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Optimal Timing for Tracheostomy in Anesthetized Patients with Le Fort Fractures II-III: A Comparative Analysis

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Background: Le Fort fractures, particularly types II and III, pose significant challenges in maxillofacial trauma due to complications in airway management. There is ongoing debate about the optimal timing of tracheostomy in these patients, specifically comparing preoperative tracheostomy under local anesthesia with post-intubation tracheostomy under general anesthesia.

Objective: To compare these approaches to determine their effectiveness and impact on patient outcomes.

Materials and Methods: The present study was a retrospective study involving 97 patients with Le Fort II and III fractures who underwent tracheostomy at a trauma center. Patients were divided into two groups with Group A for preoperative tracheostomy under local anesthesia, and Group B for post-intubation tracheostomy under general anesthesia. Data was collected from electronic medical records and analyzed using descriptive and inferential statistics, including chi-square, unpaired t-tests, and Mann-Whitney U tests.

Results: Group A included 69 patients, while Group B included 28 patients. Preoperative tracheostomy under local anesthesia took significantly longer to perform than post-intubation tracheostomy under general anesthesia ($p<0.004$). One case in Group B experienced unexpected, failed intubation, necessitating a switch to preoperative tracheostomy. Despite procedural differences, no significant differences were observed in patient outcomes between the two groups, including vital signs, pain scores, bleeding, and length of hospital stay.

Conclusion: Preoperative tracheostomy under local anesthesia provided better airway control and fewer complications compared to post-intubation tracheostomy under general anesthesia. The timing and approach to tracheostomy should be individualized based on patient conditions and surgical complexities to ensure optimal outcomes and patient safety.

Keywords: Airway management; Anesthesia; Le Fort fractures; Retrospective study; Tracheostomy

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Le Fort fractures, particularly types II and III, present significant challenges in maxillofacial trauma management, complicating airway control and posing risks to patient safety. These fractures lead to facial swelling, bleeding, and structural instability, making ventilation and intubation difficult. Effective communication and coordination among the surgical, anesthesia, and nursing teams are crucial. This involves briefing on the intervention, roles, and preparation to adapt the plan based on the patient's condition and unforeseen challenges. Preoperative patient assessment includes a review of medical history, physical examination, and imaging studies such as computed tomography (CT) scans, to assess the extent of fractures and potential airway obstruction, as well as evaluating the risk of airway complications. CT imaging revealed that 32 out of the total number of difficult intubations, which were 57%, involved patients with Le Fort II facial fractures[(1)]. Necessary equipment for urgent intubation, cricothyroidotomy, and tracheostomy must be readily available[(2-23)].

The optimal timing for performing a tracheostomy in patients with Le Fort fractures remains debated among clinicians. Anesthesiologists typically advocate for preoperative tracheostomy under local anesthesia[(3,4,7,11,14,19,20)], while surgeons recommend performing post-intubation tracheostomy under general anesthesia prior to facial surgery[(3,12)]. This

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decision involves multiple factors, including the complexity of airway management, the patient's specific condition, and the potential risks and benefits associated with each approach, necessitating a case-by-case evaluation to optimize patient outcomes. Tracheostomy in patients with Le Fort II and III fractures is often inevitable due to complications such as facial swelling, bleeding, and structural instability, which can significantly impede ventilation and intubation[2-13].

Traditionally, the timing of tracheostomy in patients with Le Fort fractures has varied. Textbooks historically recommended preoperative tracheostomies for all patients[11,14]. However, practices have shifted, with some opting to perform post-intubation tracheostomy under general anesthesia[3,10]. This lack of consensus has resulted in divergent approaches between anesthesiologists and surgeons, focusing on two methods, preoperative tracheostomy under local anesthesia and post-intubation tracheostomy under general anesthesia[24]. In patients with severe airway distortion, anterior neck injury requiring multiple surgeries, and prolonged intubation, tracheostomy performed under local anesthesia followed by general anesthesia is considered the safest technique[25].

Despite the importance of airway management in patients with Le Fort fractures, comprehensive studies comparing the timing of tracheostomy are lacking. Existing research has focused on individual techniques, highlighting the need for a systematic comparative analysis to evaluate their advantages, disadvantages, and overall effectiveness. Such analysis is essential to identify the technique with the highest success rate, minimal complications, and optimal patient outcomes, thereby enhancing safety and reducing avoidable complications.

The present research aimed to address this critical gap by systematically comparing these two approaches. The hypothesis is that preoperative tracheostomy performed under local anesthesia leads to better patient outcomes and fewer complications compared to post-intubation tracheostomy performed under general anesthesia. The primary objective was to conduct a comparative analysis of the utilization of preoperative tracheostomy under local anesthesia versus post-intubation tracheostomy under general anesthesia. Secondary objectives included comparing fundamental patient information across the two groups, assessing vital signs and analgesic administration, evaluating pain scores, and identifying complications such as bleeding or other adverse events. By providing evidence-based recommendations, the present study seeks to enhance clinical decision-making and improve outcomes for patients with Le Fort fractures, contributing valuable insights into the efficacy and implications of these two approaches[26].

Materials and Methods

The present study received approval from the Siriraj Institutional Review Board (Si-IRB), Certificate of Approval number Si 207/2024. It was also registered with the Thai Clinical Trials Registry, identifier TCTR20240710004.

The present research involved a retrospective chart review at the trauma center, university hospital in Bangkok. Data was collected using case record forms and electronic medical records. The records were anonymized by using unique codes instead of names, surnames, hospital numbers (HN), or other identifying information.

Participants were non-randomly allocated into two observational study groups, Group A with preoperative tracheostomy under local anesthesia, and Group B with post-intubation tracheostomy under general anesthesia.

The project leader and co-investigators collected data based on the predetermined sample size. To ensure confidentiality, a unique code identified each participant with Le Fort fractures II and III. Randomization of numbers in each document prevented duplicate data collection and maintained anonymity. Data integrity checks compared anesthesiologist records with nursing records from the operating room, recovery room, and other nursing units to mitigate data bias.

Inclusion criteria were patients diagnosed with Le Fort II and III fractures. Patients who underwent tracheostomy for fracture treatment. Exclusion criteria were incomplete medical records or concomitant major head and neck injuries[11].

Preoperative tracheostomy under local anesthesia

In the preoperative tracheostomy under local anesthesia intervention, patients were in supine position with neck extended to expose the trachea more effectively. Safety was prioritized by pre-oxygenating with high oxygen concentration to ensure adequate oxygen reserved before the surgical procedure. Continuous monitoring for vital signs and signs of airway obstruction, hypoxia, or other potential complications was essential, particularly during the administration of sedatives and analgesics. Surgeons administered local anesthesia to the skin and deeper tissues along the planned tracheostomy site to numb the area and minimize pain. The anesthesia team administered sedatives and analgesics as needed to ensure the patient was comfortable during the electrocauterization and tracheostomy. Surgeons then dissected the subcutaneous tissue, punctured the trachea, and inserted the tracheostomy tube through the stoma into the trachea. After confirming the placement by checking for airflow through the tube, chest rise, auscultation, and capnography, the tube was secured with ties or sutures to prevent dislodgement during surgery. The anesthesia team administered anesthetic agents and non-depolarizing muscle relaxants, and the tracheostomy tube was connected to a ventilator or oxygen source to ensure adequate ventilation before commencing facial surgery(11,17,18,22,23,26).

Post-intubation tracheostomy under general anesthesia

In the post-intubation tracheostomy under general anesthesia approach, the anesthesia team exerted significant effort in airway management while the surgical and nursing teams stand by in case of a critical situation(11,12). The anesthesia team positioned the patient comfortably to maintain the airway for breathing. Besides full monitoring and premedicating the patient with words to calm them and relieve discomfort, they administered sedatives and analgesics as minimally as possible, avoiding oversedation that could result in airway collapse. After preoxygenating the patient with high-flow oxygen, the Sellick's maneuver with cricoid pressure was applied to minimize the risk of aspiration. Techniques for endotracheal intubation, such as awake intubation with instruments like a laryngoscope, video laryngoscope, or fiberoptic bronchoscope, varied among anesthesiologists and patients' conditions. The goal was to perform this intervention with few attempts, as each insertion of a laryngoscope can displace fractured bones, increase bleeding, hematoma, facial swelling, and the risk of failing to provide a clear view of the vocal cords. After successful intubation was achieved with depolarizing muscle relaxants and the endotracheal tube correctly positioned, anesthetic agents, including non-depolarizing muscle relaxants, were administered, and the surgical procedure could begin(11,24,27).

Sample size calculation

The study aimed to investigate the optimal timing of tracheostomy in patients with Le Fort Fractures II and III. Previous studies indicated the use of local anesthesia followed by tracheostomy in 74.2% of cases among 31 patients with these fractures(28). Based on these findings, a sample size of 91 patients was calculated, with a 10% buffer to account for potential data incompleteness, resulting in a total sample size of 100 patients. The unit's report indicated an average of approximately five patients per year with Le Fort Fractures II and III necessitating tracheostomy. Data collection spanned 21 years, between February 2004 and February 2024, to gather data on 97 cases.

Statistical analysis

General patient data were analyzed using descriptive statistics. Continuous data were presented as mean ± standard deviation (SD) or as median with interquartile range (IQR): 25th percentile, 75th percentile, while categorical data were presented as frequencies and percentages The incidence of complications was reported as frequency, percentage, and accompanied by a 95% confidence interval (CI).

To compare data between the preoperative and post-intubation groups, appropriate statistical tests were applied based on the nature of the data:

Categorical data: The chi-square test or Fisher's exact test was used.

Normally distributed continuous data: The unpaired t-test was used.

Non-normally distributed continuous data: The Mann-Whitney U test was used.

Inferential statistics, including the chi-square test or Fisher's exact test, were employed to compare performance between the two groups. A p-value of less than 0.05 was considered statistically significant within a 95% CI.

Results

Ninety-seven patients with Le Fort II and III fractures were included in this retrospective study. The patients were divided into two groups. Group A consisted of 69 patients including 64 males (93%) with a median age of 26 years (IQR of 20, 36) and five females or (7%) with a median age of 29 years (IQR of 19, 48), who underwent preoperative tracheostomy under local anesthesia. Group B included 28 patients including 25 males (89%) with a median age of 29 years (IQR of 19, 48) and three females (11%) with a median age of 29 years (IQR of 19, 48), who underwent post-intubation tracheostomy

Table 1. Demographic characteristics between the two groups, A: preoperative tracheostomy under local anesthesia, and B: post-intubation tracheostomy under general anesthesia

Demographic characteristics	Tracheostomy		p-value
	Preoperative (n=69)	Post-intubation (n=28)	
Sex; n (%)			0.69
Male	64 (93)	25 (89)	
Female	5 (7)	3 (11)	
Age (years); n (%)			0.39
<18	5 (7)	5 (18)	
18 to 65	64 (93)	23 (82)	
Median (P25, P75)	26 (20, 36)	29 (19, 48)	
ASA classification; n (%)			0.54
I	42 (61)	15 (54)	
II	22 (32)	9 (32)	
III	5 (7)	4 (14)	
Le Fort type; n (%)			0.69
II	20 (29)	7 (25)	
III	49 (71)	21 (75)	
Limited neck movement; n (%)	5 (7)	2 (7)	1.00
Thyromental distance <6 cm; n (%)	3 (4)	1 (4)	1.00
Mallampati classification; n (%)			0.22
Unclassified	42 (61)	11 (39)	
I	4 (6)	3 (11)	
II	11 (16)	9 (32)	
III	5 (7)	3 (11)	
IV	7 (10)	2 (7)	
Mouth opening (cm); n (%)			0.90
Unclassified	25 (36)	12 (43)	
0.1 to 1.0	12 (17)	4 (14)	
1.1 to 2.0	23 (33)	8 (29)	
2.1 to 3.0	8 (12)	3 (11)	
3.1 to 4.0	1 (2)	1 (3)	
Co-existing conditions; n (%)	27 (39)	13 (46)	0.51
Smoking	30 (43)	16 (57)	0.22
Alcohol ingestion	30 (43)	12 (43)	0.96
Drugs Abuse	2 (3)	1 (4)	1.00
Intraoperative vital signs; mean±SD			
Body temperature (°C)	37±1	37±1	0.09
Systolic blood pressure (mmHg)	130±16	132±17	0.61
Diastolic blood pressure (mmHg)	77±10	77±11	0.91
Pulse (beats/minute)	81±12	81±12	0.89
Percutaneous O_2 saturation (%)	100±1	100±1	0.75
Clinical experience ≥5 years; n (%)			
Surgeon	69 (100)	28 (100)	1.00
Anesthesiologist	62 (90)	22 (79)	0.19

ASA=American Society of Anesthesiologists; SD=standard deviation
* p<0.05, significance

under general anesthesia. There were no statistically significant differences in the number of patients between the two groups (p=0.69) (Table 1).

The American Society of Anesthesiologists (ASA) classification for groups A and B was as follows with I, II, and III for 42 (61%), 22 (32%), and five (7%) in Group A, and 15 (54%), nine (32%), and four (14%) in Group B, respectively (p=0.54).

The distribution of Le Fort type II and III fractures was 20 (29%) and 49 (71%) in Group A, and 7 (25%) and 21 (75%) in Group B, respectively (p=0.69).

Airway assessments, including limited neck movement and thyromental distance of less than 6 cm, were five (7%) and three (4%) in Group A, and two (7%) and one (4%) in Group B, respectively (p=1.00).

Mallampati classification results for groups A and B were as follows: unclassified, I, II, III, and IV for 42 (61%), four (6%), eleven (16%), five (7%), and seven (10%) in Group A, and 11 (39%), three (11%), nine (32%), three (11%), and two (7%) in Group B, respectively (p=0.22).

Mouth opening in centimeters was recorded as unclassified, 0.1 to 1.0, 1.1 to 2.0, 2.1 to 3.0, and 3.1 to 4.0 for 25 (36%), 12 (17%), 23 (33%), eight (12%), and one (2%) in Group A, and 12 (43%), four (14%), eight (29%), three (11%), and one (3%) in Group B, respectively (p=0.90).

Co-existing conditions such as smoking, alcohol ingestion, and drug abuse were found in 30 (43%), 30 (43%), and two (3%) of Group A, and 16 (57%), 12 (43%), and one (4%) of Group B, respectively (p=0.22, 0.96, and 1.00).

Intraoperative vital signs, including body temperature, blood pressure, heart rate, and oxygen saturation, were comparable between the two groups. Surgeon and anesthesiologist experience of five years or longer was noted in 69 (100%) and 62 (90%) of Group A, and 28 (100%) and 22 (79%) of Group B, respectively (p=0.22).

Most intraoperative anesthetic administrations, including induction agents, muscle relaxants, and analgesics, were comparable between the two groups (Table 2).

The administration of induction agents, including Midazolam, Thiopental, and Propofol, were recorded in Group A as 32 (46%), 20 (29%), and 48 (70%), respectively, and in Group B as six (21%), five (18%), and 19 (68%), respectively (p=0.023, 0.26, and 0.87).

The use of non-depolarizing muscle relaxants such as Atracurium, Cisatracurium, Pancuronium, Vecuronium, and Rocuronium, were observed in Group A as 31 (45%), 15 (22%), 17 (25%), four (6%), and two (3%), respectively, and in Group B as 13 (46%), 10 (36%), three (11%), 0 (0%), and two

Table 2. Intraoperative anesthetics administration including induction agents, muscle relaxants, and analgesics were compared between the two groups, A: preoperative tracheostomy under local anesthesia, and B: post-intubation tracheostomy under general anesthesia

Intravenous anesthetics administration	Tracheostomy; n (%)		p-value
	Preoperative (n=69)	Post-intubation (n=28)	
Induction agents			
Midazolam	32 (46)	6 (21)	0.02
Thiopenthal	20 (29)	5 (18)	0.26
Propofol	48 (70)	19 (68)	0.87
Muscle relaxant			
Depolarizing agent	1 (1)	8 (29)	<0.001*
Non-depolarizing agent			0.21
• Atracurium	31 (45)	13 (46)	
• Cisatracurium	15 (22)	10 (36)	
• Pancuronium	17 (25)	3 (11)	
• Vecuronium	4 (6)	0 (0)	
• Rocuronium	2 (3)	2 (7)	
Analgesics			
Fentanyl	52 (75)	19 (68)	0.46
Morphine	57 (83)	26 (93)	0.34
Pethidine	3 (4)	0 (0)	0.55
Paracetamol	3 (4)	5 (18)	0.04

* p<0.05, significance

(7%), respectively (p=0.21). However, the use of depolarizing muscle relaxants showed a statistically significant difference between Group A at 1% and Group B at 29% (p<0.001).

The administration of analgesics, including Fentanyl, Morphine, Pethidine, and Paracetamol, were recorded in Group A as 52 (75%), 57 (83%), three (4%), and three (4%), respectively, and in Group B as 19 (68%), 26 (93%), 0 (0%), and 5 (18%), respectively (p=0.46, 0.34, 0.55, and 0.042).

Airway management parameters, including difficult mask ventilation, the number of intubation attempts as one and more than one, use of specialized equipment such as laryngoscope and video laryngoscope, and incidences of difficult or failed intubation, were evaluated. In Group A, which underwent preoperative tracheostomy under local anesthesia, the rates were as follows: difficult mask ventilation in five patients (17%), one intubation attempt in 26 patients (90%) and more than one intubation attempts in three patients (10%), use of a laryngoscope in 18 patients (62%) and a video laryngoscope in 11 patients (38%), difficult intubation in seven patients (24%), and failed intubation in one patient (4%) (Table 3).

Table 3. Airway management between the two groups, A: preoperative tracheostomy under local anesthesia, and B: post-intubation tracheostomy under general anesthesia

Airway management	Tracheostomy		p-value
	Preoperative (n=69)	Post-intubation (n=28)	
Timing of tracheostomy (minutes)#; mean±SD	19±7	14±6	0.004*
Difficult mask ventilation†; n (%)		5 (17)	
Difficult intubation†; n (%)		7 (24)	
Intubation attempt (times)@; n (%)			
1		26 (90)	
>1		3 (10)	
Specialized equipment@; n (%)			
Laryngoscope		18 (62)	
Video laryngoscope		11 (38)	
Failed intubation@; n (%)		1 (4)	

SD=standard deviation

* p<0.05, significance

† 1 intubation attempt in 26 patients (90%) and ≥1 intubation attempts in 3 patients (10%), use of a laryngoscope in 18 patients (62%)

Mean difference 4.59 (95% CI 1.51 to 7.66)

The timing of tracheostomy was significantly different between Group A at 19±7 minutes and Group B at 14±6 minutes, with Group A taking longer (p<0.004).

Postoperative pain management and patient outcomes, such as vital signs, pain score, analgesic administration, post-anesthesia care unit (PACU) time, bleeding, tracheostomy removal, and length of stay, appeared comparable between the two groups (Table 4).

Vital signs, including body temperature in degree Celsius (°C), systolic blood pressure (mmHg), diastolic blood pressure (mmHg), pulse rate (beats/minute), and percutaneous oxygen saturation (%), were recorded as 37.4±0.9, 140.9±17.5, 84.3±13.2, 89.7±15.9, and 100±1 in Group A, and 37.1±0.6, 143.2±20, 82.8±15.6, 86.8±1, and 100±1 in Group B, respectively (p=0.08, 0.58, 0.62, 0.42, and 0.75).

Pain scores and the administration of analgesics, including Fentanyl, Morphine, Pethidine, Dynastat, and Ketorolac, were as follows: in Group A, the pain score was 5.5±4.2, with two patients (3%) receiving Fentanyl, 36 patients (52%) receiving Morphine, seven patients (10%) receiving Pethidine, three patients (4%) receiving Dynastat, and two patients (3%) receiving Ketorolac. In Group B, the pain score was 4.2±3.9, with two patients (7%) receiving Fentanyl, 15 patients (54%) receiving Morphine, and two patients (7%) receiving Ketorolac. No patients in Group B received Pethidine or Dynastat (p=0.58, 0.90, 0.19, 0.55, and 0.58).

Table 4. Postoperative pain management and patients outcomes between the two groups, A: preoperative tracheostomy under local anesthesia, and B: post-intubation tracheostomy under general anesthesia

Postoperative pain management & patients outcomes	Tracheostomy		Effect size# (95% CI)	p-value
	Preoperative (n=69)	Post-intubation (n=28)		
Vital signs; mean±SD				
Body temperature (°C)	37.4±0.9	37.1±0.6	0.31 (–0.04 to 0.67)	0.08
Systolic blood pressure (mmHg)	140.9±17.5	143.2±20.0	–2.28 (–10.40 to 5.84)	0.58
Diastolic blood pressure (mmHg)	84.3±13.2	82.8±15.6	1.55 (–4.64 to 7.75)	0.62
Pulse (beats/minute)	89.7±15.9	86.8±1	2.89 (–4.26 to 10.04)	0.42
Percutaneous O_2 saturation (%)	99.6±0.8	99.7±0.7	–0.06 (–0.40 to 0.29)	0.75
Pain score; mean±SD	5.5±4.2	4.2±3.9	1.31 (–0.54 to 3.15)	0.16
Analgesics; n (%)				
Fentanyl	2 (3)	2 (7%)	0.40 (0.06 to 2.74)	0.58
Morphine	36 (52)	15 (54%)	0.97 (0.65 to 1.47)	0.90
Pethidine	7 (10)	0 (0%)	NA	0.19
Dynastat	3 (4)	0 (0%)	NA	0.55
Ketorolac	2 (3)	2 (7%)	0.41 (0.06 to 2.74)	0.58
PACU time (minutes); mean±SD	80.9±33.7	72.3±32.0	8.62 (–6.17 to 23.42)	0.25
Bleeding; n (%)	8 (12)	0 (0%)	NA	0.01
Tracheostomy removal (days); mean±SD	4.4±2.7	5.0±2.4	–0.62 (–1.77 to 0.54)	0.29
Length of stay (days); mean±SD	9.6±6.8	9.7±7.4	–0.16 (–3.26 to 2.93)	0.92

* p<0.05, significance

Effect size for quantitative outcome showed as mean difference (preoperative and post-intubation) and for qualitative outcome showed as relative risk (reference: post-intubation)

The PACU time, in minute, bleeding, tracheostomy removal time in days, and length of hospital stay in days were recorded as follows: in Group A, the PACU time was 80.9±33.7 minutes, eight patients (12%) experienced bleeding, tracheostomy removal occurred at 4.4±2.7 days, and the length of stay was 9.6±6.8 days. In Group B, the PACU time was 72.3±32.0 minutes, no patients experienced bleeding, tracheostomy removal occurred at 5.0±2.4 days, and the length of stay was 9.6±6.8 days (p=0.25, 0.01, 0.29, 0.92). Additionally, the incidence of bleeding was 8% (95% CI 4 to 16) in Group A and 0% in Group B.

Discussion

The comparative analysis revealed that the majority of patients with Le Fort fractures were males between the ages of 18 and 65. The timing of preoperative tracheostomy under local anesthesia was significantly longer than post-intubation tracheostomy under general anesthesia (p<0.004). However, the anesthesia team encountered unexpected, failed intubation in one patient under general anesthesia, necessitating waking the patient and switching to preoperative tracheostomy under local anesthesia. On the other hand, during preoperative tracheostomy under local anesthesia, the anesthesia team had to administer general anesthesia to calm an uncooperative patient for endotracheal intubation. Thus, the use of depolarizing muscle relaxants revealed statistically significant differences between the two groups (p<0.001). Additionally, preoperative tracheostomy under local anesthesia clinically resulted in better patient outcomes and fewer complications[26].

Studies have shown that males, particularly younger males, are more likely to engage in risk-taking behaviors. Statistical analyses of traffic accidents indicate that males are more frequently involved in severe crashes than females, primarily due to higher speeds, aggressive driving, lower seatbelt usage, and increased alcohol and substance abuse[9,12,13,16,17,29-31].

Additionally, males are disproportionately employed in high-risk occupations such as construction and manufacturing, and they participate more frequently in extreme sports and physical altercations, often in potentially hazardous environments. These factors collectively contribute to a higher incidence of severe facial trauma among males[12,13,29,32].

The study revealed that the timing of preoperative tracheostomy under local anesthesia was significantly longer than post-intubation tracheostomy under general anesthesia (p<0.004). This discrepancy was attributed to the complexity of airway management under local anesthesia, rather than the experience of the surgeon and anesthesiologist (p=0.22). Lee et al. found that the average procedure time for tracheostomy was 35.2 minutes, while tracheal intubation, including temporary draping, took 36.9 minutes, highlighting the relative efficiency of different airway management techniques in maxillofacial trauma patients[14].

Preoperative tracheostomy under local anesthesia is often preferred by anesthesiologists for its ease in securing the airway and preventing airway compromise[2,3]. They caution against post-intubation tracheostomy under general anesthesia or awake intubation under sedation due to the potential for severe facial structural distortion caused by soft tissue swelling, swollen tongue, fragile tissues, or debris from fractures with bleeding. These factors can lead to a false airway passage, complicating the procedure. In addition, endotracheal intubation under general anesthesia may not be suitable for patients with cervical spine instability that compromises the upper airway, making nasotracheal or orotracheal intubation difficult or impossible[33]. Moreover, securing the endotracheal tube, managing secretions, and ensuring proper humidification and oxygenation necessitate additional resources and careful monitoring[14,34].

Notably, preoperative tracheostomy can be efficiently performed by the surgical team under local infiltration. This approach enhances surgical access, visualization, and reduces the risk of bleeding and intraoperative instability. Collaboratively, the administration of analgesics and mild sedation with oxygenation and close monitoring by the anesthesia team improves patient comfort and communication, reducing the risk of intraoperative complications. Additionally, preoperative tracheostomy leads to smoother perioperative anesthetic management, minimizes the risk of airway compromise, enhances intraoperative monitoring and airway control, and improves patient outcomes due to better oxygenation and ventilation. It provides a secure and stable airway for long-term ventilation[33], facilitates easier management of surgical wounds, and allows for appropriate weaning from mechanical ventilation, thus shortening intensive care unit (ICU) stays.

Despite anesthesiologists advocating early tracheostomy as a potential option, its use remains controversial due to surgeons suggesting that preoperative tracheostomy may not be necessary in emergency cases, as awake endotracheal intubation can be effective. Instead, surgeons recommend early removal of the endotracheal tube and conversion to a tracheostomy tube after induction of anesthesia and intubation[35]. Additionally, surgeons express concerns about the potential risks and complications associated with preoperative tracheostomy, including airway obstruction, breathing difficulties, soft tissue swelling, aspiration, and vocal cord injury. While local anesthesia can numb the surgical site, patients may still experience discomfort, limiting their cooperation during the procedure. The visible scar left by tracheostomy and the potential discomfort if relied on for an extended period are also significant considerations for patient satisfaction. Furthermore, this intervention is considered a necessary precaution for airway protection during the recovery period and can facilitate improved airway management, patient comfort, early mobilization, and recovery. Thus, the surgical team must prioritize patient comfort and well-being and ensure effective communication during the procedure[34,36].

Although post-intubation tracheostomy under general anesthesia was significantly faster than preoperative tracheostomy under local anesthesia, challenges arose during the intervention. In eight cases under general anesthesia with depolarizing muscle relaxants, the anesthesia team encountered unexpected, failed intubation in only one case, requiring the patient to be awakened and a preoperative tracheostomy to be performed under local anesthesia. Conversely, during preoperative tracheostomy under local anesthesia, the anesthesia team sometimes had to administer general anesthesia to calm an uncooperative patient for endotracheal intubation[14,25,27].

Barak et al. supported these findings, emphasizing the complexities of airway management and highlighting that tracheostomy under local anesthesia is a lifesaving procedure for selected patients in “cannot intubate, cannot ventilate” situations[2-4]. Additionally, Mohan et al. and Lee et al. noted the challenges associated with preoperative tracheostomy in maxillofacial trauma, but they also pointed out that this approach offers better airway control. However, studies by Lee et al. and Kita et al. presented differing views on the effectiveness of this approach[31,34].

Despite these procedural differences, patient outcomes, including vital signs, bleeding, pain scores, pain management, PACU time, ventilation weaning, tracheostomy tube removal, and length of stay, showed no significant differences between the groups. This reflected the efficiency and effectiveness of collaboration among surgical, anesthesia, and nursing teams. Barak et al. discussed algorithms for airway management, underscoring the importance of a systematic approach and supporting evidence-based recommendations[4].

As a result, the hypothesis that preoperative tracheostomy under local anesthesia results in better patient outcomes and fewer complications than post-intubation tracheostomy under general anesthesia was clinically, but not statistically significant[31].

Limitation

It is crucial to acknowledge certain limitations of the present study. Firstly, the retrospective design inherently limits causal inference. Unlike randomized controlled trials, retrospective studies are observational and can only establish associations rather than causality. This limitation means that the findings must be interpreted with caution, as they do not prove a direct cause-and-effect relationship between the interventions and outcomes observed. Future research using a randomized controlled trial design would be more robust in establishing causality and determining the efficacy of the different approaches to tracheostomy timing in patients with Le Fort fractures.

Secondly, the present study was conducted at a single center, which may limit the generalizability of the results to other settings. Single-center studies can introduce biases related to specific institutional practices, patient populations, and healthcare provider expertise. The findings might not be applicable to different hospitals, regions, or healthcare systems with varying protocols and resources. Multi-center studies involving diverse populations and settings would be beneficial to confirm the generalizability of the results and to ensure that the findings are applicable across a broader spectrum of clinical environments.

Thirdly, despite rigorous data collection efforts, there remains a potential for selection bias. Selection bias could occur if the patients included in the study are not representative of the broader population of individuals with Le Fort fractures. Factors such as the severity of the fractures, comorbid conditions, and the specific criteria for performing tracheostomy could influence the study population, thereby affecting the outcomes. Although measures were taken to ensure comprehensive data collection and coding, the non-random allocation of patients into study groups may have introduced biases that could impact the study's findings. Future studies should aim to use randomized patient selection and allocation methods to minimize selection bias and provide a more accurate assessment of the interventions' effectiveness.

Addressing these limitations in future research will enhance the validity and reliability of the findings, contributing to a more comprehensive understanding of the optimal timing and techniques for tracheostomy in patients with Le Fort fractures.

Suggestions for future study

Future research should aim to address the limitations identified in the present study. Additionally, it should include long-term follow-up to assess the outcomes of different tracheostomy timing approaches beyond the immediate postoperative period. Long-term data would provide valuable insights into the sustained effects, potential complications, and overall impact on patient quality of life.

Exploring additional variables that may influence outcomes, such as the severity of the fractures, patient comorbidities, and specific surgical techniques, could further refine the understanding of optimal tracheostomy timing. Investigating these factors systematically would contribute to personalized and evidence-based clinical decision-making.

Lastly, qualitative studies exploring patient and healthcare provider perspectives on tracheostomy timing could provide a holistic view of the decision-making process and identify potential areas for improvement in clinical practice. Understanding the experiences and preferences of patients and clinicians can guide the development of patient-centered care protocols and enhance the overall management of Le Fort fractures.

Conclusion

Le Fort fractures pose significant challenges for airway management, requiring meticulous coordination among surgical, anesthesia, and nursing teams. The debate over the optimal timing and approach for tracheostomy—whether preoperative under local anesthesia or post-intubation under general anesthesia—remains unresolved. The present study seeks to fill the gap in literature by comparing these two methods, hypothesizing that preoperative tracheostomy under local anesthesia yields better outcomes. Through a detailed comparative analysis, the study aims to provide evidence-based recommendations, enhancing clinical decision-making and improving patient care in cases of Le Fort fractures.

What is already known about this topic?

Le Fort fractures, particularly types II and III, present complex challenges in airway management due to facial trauma, swelling, bleeding, and structural instability. These fractures make intubation and ventilation difficult, necessitating a well-coordinated approach between surgical, anesthesia, and nursing teams. The optimal timing for tracheostomy in these patients is a topic of debate. Historically, clinicians favored preoperative tracheostomy under local anesthesia, which allows for airway control before surgery. However, more recent practices include post-intubation tracheostomy under general anesthesia. Each approach has its benefits and risks, with anesthesiologists often advocating for preoperative tracheostomy to secure the airway before complications arise, while surgeons may prefer post-intubation tracheostomy to avoid early intervention. Despite the importance of timely airway management, comprehensive comparative studies examining the outcomes of these different tracheostomy timings in patients with Le Fort fractures are limited, and no consensus exists on the best approach.

What does this study add?

This study provides a systematic comparative analysis of preoperative tracheostomy under local anesthesia versus post-intubation tracheostomy under general anesthesia in patients with Le Fort II-III fractures. It highlights that preoperative tracheostomy, though taking longer, results in better patient outcomes and fewer complications compared to the post-intubation approach. The findings support a more favorable outcome for preoperative tracheostomy, enhancing clinical decision-making by providing evidence-based recommendations for optimizing airway management in these patients. This study contributes significantly to filling the gap in literature, offering insights into the most effective tracheostomy timing for improving patient safety and reducing complications.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Yang J, Trivedi A, Alvarez Z, Bhattacharyya R, Sartorato F, Gargano F, et al. Predicting difficult airway intubation based on maxillofacial trauma: A retrospective study. Cureus 2022;14:e24844.
2. Mohan R, Iyer R, Thaller S. Airway management in patients with facial trauma. J Craniofac Surg 2009;20:21-3.
3. Lee SS, Huang SH, Wu SH, Sun IF, Chu KS, Lai CS, et al. A review of intraoperative airway management for midface facial bone fracture patients. Ann Plast Surg 2009;63:162-6.
4. Barak M, Bahouth H, Leiser Y, Abu El-Naaj I. Airway management of the patient with maxillofacial trauma: Review of the literature and suggested clinical approach. Biomed Res Int 2015;2015:724032. doi: 10.1155/2015/724032.
5. Jacomet A, Tasman AJ. Airway management in facial trauma patients. Facial Plast Surg 2015;31:319-24.
6. Saini S, Singhal S, Prakash S. Airway management in maxillofacial trauma. J Anaesthesiol Clin Pharmacol 2021;37:319-27.
7. Ray BR, Baidya DK, Goswami D, Trikha A, Roychoudhury A, Bhutia O. Anaesthetic management of maxillofacial trauma. Trends in Anaesthesia and Critical Care 2013;3:231-7.
8. Moe J, Steed MB. Le fort II and III fractures. In: Bagheri SC, editor. E-Book: Clinical review of oral and maxillofacial surgery A case-based approach. St. Louis, Missouri: Elsevier; 2013. p. 270-82.e1.
9. Glasheen J, Hennelly D, Cusack S. Maxillofacial injury-not always a difficult airway. Prehosp Disaster Med 2015;30:421-4.
10. Pswarayi R, Burns C. Le Fort III fractures: An approach to resuscitation and management. Ann Med Surg (Lond) 2022;81:104513. doi: 10.1016/j.amsu.2022.104513.
11. Krohner RG. Anesthetic considerations and techniques for oral and maxillofacial surgery. Int Anesthesiol Clin 2003;41:67-89.
12. Emara TA, El-Anwar MW, Omara TA, Anany A, Elawa IA, Rabea MM. Submental intubation versus tracheostomy in maxillofacial fractures. Oral Maxillofac Surg 2019;23:337-41.
13. Kummer C, Netto FS, Rizoli S, Yee D. A review of traumatic airway injuries: potential implications for airway assessment and management. Injury 2007;38:27-33.
14. Le TT, Oleck NC, Khan W, Halsey JN, Liu FC, Hoppe IC, et al. Implications of facial fracture in airway management of the adult population: What is the most effective management strategy? Ann Plast Surg 2019;82(4S Suppl 3):S179-84.
15. Phillips BJ, Turco LM. Le Fort fractures: A collective review. Bull Emerg Trauma 2017;5:221-30.
16. Hernández EF, Villegas SB, Aguilera-Callejas DE, González JMG, Cortés-Contreras AP, Gómez-González J, et al. Le Fort fractures: a review. Int J Surg 2024;11:1047-50.
17. Oliveira-Campos GH, Lauriti L, Yamamoto MK, Júnior RC, Luz JG. Trends in Le Fort fractures at a South American Trauma Care Center: Characteristics and management. J Maxillofac Oral Surg 2016;15:32-7.
18. Luqman U, Qayyum MU, Tasneem S, Ullah K, Khan

M, Khan J. Our experience of submental intubation: a reliable alternative to elective tracheostomy in maxillofacial trauma patients. Anaesth Pain Intensive Care 2018;22 Suppl 1:S113-7.
19. Ghabach MB, Abou Rouphael MA, Roumoulian CE, Helou MR. Airway management in a patient with Le Fort III fracture. Saudi J Anaesth 2014;8:128-30.
20. Jain U, McCunn M, Smith CE, Pittet JF. Management of the traumatized airway. Anesthesiology 2016;124:199-206.
21. Kovacs G, Sowers N. Airway management in trauma. Emerg Med Clin North Am 2018;36:61-84.
22. Ghysen D, Ozsarlak O, van den Hauwe L, Van Goethem J, De Schepper AM, Parizel PM. Maxillofacial trauma. JBR-BTR 2000;83:181-92.
23. Chukwulebe S, Hogrefe C. The diagnosis and management of facial bone fractures. Emerg Med Clin North Am 2019;37:137-51.
24. Agrawal M, Kang LS. Midline submental orotracheal intubation in maxillofacial injuries: A substitute to tracheostomy where postoperative mechanical ventilation is not required. J Anaesthesiol Clin Pharmacol 2010;26:498-502.
25. Singh S, Kumar S, Kumar K, Gupta B. Anesthetic challenges and management of maxillofacial trauma. J Anesth Surg 2017;4:134-40.
26. Raval CB, Rashiduddin M. Airway management in patients with maxillofacial trauma - A retrospective study of 177 cases. Saudi J Anaesth 2011;5:9-14.
27. Malhotra N. Submento-tracheal intubation. J Anaesthesiol Clin Pharmacol 2012;28:287-90.
28. Thompson JN, Gibson B, Kohut RI. Airway obstruction in LeFort fractures. Laryngoscope 1987;97:275-9.
29. Bagheri SC, Holmgren E, Kademani D, Hommer L, Bell RB, Potter BE, et al. Comparison of the severity of bilateral Le Fort injuries in isolated midface trauma. J Oral Maxillofac Surg 2005;63:1123-9.
30. Cherpitel CJ, Witbrodt J, Ye Y, Monteiro MG, Málaga H, Báez J, et al. Road traffic injuries and substance use among emergency department patients in the Dominican Republic and Peru. Rev Panam Salud Publica 2021;45:e31.
31. Kita R, Kikuta T, Takahashi M, Ootani T, Takaoka M, Matsuda M, et al. Efficacy and complications of submental tracheal intubation compared with tracheostomy in maxillofacial trauma patients. J Oral Sci 2016;58:23-8.
32. Yoffe T, Shohat I, Shoshani Y, Taicher S. Etiology of maxillofacial trauma--a 10-year survey at the Chaim Sheba Medical Center, Tel-Hashomer. Harefuah 2008;147:192-6, 280.
33. Mittal G, Mittal RK, Katyal S, Uppal S, Mittal V. Airway management in maxillofacial trauma: do we really need tracheostomy/submental intubation. J Clin Diagn Res 2014;8:77-9.
34. Lee KC, Chuang SK, Eisig SB. The characteristics and cost of Le Fort fractures: A review of 519 cases from a nationwide sample. J Oral Maxillofac Surg 2019;77:1218-26.
35. Schütz P, Hamed HH. Submental intubation versus tracheostomy in maxillofacial trauma patients. J Oral Maxillofac Surg 2008;66:1404-9.
36. Ikeda AK, Burke AB. LeFort fractures. Semin Plast Surg 2021;35:250-5.