

Stability of Nasoendotracheal Tube with Transeptal Flower Stitch versus Simple Surgical Knot in Patients undergoing Maxillofacial Trauma Surgery: A Cross-sectional Study

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ABSTRACT

Introduction: Nasoendotracheal (NET) tubes are exposed to various external forces, handling, slippage, and accidental extubation, with the potential for fatal complications. In the modern era, several techniques have been developed to reduce the complication rate of Nasoendotracheal Intubation (NTI). NET tubes can be secured using twill or cotton tape, adhesive tape, gauze, or a manufactured device, either individually or in combination. In present study, a transcolumellar stitch and transeptal stitch were designed with 2-0 silk suture material and utilised by many anaesthetists and surgeons to secure the NET, providing good stability but sometimes leading to columellar ischaemia and cutting through.

Aim: To compare the intraoperative stability of Nasoendotracheal Tubes (NETT) secured by a transept flower stitch with those secured using a simple surgical knot in patients undergoing NET Intubation (NETI) for open reduction and internal fixation of maxillofacial trauma.

Materials and Methods: This cross-sectional study was conducted in the Department of Oral and Maxillofacial Surgery at Sharad Pawar Dental College and Hospital and Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha, Maharashtra, India, over a period of six months from March 2023 to August 2023. The study involved 30 patients with maxillofacial fractures who were divided into two groups. Preoperative assessments

included case history, physical examinations, and maxillofacial evaluations. Patients were divided into two groups: Group A underwent simple surgical knot using 2-0 silk suture (odd-numbered patients), while patients in Group B underwent transeptal flower stitch using 2-0 silk suture (even-numbered patients). All parameters were recorded by the same surgeon at the beginning and end of the procedure. The data was collected, tabulated, and statistically analysed using Statistical Package for the Social Sciences (SPSS) statistical software version 23.0.

Results: Out of the total 30 patients enrolled in the study, 24 (80%) were male and 6 (20%) were female. The comparison between the two groups regarding the duration of surgery showed no statistically significant difference. Three parameters, namely the amount of NETT displacement, nasal tip laceration, and tip ischaemia, were evaluated and recorded both preoperatively and immediately after extubation. The amount of NETT displacement (p -value=0.031) and nasal tip laceration, haemorrhage, or necrosis (p -value=0.049) were shown to differ statistically significantly between the groups.

Conclusion: The present study highlighted that the flower stitch method is an extremely beneficial approach. It offers advantages in terms of better stability and is associated with fewer complications and lower morbidity when compared to the simple surgical knot group.

Keywords: Anaesthesia, Silk suture, Transcolumellar stitch

INTRODUCTION

Anaesthesiology is a very important part of every surgical subject [1]. Maxillofacial trauma patients are at great risk of airway obstruction. Patients with head injuries and maxillofacial trauma with a moderate to severely degraded Glasgow Coma Score (GCS) may require oral or nasal intubation to maintain the airway. The management of maxillofacial injuries may involve open reduction and internal fixation under general anaesthesia, making airway management a crucial aspect of anaesthesia administration for surgical procedures [2].

These methods encompass various techniques, such as using bag-mask methods, inserting airways through oral or nasal passages, employing supraglottic airway devices, conducting oral or NETI, performing percutaneous dilated cricothyroidotomy, or resorting to tracheostomy [1].

The NTI which involves passing a tracheal tube through the nose, facilitates better surgical access for intraoral procedures. The nasal intubation technique was first described in 1902 by Kuhn [3]. NTI involves two primary anatomical pathways within the nostril for the passage of the endotracheal tube [4]. The lower pathway runs along the floor of the nose, situated below the inferior turbinate, while the

upper pathway is located above the inferior turbinate and beneath the middle turbinate. When the tube is inserted into one pathway, migration to the other pathway is typically impeded by the medial border of the inferior turbinate near the nasal septum [4].

Operating in the head and neck region involves various degrees of head manipulations and movement to gain appropriate access to the surgical sites. One of the most common complications is epistaxis, a characteristic feature of many septal deviations that can occasionally pose challenges, even when vasoconstrictors minimally affect nasal function [5]. Therefore, patient comfort is equally important, necessitating the use of a small, softened, well-lubricated tube and ensuring patent nostrils. Thus, ensuring the secure stabilisation of the endotracheal tube is widely recognised as a critical step to prevent unintended movement that might lead to patient extubation or cause potential harm to the nasal tissues.

Many methods and devices have been attempted for fixation of these tubes for various types of surgical procedures on the face. Blood, saliva, and disinfectant solutions interfere with tape adhesion [6]. During maxillofacial surgeries, anaesthesiologists must ensure that the operating team has optimal access to the head region of

the patient while maintaining the security of the endotracheal tube [7]. Some methods relying on tape for stabilising equipment can be unreliable, as the effectiveness of the tape may diminish after surgical site scrubbing with betadine, due to perspiration, or when dealing with oily skin. Adhesive tapes, velcro tapes, or devices with compressible materials placed around the head can pose issues due to pressure on sensitive areas like ear cartilage and the eyes. Additionally, custom-made holders may not universally accommodate all types of breathing circuits and may not be readily available in all operating room settings [8].

Due to all these aforementioned problems, a new technique was designed to secure the NETT using 2-0 silk suture material, which is readily available in any operating room setup. This technique includes the transeptal passing of a long 2-0 silk suture material, tied at the other end in a simple surgical knot or a flower-type knot, i.e., a three double-thread knot is used to make a flower, securing the tube to the nasal septum. The goal of the present study was to make a comparison of the intraoperative stability of a NETT secured by a transeptal flower stitch with those secured using a simple surgical knot in patients undergoing NTI for open reduction and internal fixation of maxillofacial trauma.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Department of Oral and Maxillofacial Surgery at Sharad Pawar Dental College and Hospital in Collaboration with Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha, Maharashtra, India. The study lasted for six months, from March 2023 to August 2023, after obtaining approval from the Institutional Ethical Committee [DMIHER(DU)/IEC/2023/752]. All subjects available during the study period were included. The study involved the analysis of 30 consecutive patients with maxillofacial fractures (15 in each group).

Inclusion and Exclusion criteria: The study included individuals aged 18 to 60 years diagnosed with maxillofacial fractures who underwent surgical open reduction and internal fixation requiring nasal intubation. Excluded from the study were neonatal and paediatric patients, those with contraindications for nasal intubation, cases indicated for closed reduction, patients unfit for surgery, and patients with nasal septal injuries. Explicit consent was obtained from each patient participating in the research.

Study Procedure

Preoperative assessments were conducted, including a comprehensive case history, physical and local examinations, and maxillofacial evaluations. Radiological investigations, such as computed tomography, were performed, and all findings were meticulously recorded in a detailed case history form. The study participants were then divided into two groups: Group A, which involved a simple surgical knot [Table/Fig-1] using 2-0 silk suture (odd-numbered patients), and Group B, which utilised a transeptal flower stitch using 2-0 silk suture (even-numbered patients) [Table/Fig-2].



[Table/Fig-1]: Simple surgical knot. **[Table/Fig-2]:** Transeptal flower stitch. (Images from left to right)

Surgical protocol: After meticulously adhering to aseptic conditions, the anaesthetist initiated the standard NTI. In Group A,

the procedure involved tying the ends of a 2-0 silk suture material into a simple surgical knot, followed by the passage of the needle transeptally through the other nostril [Table/Fig-3].

Amount of NETT displacement (in cm)	Grade
No displacement	0
1 cm	1
2 cm	2
More than 3 cm	3
Complete accidental extubation	4

[Table/Fig-3]: Scale used for grading the NETT displacement.

In contrast, Group B involved tying the ends of a 2-0 silk suture material into a three double-thread knot to create a flower, with the needle then passed transeptally through the other nostril [Table/Fig-4].

Incidence	Present	Absent
Grade	1	0

[Table/Fig-4]: Nasal septal injury/laceration.

The NETT was secured by fastening the suture knots around it, ensuring the tube's stability. Pre-procedural markings were made on the endotracheal tube and documented by the surgeon.

Following the completion of the surgical procedure, the same surgeon reassessed the markings on the NETT just before the reversal of general anaesthesia and patient extubation. All parameters were consistently recorded by the same surgeon at the commencement and conclusion of the procedure.

The present study evaluated three key parameters. The primary outcome was determined by measuring the amount of NETT displacement or change in position, recorded in centimeters according to a specific scale designed to note both intraoperative and postoperative changes in tube position, ranging from minor displacements to those potentially leading to accidental extubations [Table/Fig-3]. They were graded from 0-4, i.e., No displacement (Grade-0), 1 cm displacement (Grade-1), 2 cm displacement (Grade-2), More than 3 cm displacement (Grade-3), and complete accidental extubation (Grade-4). The secondary outcomes included the presence or absence of nasal septal injury or laceration [Table/Fig-4] and the presence or absence of nasal tip ischaemia [Table/Fig-5], with these parameters denoted as "1" for present and "0" for absent. All observations and results were compiled in a master chart and subsequently analysed.

Incidence	Present	Absent
Grade	1	0

[Table/Fig-5]: Nasal tip ischaemia.

STATISTICAL ANALYSIS

The data for this study was entered into Microsoft Excel 2007 and analysed using SPSS version 23.0. Descriptive statistics included frequency, percentage, mean, and standard deviation. A significance level of 5% was used. Intergroup comparisons of ordinal variables were done using the Chi-square test, while comparisons of continuous variables were conducted using the independent t-test, depending on data normality.

RESULTS

In this comparative study, there were a total of 30 patients, evenly distributed with 15 (50%) individuals in each group. Among the participants, 24 (80%) were male, and 6 (20%) were female. The average duration of surgery in Group A was approximately 3.1473 hours, whereas in Group B, it averaged around 3.0567 hours. The comparison between the two groups regarding the duration of

surgery showed no statistically significant difference, as indicated by a p-value of 0.778 (comparison was done using the independent t-test depending on the normality of the data) [Table/Fig-6].

Group	Mean	SD	SE	p-value
Group A	3.1473	0.81544	0.21054	0.778 (Non significant)
Group B	3.0567	0.63029	0.16274	

[Table/Fig-6]: Showing the duration of surgery performed in both groups.

In Group A (simple surgical knot), 9 (60%) of the patients exhibited Grade-0 NETT displacement, while 4 (26.7%) had Grade-1 displacement, and there was 1 (6.7%) patient each with Grade-2 and Grade-3 displacement. In contrast, Group B (transeptal flower stitch) showed a different pattern, with 12 (80%) of the patients demonstrating Grade-0 displacement, 1 (6.7%) patient each with Grade-1 and Grade-2 displacement, and none with Grade-3 displacement, as presented in [Table/Fig-7].

Group	Grade-0	Grade-1	Grade-2	Grade-3	p-value
Group A	9	4	1	1	0.031 (Significant)
	60.0%	26.7%	6.7%	6.7%	
Group B	12	1	1	0	
	80.0%	6.7%	6.7%		

[Table/Fig-7]: Intergroup comparison of Nasoendotracheal Tube (NETT) displacement between the groups.

These findings exhibited statistical significance, indicated by a p-value of 0.031 suggesting that Group B displayed superior NETT stability compared to Group A.

The comparison between the two groups regarding nasal septal injury or laceration is detailed in [Table/Fig-8]. In Group A, 13 (87.6%) of the patients had no laceration, while 2 (13.3%) showed evidence of laceration. In contrast, Group B had 15 (100%) of patients with no lacerations. The results obtained by statistical evaluation showed statistical significance when the comparison was done, which was represented by $p=0.049$, indicating that Group B exhibited better results in terms of nasal septal injury or laceration compared to Group A. The intergroup comparison for nasal tip ischaemia between Group A and Group B showed that 100% of the patients did not exhibit any signs of ischaemia.

Group	Absent	Present	p-value
Group A	13	2	0.049 (Significant)
	86.7%	13.3%	
Group B	15	0	
	100%	0%	

[Table/Fig-8]: Intergroup comparison of nasal septal injury/laceration between the groups.

The intergroup comparison between Group A and Group B was statistically significant when analysed using the Chi-square test.

DISCUSSION

Once patients are intubated in the operative setup, maintenance of the airway can prove to be a challenging task [9]. The importance of adopting the NETI safe position is primarily associated with surgeries of extended duration, especially in cases where ensuring easy access to facial regions is crucial and intraoral structures are paramount. This positioning is particularly advantageous for procedures involving trauma or tumors, as it helps mitigate potential complications that can arise during lengthy surgeries. Endotracheal Tube (ETT) intubation may lead to various potential complications, such as laryngeal trauma, hypotension, hypoxemia, airway perforation, bronchospasm, and vertebral column injury. Additionally, it may result in lip ulcers, nasal skin tears, endotracheal tube dislodgement or advancement, or endotracheal tube malfunction [10].

Additionally, the endotracheal tube may become kinked (primarily at the exit angle from the nares during neck flexion or extension, as head movement is required during surgery [11]. Sometimes significant facial blistering or burns can be seen, which make it much harder to secure endotracheal tubes by many folds [12].

Various methods are employed in contemporary clinical practice to effectively secure the endotracheal tube, ensuring airway patency and minimising complications [10]. Numerous research studies have examined the advantages and disadvantages of different methods and devices for securing endotracheal tubes [11,12]. The aim is to avoid accidental extubation and ensure proper positioning of the tubes [13].

In the present study, the primary outcome measure was the amount of NETT displacement or change in position (measured in centimeters) in both groups. Ensuring tube stability is of utmost importance to optimise ventilation and prevent displacement or unintended extubation. This situation can result in serious complications, including bronchospasm, respiratory distress, and myocardial infarction. Excessive head movements during surgery can also increase the risk of accidental extubation.

The intergroup comparison between Group A and Group B regarding the NETT displacement was statistically significant, with a p-value of 0.031 indicating that Group B (transeptal flower stitch) offered better stability compared to Group A (simple surgical knot).

This aligns with a study by Clarke T et al., which conducted a 5-month investigation aiming to assess the comparability of two methods [14]. The assessment of these techniques included analysing ETT movement, malposition, dislodgement, inadvertent extubation, compromised skin integrity, damage to the pilot tube, and nurse satisfaction. The primary outcome measures compared were ETT movement. ETT malposition was assessed as being less than 3 cm or greater than 6 cm above the carina. Other aspects evaluated included dislodgement, accidental extubation, compromised skin integrity, and inadvertent cutting of the pilot tube. The results indicated that both methods were comparable concerning ETT movement exceeding 2 cm.

In present study, the secondary outcome measures were nasal septal injury/laceration and nasal tip ischaemia. The intergroup comparison between Group A and Group B revealed a statistically significant difference. However, the results for nasal tip ischaemia show that there was no statistically significant difference between both groups, as evidenced by a p-value of 1.000. This data suggested that Group B was better in terms of nasal septal injury or tip ischaemia compared to Group A.

A similar study was conducted by Landsperger JS et al., involving approximately 500 critically ill adults who were randomly assigned to receive either adhesive tape or an endotracheal tube fastener upon intubation [10]. The main objectives were to determine whether lip ulcers, ventilator-associated pneumonia, facial skin rips, or endotracheal tube dislodgement (defined as movement of at least 2 cm) occurred within 48 hours following extubation. The research findings indicate that the utilisation of an endotracheal tube fastener, as opposed to adhesive tape, can decrease the probability of a composite consequence, such as lip ulcers, facial skin rips, or endotracheal tube dislodgement.

A systematic review was conducted by Gardner A et al., with the aim of determining which approach is most effective in reducing tube displacement and minimising the occurrence of unpredicted or accidental extubations [15]. The stabilisation methods considered incorporated twill or cotton tape, adhesive tape, gauze, or manufactured devices. The key outcome of their review revealed that no single method of ETT stabilisation demonstrated superiority in minimising tube displacement or preventing unplanned extubations. Thus, it concluded that there is a need for rigorous Randomised Controlled Trials (RCTs) that clearly define and describe ETT

stabilisation methods. The call for well-designed RCTs underscores the current lack of definitive guidance in determining best practices for ETT stabilisation [15].

The simple surgical knot is easy to make and can be easily created by an inexperienced surgeon or trainee. The disadvantage is that it does not provide good stability. Therefore, the modified type of knot (flower stitch) was developed. This knot stays intact against the opposite nasal septum and holds the NETT more firmly but is a little more difficult to create compared to the simple knot. This study aims to provide evidence for determining a better modality between the simple surgical knot and the transeptal flower stitch for securing the NETT intraoperatively in patients undergoing NTI for open reduction and internal fixation of maxillofacial trauma.

Limitation(s)

The study had a small sample size due to its limited duration. The present cross-sectional study of 30 patients with maxillofacial fractures lacked a control group and did not compare procedures or outcomes to other established methods for securing the NETT. Additionally, no follow-up was conducted, limiting the conclusions to the observations within the study.

CONCLUSION(S)

The current study findings showed that no statistically significant variances were noted between the two groups regarding the third parameter, nasal tip ischaemia. However, a statistically significant difference was detected between the groups concerning the amount of NETT displacement and nasal tip laceration, bleeding, or necrosis. In conclusion, the transeptal flower stitch method, as described in present study, has proven to be an extremely beneficial approach. It offers advantages in terms of better stability and is associated with fewer complications when compared to the simple surgical knot group.

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