

Tracheostomy in Pediatric Otolaryngology: A Clinical Audit of 30 Consecutive Cases

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Abstract:

Introduction: Pediatric tracheostomy is a vital airway intervention performed for conditions such as airway obstruction, neuromuscular weakness, or prolonged ventilation. The procedure poses unique challenges due to pediatric anatomical differences and associated risks.

Materials and Methods: A prospective observational study was conducted over three years at a tertiary care hospital in Gujarat, including 30 children aged 6 months to 12 years who underwent tracheostomy. Clinical data were recorded, and descriptive analysis was performed using SPSS v25. Ethical clearance and informed consent were obtained.

Results: Out of 30 patients, 63.3% were males. The most affected age group was 8.1–10 years. TMJ ankylosis (23.3%), diphtheria (20%), and brain tumors (13.3%) were the leading indications. A total of 16 complications (53.3%) were observed, with reinsertion due to blockage (13.3%) and tracheitis (10%) being most common. The mortality rate was 20%, with 13.3% due to primary illness and 6.6% due to tracheostomy-related complications.

Conclusion: TMJ ankylosis, diphtheria, and tumors were the major indications for pediatric tracheostomy. While complication and mortality rates were notable, outcomes largely depended on the underlying condition, underscoring the need for timely management and meticulous postoperative care.

Keywords: Pediatric tracheostomy, airway obstruction, complications, TMJ ankylosis, clinical audit.

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Introduction

Pediatric tracheostomy is a critical and life-saving procedure employed in children with prolonged ventilatory needs, upper airway obstruction, or congenital anomalies of the airway. [1] While tracheostomy in adults is relatively straightforward, performing this procedure in pediatric patients presents unique anatomical and physiological challenges. [2] The pediatric airway is narrow, more compliant, and vulnerable to complications such as tracheomalacia, accidental decannulation, or stomal infections. [3] With advancements in neonatal care and prolonged mechanical ventilation, the indications for pediatric tracheostomy have evolved significantly over the past few decades. [4] Historically, pediatric tracheostomies were primarily performed in emergency settings due to acute airway obstruction. [5] However, current trends show a shift toward elective procedures, especially in children requiring long-term ventilation, neuromuscular support, or postoperative airway management. Despite its life-saving role, tracheostomy in children is associated with higher morbidity compared to adults, making it imperative to understand the

clinical profile, indications, procedural techniques, and outcomes specific to the pediatric population. [6] There remains considerable variation in practice patterns and complication rates across institutions, particularly in resource-limited settings. This study aims to evaluate and analyze 30 cases of pediatric tracheostomy performed in our tertiary care center.

Material and Methods

This was a prospective observational study conducted in the Department of ENT (Otorhinolaryngology) at a tertiary care hospital affiliated with Gujarat University. The study included a total of 30 pediatric patients who underwent tracheostomy over a span of three years. Ethical approval for the study was obtained from the Institutional Review Board, and informed consent was taken from the parents or legal guardians of all subjects enrolled in the study. Patients were recruited based on predefined inclusion criteria, and data was collected systematically using a structured proforma. Patients aged 6 months to 12 years who presented with clinical indications requiring tracheostomy were in-

cluded. These indications primarily involved upper airway obstruction, respiratory distress with stridor, excessive secretions, or neuromuscular disorders such as respiratory paralysis. Patients with neurological conditions leading to compromised airway control were also considered. Emergency cases or patients with incomplete documentation were excluded. All patients were referred from the pediatric department and underwent a full clinical evaluation by the ENT team before proceeding to surgery.

Prior to the procedure, each child was thoroughly assessed both clinically and radiologically, when needed. Preoperative evaluation included checking for signs of respiratory obstruction and assessing the need for airway access. All tracheostomies were performed under strict aseptic precautions in the operation theatre, preferably under general anesthesia, unless contraindicated. Standard operative protocols were followed for all cases. Surgical technique involved minimal, midline soft tissue dissection and gentle retraction of the thyroid isthmus. It was ensured that the anatomical variations in the pediatric airway, including smaller tracheal size and proximity to vital structures like the thymus, large vessels, and pleural dome, were carefully considered during dissection.

A vertical incision was placed over the trachea, and the trachea was stabilized using a hook before inserting the tracheostomy tube. In most cases, standard metal Jackson tracheostomy tubes of appropriate pediatric sizes were used. However, in two cases, PVC cuffed tubes were introduced due to spe-

cific clinical indications. Postoperative care included proper tracheostomy tube care, regular suctioning, humidification, and vigilant monitoring for complications such as bleeding, infection, subcutaneous emphysema, pneumothorax, or tube displacement. Parents were counseled regarding tracheostomy care and early signs of complications. Decannulation was planned based on the patient's clinical improvement and underlying condition. In cases where tracheostomy was required for long-term support due to the nature of the primary illness, decannulation was not attempted during the study period. Long-term follow-up was advised for such cases, although extended outcomes were not included in the scope of this study. The data collected was analyzed descriptively to assess indications, surgical techniques, postoperative outcomes, and complications associated with pediatric tracheostomy. Data were entered in Microsoft Excel and analyzed using SPSS version 25. Descriptive statistics were used to present results as frequencies, percentages, mean, and standard deviation. Categorical variables were compared using the Chi-square or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

Results

Out of the 30 pediatric patients, 19 (63.3%) were males and 11 (36.7%) were females, resulting in a male-to-female ratio of 2.3:1. The most commonly affected age group was 8.1–10.0 years (26.6%), followed by 4.1–6.0 years (20%). Infants aged 0–2 years constituted 10% of the cases. (Table 1&2)

Table 1: Age Spectrum of Children Requiring Tracheostomy

Age Group (Years)	Male (%)	Female (%)	Total (%)
0.0–2.0	1 (3.3%)	2 (6.7%)	3 (10.0%)
2.1–4.0	4 (13.3%)	1 (3.3%)	5 (16.6%)
4.1–6.0	3 (10.0%)	3 (10.0%)	6 (20.0%)
6.1–8.0	3 (10.0%)	1 (3.3%)	4 (13.3%)
8.1–10.0	7 (23.3%)	1 (3.3%)	8 (26.6%)
10.1–12.0	1 (3.3%)	3 (10.0%)	4 (13.3%)
Total	19 (63.3%)	11 (36.7%)	30 (100%)

The most common clinical indication for tracheostomy was TMJ ankylosis (23.3%) requiring elective airway management.

This was followed by diphtheria (20%) and brain tumors (13.3%). Other indications included infec-

tious causes such as tetanus, Ludwig's angina, and systemic or structural conditions like Guillain-Barre syndrome, spinal cord injury, laryngeal stenosis, inverted papilloma, and bleeding disorders. (Table 2)

Table 2: Indications for Tracheostomy

No.	Indication	System/Type	No. of Patients	Percentage (%)
1	Diphtheria	Infectious	6	20.0%
2	Tetanus	Infectious	1	3.3%
3	Foreign body (Bronchoscopy)	Airway Obstruction	2	6.6%
4	TMJ Ankylosis (for ventilation)	Neurological/Structural	7	23.3%
5	Ludwig's angina	Infectious	1	3.3%
6	Head injury	Neurological/Trauma	1	3.3%
7	Cystic swelling (Neck)	Benign Swelling	1	3.3%

8	Brain tumor	Tumor (CNS)	4	13.3%
9	Laryngeal stenosis	Structural Airway	3	10.0%
10	Guillain-Barre syndrome	Neuromuscular	1	3.3%
11	Spinal cord injury	Neurological/Trauma	1	3.3%
12	Inverted papilloma	Tumor (Laryngeal)	1	3.3%
13	Bleeding disorder (DIC)	Hematological/Systemic	1	3.3%
	Total		30	100%

A total of 16 complications were observed in 9 patients, representing 30% of the cohort.

The most frequently encountered complication was the need for reinsertion due to tube blockage

(13.3%), followed by tracheitis (10%) and subcutaneous emphysema (10%). Additional complications included pneumothorax, pneumomediastinum, and dislodgement of the tracheostomy tube, false passage, and tracheal hemorrhage.

Table 3: Complications Observed Post-Tracheostomy

Complication	Male (%)	Female (%)	Total (%)
Subcutaneous emphysema	2 (6.6%)	1 (3.3%)	3 (10.0%)
Pneumothorax	1 (3.3%)	0	1 (3.3%)
Pneumomediastinum	1 (3.3%)	0	1 (3.3%)
False passage	1 (3.3%)	0	1 (3.3%)
Reinsertion due to blockage	4 (13.3%)	0	4 (13.3%)
Dislodgement of tube	2 (6.6%)	0	2 (6.6%)
Tracheitis (granulation)	3 (10.0%)	0	3 (10.0%)
Tracheal erosion & hemorrhage	0	1 (3.3%)	1 (3.3%)
Total	14 (46.7%)	2 (6.7%)	16 (53.3%)

The mortality rate in the study was 20% (6 out of 30 patients). Of these, four patients (13.3%) died due to the primary illness, while two patients

(6.6%) succumbed to complications related to the tracheostomy procedure itself, specifically tube blockage.

Table 4: Mortality in Tracheostomised Patients

Cause of Mortality	Male (%)	Female (%)	Total (%)
Due to primary disease	3 (10.0%)	1 (3.3%)	4 (13.3%)
Due to tracheostomy complications	2 (6.6%)	0	2 (6.6%)
Total	5 (16.6%)	1 (3.3%)	6 (20.0%)

Discussion

In our study, the majority of pediatric tracheostomies were performed in males (63.3%), with a male-to-female ratio of 2.3:1. The most affected age group was 8.1–10 years (26.6%), and only 10% of tracheostomies occurred in infants under 2 years. This contrasts with the findings of Roberts et al. [7], where the median age at tracheostomy was much lower—141 days—with the majority of patients under 1 year, reflecting a trend toward early intervention in ventilated neonates and infants. Similarly, Muller et al. [8] reported that tracheostomy rates varied geographically in the U.S., but a notable finding was the increasing complexity and younger age profile of patients over time. Schweiger et al. [9] also reported a median age of 6.96 months at tracheostomy, suggesting that early-age intervention is increasingly common in tertiary care settings. Our higher age group predominance may reflect local differences in disease burden, access to surgical care, or delay in referral for chronic conditions like TMJ ankylosis and brain tumors. In our cohort, TMJ ankylosis (23.3%) and diphtheria

(20%) were the most frequent indications, followed by brain tumors (13.3%). This pattern differs significantly from the findings of Roberts et al. [7], where the dominant indication was long-term ventilation (38.4%), especially for respiratory and cardiac causes. Similarly, the U.S. national study by Muller et al. [8] and the systematic review by Ribeiro de Araujo et al. [10] identified respiratory failure and prolonged mechanical ventilation as the most common reasons for tracheostomy, with fewer surgical or infectious causes. Hebbar et al. [11] also found pulmonary indications (40%) to be predominant, followed by anatomical and neurological causes. Our higher rate of structural and infectious causes such as TMJ ankylosis and diphtheria suggests a regional variance in etiology, possibly influenced by differing public health disease patterns and specialized surgical caseloads.

A complication rate of 53.3% was observed in our study, with reinsertion due to tube blockage (13.3%) and tracheitis (10%) being most common. These findings align with Lubianca Neto et al. [12], who reported an average complication rate of 40%

in children, with higher rates associated with young age, comorbidities, and emergency procedures.

The types of complications in our series—including pneumothorax, subcutaneous emphysema, and hemorrhage—were consistent with those described in the literature, though our rates were slightly higher. Roberts et al. [7] reported late complication rates of 40%, and their data highlighted the long-term morbidity burden. Sanders et al. [13] further emphasized infectious complications, showing a significant association between chronic bacterial colonization (especially *Pseudomonas* and gram-negative rods) and extended ICU stay, supporting the significance of our finding that tracheitis was among the leading late complications.

The overall mortality rate in our study was 20%, with 13.3% attributable to the primary disease and 6.6% due to tracheostomy complications. This is comparable to the findings by Teplitzky et al. [14], who reported a 16.8% mortality rate in their cohort, with 9% directly attributed to tracheostomy complications such as obstruction and accidental decannulation. Similarly, Hebbar et al. [11] documented a 27% mortality rate among tracheostomy-dependent children, though mortality did not significantly differ by indication.

Importantly, their study showed that pulmonary indications were associated with shorter time to death, echoing the need for vigilance even in non-structural tracheostomy indications. Lubianca Neto et al. [12] also identified cannula obstruction as the main procedural cause of death in children, which resonates with our findings of fatal tube blockage in diphtheria cases.

Although decannulation outcomes were not a primary focus in our study, the chronic nature of many indications (e.g., TMJ ankylosis, tumors, spinal cord injury) implies long-term tracheostomy dependence in most cases. Schweiger et al. [9] reported a decannulation success rate of 22.5%, with reduced likelihood in children with pulmonary or neurological comorbidities.

Roberts et al. [7] documented a decannulation rate of 44.4%, highlighting that a substantial portion of children can eventually be weaned off tracheostomy with adequate support. Factors like age at tracheostomy, presence of post-intubation laryngitis, and comorbidity load influenced decannulation probability. Our study's high proportion of structural and neurologic indications suggests a lower expected decannulation rate, consistent with these observations, though longer follow-up would be necessary to assess that conclusively.

The study was limited by its small sample size and single-center scope. Lack of long-term follow-up, particularly regarding decannulation and functional

outcomes, restricts broader conclusions about prolonged tracheostomy care.

Conclusion

Pediatric tracheostomy in our setting was most commonly indicated for TMJ ankylosis, diphtheria, and brain tumors, with a higher prevalence in male children and those aged 4–10 years. Complications such as tube blockage and tracheitis were frequently encountered, and mortality was primarily due to underlying disease rather than the procedure itself. The findings emphasize the need for early identification of indications, careful surgical technique, and vigilant postoperative care to improve clinical outcomes in pediatric tracheostomy patients.

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