)	MTF (n=47)	p-value
Age (years), mean ± SD	**48.45 ± 11.90**	**45.98 ± 12.67**	**0.760**
Male, n (%)	**38 (80.85)**	**36 (76.60)**	**0.801**
Female, n (%)	**9 (19.15)**	**11 (23.40)**	**–**
ASA I, n (%)	**7 (14.89)**	**7 (14.89)**	**0.662**
ASA II, n (%)	**32 (68.09)**	**35 (74.47)**	**–**
ASA III, n (%)	**8 (17.02)**	**5 (10.64)**	**–**

MTF = Modified Tube-First; ASA = American Society of Anesthesiologists; SD = standard deviation. Chi-square / independent t-test.

Intubation Times: Total intubation time—the primary outcome—was significantly shorter in the MTF group (104.49 ± 47.81 s) than in the conventional group (125.72 ± 41.31 s), a saving of 21.23 s (16.9%; p = 0.024). Time to intubation (T2) was likewise significantly shorter with MTF (31.43 ± 15.69 vs 39.15 ± 16.79 s; p = 0.024). Time to vocal-cord visualization (T1) was 15.6% shorter with MTF (73.06 ± 40.51 vs 86.57 ± 31.07 s) but did not reach significance (p = 0.073) (Table 2; Figure 1).

Table 2: Comparison of intubation times (seconds)

Time interval	Conventional (n=47)	MTF (n=47)	p-value
T1: to vocal-cord visualization	**86.57 ± 31.07**	**73.06 ± 40.51**	**0.073**
T2: visualization to intubation	**39.15 ± 16.79**	**31.43 ± 15.69**	**0.024***
Total intubation time	**125.72 ± 41.31**	**104.49 ± 47.81**	**0.024***

Values are mean ± SD. Independent Student's t-test. *Statistically significant (p < 0.05).

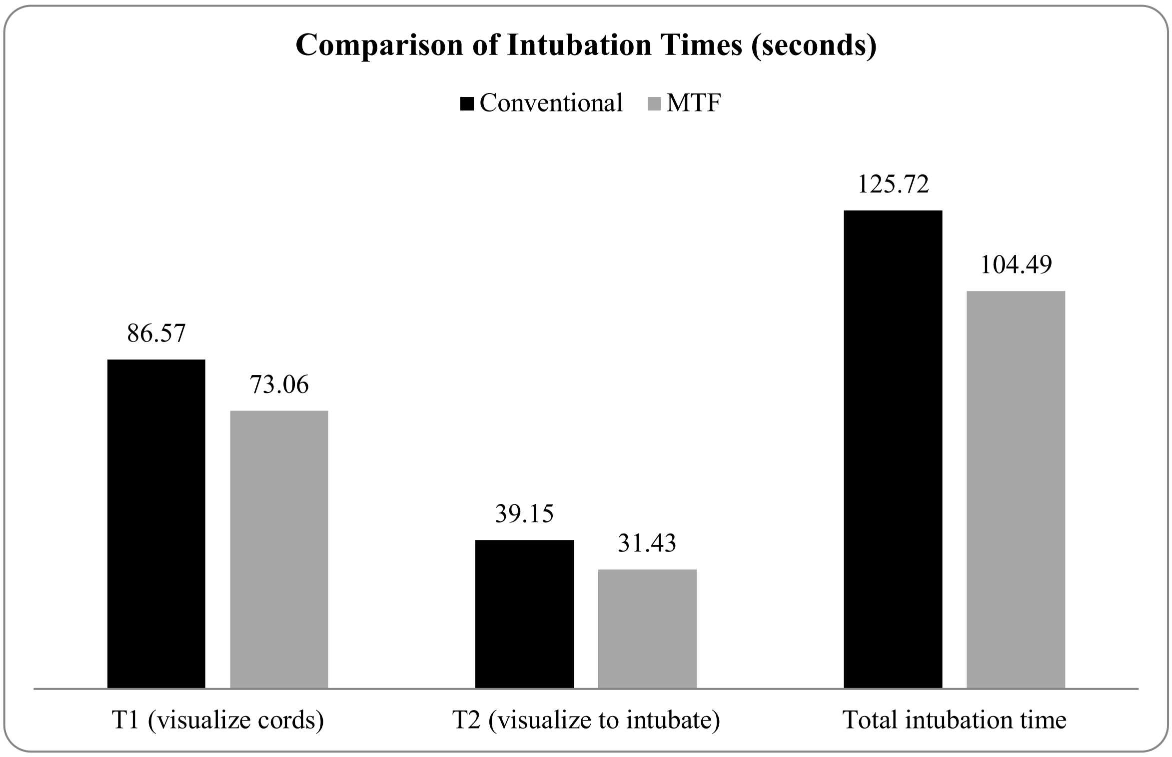

Figure 1: Comparison of mean time to vocal-cord visualization (T1), time from visualization to intubation (T2) and total intubation time between the conventional and modified tube-first (MTF) techniques. T2 and total intubation time were significantly shorter with MTF (p = 0.024 for each).

Procedural Performance, Patient Response and Complications: First-attempt success was significantly higher with the MTF technique (53.19% vs 23.40%; p = 0.010), and three attempts were required in only 12.77% of MTF patients versus 27.66% of conventional patients. The MTF group required significantly fewer rescue manoeuvres: oxygen insufflation through the bronchoscope (27.66% vs 55.32%; p = 0.012) and bronchoscope reinsertion (46.81% vs 76.60%; p = 0.006). Patient tolerance was better with MTF, with a lower mean reaction score (3.09 ± 1.00 vs 3.55 ± 1.10; p = 0.048) and fewer severe reactions (scores 4–5: 25.53% vs 55.31%). Easier glottic visualization (36.17% vs 19.15%; p = 0.107) and easier tube placement (68.09% vs 48.94%; p = 0.094) both trended in favour of MTF without reaching significance. Epistaxis, the only complication observed, was less frequent with MTF (42.55% vs 61.70%; p = 0.099). No laryngospasm, aspiration or structural airway injury occurred in either group (Table 3; Figure 2).

Table 3: Procedural outcomes, patient response and complications

Parameter	Conventional (n=47)	MTF (n=47)	p-value
First-attempt success, n (%)	**11 (23.40)**	**25 (53.19)**	**0.010***
Easy glottic visualization, n (%)	**9 (19.15)**	**17 (36.17)**	**0.107**
Easy tube placement, n (%)	**23 (48.94)**	**32 (68.09)**	**0.094**
O_2 via bronchoscope, n (%)	**26 (55.32)**	**13 (27.66)**	**0.012***
Bronchoscope reinsertion, n (%)	**36 (76.60)**	**22 (46.81)**	**0.006***
Patient reaction score, mean ± SD	**3.55 ± 1.10**	**3.09 ± 1.00**	**0.048***
Epistaxis, n (%)	**29 (61.70)**	**20 (42.55)**	**0.099**
Laryngospasm / aspiration / injury	**0 (0.00)**	**0 (0.00)**	**–**

MTF = Modified Tube-First. Chi-square / Fisher's exact test; patient reaction score by t-test. *Statistically significant (p < 0.05).

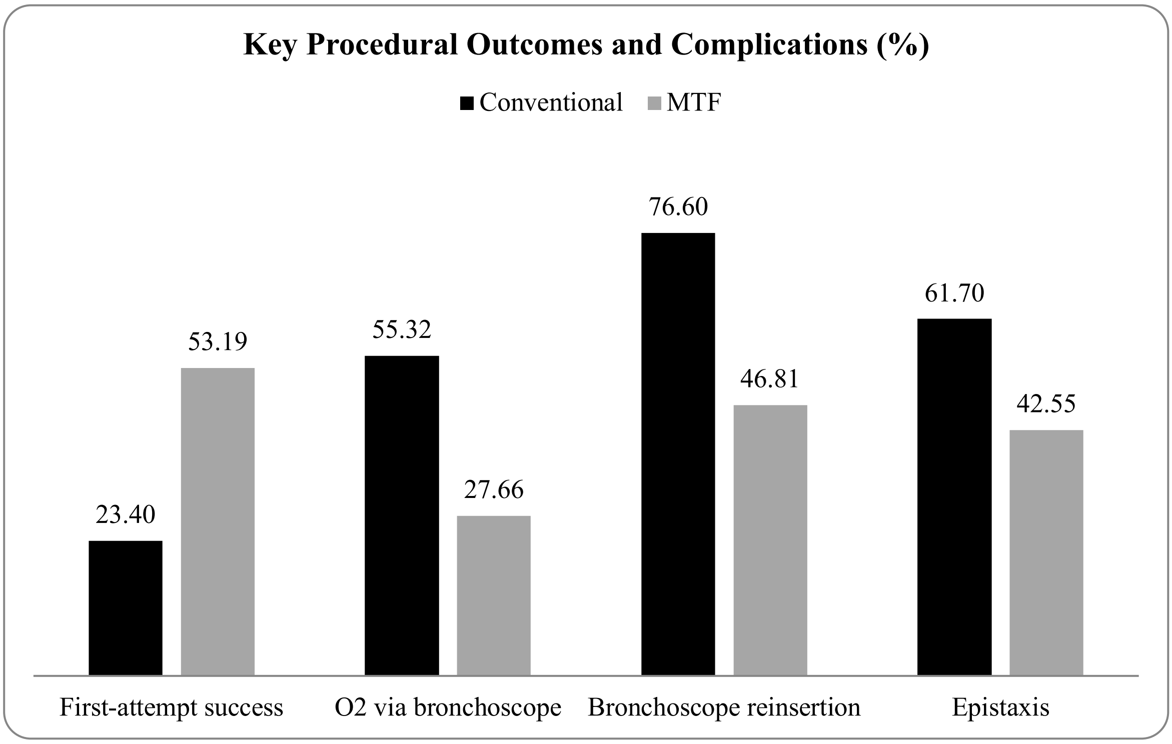

Figure 2: Comparison of key procedural outcomes and complications (%) between the conventional and modified tube-first (MTF) techniques. First-attempt success was higher with MTF (p = 0.010); oxygen insufflation through the bronchoscope (p = 0.012) and bronchoscope reinsertion (p = 0.006) were significantly lower with MTF. Epistaxis was less frequent with MTF but not significantly (p = 0.099).

Discussion

This randomized comparative trial in 94 patients with an anticipated difficult airway demonstrated that the modified tube-first technique is faster, achieves higher first-attempt success, requires fewer rescue manoeuvres and is better tolerated than the conventional scope-first technique for awake nasal fibre-optic intubation, while both techniques were equally safe. Because the two groups were well matched for age, sex and ASA status, the observed differences can reasonably be attributed to the technique rather than to patient factors. [12,13]

The primary outcome, total intubation time was significantly shorter with MTF (a saving of about 21 s, 16.9%), as was the time from cord visualization to intubation. Time to visualize the cords was also shorter with MTF but did not reach significance, most likely reflecting the wide variation in timing values and differences in operator fibre-optic experience. Our results are consistent with Syal et al., who found significantly shorter total intubation time with MTF, and with Shoukry et al. and Mohammadzadeh et al., who reported markedly shorter times with tube-first and NASAL-18 conduit methods; Spinella et al. similarly reported a short mean intubation time of 68.5 s using a strict tube-first protocol. [6,11,12,13] The mechanistic explanation is that the pre-positioned tube keeps the scope clean and acts as a guide, so the tube slides in without impinging at the arytenoid cartilages a common cause of delay in the conventional method. [9]

First-attempt success was substantially higher with MTF (53.19% vs 23.40%). This mirrors the higher success and fewer attempts reported by Syal et al., the 97.8% first-pass success of Spinella et al., the 88.3% first-attempt success of Song et al., and the higher overall success of Mohammadzadeh et al. with the tube-first method. [6,11,12,18] By guiding the scope directly toward the cords, the pre-placed tube reduces the number of attempts required—an advantage that is especially valuable for operators still developing fibre-optic expertise. [18]

The clearest evidence of how the technique works lies in the rescue manoeuvres: the MTF group needed significantly less oxygen insufflation through the scope and significantly fewer scope reinsertions. Because the tube shields the camera from secretions, the scope is soiled less often and needs less cleaning and reinsertion. These findings agree with Meena RK et al., who reported less coughing and camera soiling with the tube-first (SPLIT) method, and with other conduit-based approaches. [6,14,15]

Patients tolerated the MTF technique better, with lower reaction scores and fewer severe reactions, reflecting a quicker procedure that disturbed the airway less. This is consistent with the steadier haemodynamics reported by Shoukry et al. and the smoother course with less desaturation reported by Syal et al. [12,13] Epistaxis, the only complication observed, was less frequent with MTF but the reduction was not significant; Meena RK et al. reported comparable mild nasal bleeding with conventional intubation, while stronger reductions with conduit methods have been described by Meena K et al. and Abd Al-Qader et al. [14,16,17] The likely reason for less bleeding with MTF is that the tube is passed gently once rather than moving the scope and tube back and forth through the nose.

An important clinical theme is that the tube-first method depends less on operator skill: Spinella et al. obtained good results irrespective of operator experience, and Song et al. showed that trainees became competent after roughly thirty procedures. [11,18] This matters because El-Boghdadly et al., in a large cohort of 600 awake fibre-optic intubations, identified operator experience as the main factor associated with complications.19 Performed while following current difficult-airway guidelines, our results add to the evidence that MTF is a simple and useful refinement of the conventional method. [3,20]

Limitations

This was a single-centre study, which may limit generalizability. Although adequately powered for the primary outcome, the sample size may have been insufficient to detect differences in rare complications. Awake fibre-optic intubation is highly operator-dependent, and variation in individual proficiency may have influenced procedural time and ease and contributed to the wide range of timing values. Blinding of the anaesthesiologist was not feasible because the two techniques are visibly different, which may have introduced observer or performance bias for subjective outcomes such as ease and patient reaction. Only intraprocedural outcomes were assessed; later outcomes such as sore throat and patient satisfaction were not studied. Finally, the findings apply to elective oral and maxillofacial patients with an anticipated difficult airway and may not extend to emergency or other populations.

Conclusion

The modified tube-first technique is a faster, easier and better-tolerated alternative to the conventional scope-first technique for awake nasal fibre-optic intubation in patients with an anticipated difficult airway. It significantly shortened total intubation time, improved first-attempt success, reduced the need for rescue manoeuvres and improved patient tolerance, with a safety profile comparable to the conventional method. These findings support wider adoption of the modified tube-first technique as a simple and reliable way to improve awake nasal fibre-optic intubation, particularly where operators of differing experience manage difficult airways.

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Declarations

Ethical Approval: The study was approved by the Institutional Ethics Committee and Research Review Board of Sawai Man Singh Medical College, Jaipur (approval number 1196/MC/EC/2024) and was prospectively registered with the Clinical Trials Registry of India (CTRI/2025/11/097135). It was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines.

Informed Consent: Written informed consent was obtained from all individual participants included in the study prior to enrolment.

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Conflict of Interest: The authors declare that they have no conflict of interest.

Author Contributions: All authors contributed to the study conception and design, data acquisition, analysis and interpretation, and drafting and critical revision of the manuscript. All authors read and approved the final version and agree to be accountable for all aspects of the work.

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