

Original Article

# Post-operative care and complications following transoral robotic surgery for obstructive sleep apnoea

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## ABSTRACT

**INTRODUCTION.** Transoral robotic surgery for base-of-tongue reduction (TORS-BOT) is an effective treatment for obstructive sleep apnoea (OSA) in patients with tongue base collapse and lingual tonsil hypertrophy. However, post-operative complications may considerably affect recovery. This study evaluated post-operative outcomes, particularly dysphagia, pain management and nutritional challenges, in a Danish cohort.

**METHODS.** This retrospective cohort study included patients who underwent TORS-BOT at a single Danish centre between April 2022 and September 2024. Data were extracted from electronic medical records. Outcomes included dysphagia, pain management, nasogastric tube (NGT) use and infection rates.

**RESULTS.** Forty patients, primarily middle-aged, overweight males, underwent TORS-BOT. Most also received additional sleep surgery procedures. The median hospital stay was 3.5 days. Readmission occurred in 20%, mainly due to pain, infection or bleeding. More than 80% experienced complications, with dysphagia (70%) being the most common, often requiring NGT support. Pain control was frequently insufficient, resulting in impaired oral intake. Constipation was prevalent (68%), whereas laxative prophylaxis was inconsistent. Antibiotics were administered to 40%, mainly for aspiration pneumonia.

**CONCLUSIONS.** Post-operative dysphagia, pain and nutritional issues were common after TORS-BOT for OSA. Standardised post-operative protocols focusing on pain management, dysphagia interventions and nutritional support are needed.

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Obstructive sleep apnoea (OSA) is characterised by recurrent upper airway obstruction during sleep [1], leading to intermittent hypoxemia, sympathetic activation and sleep arousals [2]. It is also linked to serious comorbidities, including cardiovascular and metabolic disorders [1].

OSA is highly prevalent, with an estimated one billion affected and approximately 425 million adults aged 30-69 years with moderate-severe OSA [3]. Continuous positive airway pressure (CPAP) is the first-line treatment, but surgery is considered when CPAP is not tolerated. Among surgical options, transoral robotic surgery for base-of-tongue reduction (TORS-BOT) targets retrolingual collapse with hyperplastic lingual tonsils [4].

TORS-BOT has demonstrated improvements in OSA metrics, but post-operative morbidity can be considerable [5, 6]. A meta-analysis reported an overall complication rate of 22% following TORS-BOT [5]. These

complications comprise dysphagia, pain, dehydration, dysgeusia, aspiration and tongue oedema [7]. Long-term swallowing difficulties, including penetration, major haemorrhage, and pharyngeal scarring, are less frequent but are also a concern [7, 8]. Optimising perioperative care is therefore essential.

Post-operative complications following TORS-BOT for OSA pose considerable challenges to patient recovery, demanding targeted interventions for optimal symptom management and adherence to recovery protocols. Effective pain management is crucial for food intake, yet balancing analgesic efficacy with potential side effects remains a considerable obstacle [9]. Additionally, dysphagia, which often requires nasogastric tube placement and careful aspiration prevention [10], along with opioid-induced constipation, further complicates recovery [11]. Early identification of these issues, coupled with proactive interventions such as laxative prescriptions and educational strategies promoting hydration and mobility, is vital.

This study is the first Danish cohort with follow-up after TORS-BOT for OSA, specifically examining the frequency and severity of post-operative complications as well as post-operative care. Our objective was to identify challenges in current post-operative management to inform better protocols and improve patient outcomes.

## Methods

### Study design and setting

This retrospective cohort study was conducted at the Department of Otorhinolaryngology, Head & Neck Surgery, Gødstrup Hospital, Denmark, including all patients who underwent TORS-BOT between April 2022 and September 2024. The study adhered to STROBE guidelines [12], with a completed checklist available ([Supplementary materials](#)). Data were collected from electronic patient records and registered in a REDCap database. The exposure of interest was TORS-BOT, with or without additional soft tissue sleep surgery. All procedures were performed in-house. Routine follow-up occurred at one and three months after surgery. Unscheduled contacts after discharge were registered.

### Participants

Eligibility required OSA confirmed by Type 3 at-home cardio-respiratory monitoring with drug-induced sedation endoscopy (DISE)-verified retrolingual collapse and lingual tonsil hypertrophy. All patients undergoing TORS-BOT at the Department within the study period were included in this study cohort.

### Variables

Variables included demographics (sex, age, BMI, occupational status), operative details (additional procedures) and post-operative outcomes (hospital stay duration, readmission rate, time to readmission and unscheduled outpatient contacts post-discharge). All patients received perioperative prophylactic antibiotics. Post-operative antibiotic use was recorded along with its indications.

Pain management was assessed using a numerical rating scale (NRS), noting pain's impact on eating and mobility. Nasogastric tube (NGT) placement, varying among surgeons but often performed perioperatively for ease of administration under anaesthesia, was documented along with its duration. Swallowing function was evaluated, including clinical dysphagia and pain-related difficulties. Furthermore, ergotherapy interventions, swallowing assessments and nutrition screenings were recorded. Constipation episodes and laxative use were also documented, along with height and weight measurements.

### Ethics

Approval for accessing and recording data from electronic patient journals was obtained from the local hospital Open Access under Creative Commons License CC BY-NC-ND 4.0

ethics committee.

## Statistical analysis

Binary variables were summarised as counts and percentages; continuous variables, as means or medians with ranges. Missing data were described relative to the cohort size.

*Trial registration:* not relevant.

## Results

### Patient demographics and operative procedures

Forty patients underwent TORS-BOT; 80% were male, with a median age of 47 years and a mean BMI of 28.6. Most were employed, with desk jobs being the most common occupation. Additional surgical procedures were frequently performed, particularly pharyngoplasty and epiglottoplasty, whereas only a small proportion underwent TORS-BOT alone (**Table 1**).

**TABLE 1** Patient demographics and operative procedures.

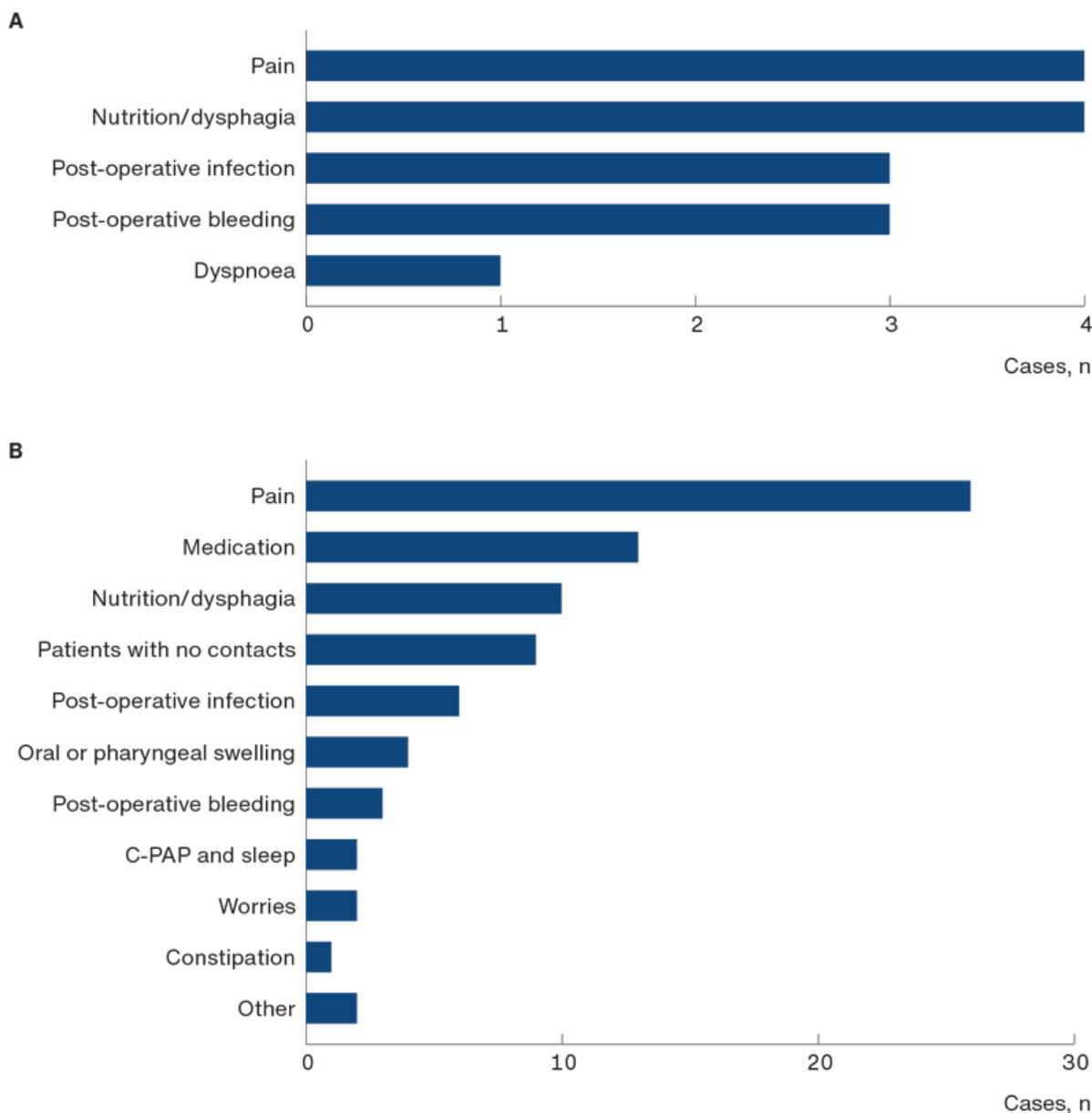
|  |                  |
|--|------------------|
| Patients, n                            | 40               |
| <i>Sex, n (%)</i>                      |                  |
| Female                                 | 8 (20)           |
| Male                                   | 32 (80)          |
| Age, median (range), yrs               | 47 (26-62)       |
| BMI, mean (range), kg/m <sup>2</sup>   | 28.0 (25.2-36.3) |
| <i>Work type</i>                       |                  |
| Desk job                               | 15 (37.5)        |
| Manual labour                          | 13 (32.5)        |
| Unemployed                             | 4 (10)           |
| Not reported                           | 8 (20)           |
| <i>Additional operative procedures</i> |                  |
| None                                   | 4 (10)           |
| Pharyngoplasty                         | 27 (67.8)        |
| Tonsillectomy                          | 14 (35)          |
| RFA of the soft palate                 | 1 (2.5)          |
| Epiglottoplasty                        | 18 (45)          |

RFA = radiofrequency.

#### Admissions, readmissions and outpatient contacts

The median length of hospital stay was three and a half days, although some patients required extended admissions. Approximately one in five patients were readmitted, most often for pain, followed by post-operative bleeding and infection (**Figure 1 A**). Unscheduled outpatient follow-up was frequent, with phone consultations being more common than in-person visits. Among outpatient contacts, pain was again the leading cause, followed by medication-related concerns, dysphagia and signs of infection (**Figure 1 B**).

**FIGURE 1 A.** Histogram of readmission reasons. **B.** Histogram of reasons for unscheduled outpatient contacts.



CPAP = continuous positive airway pressure.

## Post-operative complications and inpatient care

More than 80% of patients had either post-operative infection, bleeding, uncontrolled pain or dysphagia. Post-operative administration of antibiotics was common and used mainly for pneumonia. Pain management was insufficient for a considerable number of patients, though the frequency of pain assessments varied widely. Early dysphagia was common, resulting in a high rate of NGT use, often for several days. Swallowing assessments were performed in most cases, whereas ergotherapy was initiated only in about one-third of patients. A high incidence of post-operative constipation was observed among patients, potentially attributable to the routine administration of morphine. However, prophylactic laxative use was not universal (Table 2). Three patients (7.5%) required post-operative observation in the intensive care unit for airway swelling or bleeding. No

patient underwent tracheotomy.

**TABLE 2** Post-operative complications and inpatient care.

|   |              |
|---|--------------|
| Post-operative admission, median (range), days                                | 3.5 (2-14)   |
| <i>Readmissions, n (%)</i>  |              |
| 1   | 7 (17.5)     |
| 2   | 2 (5)        |
| Readmission, mean (range), days   | 2.3 (1-5)    |
| Any post-operative complication <sup>a</sup> , n/N (%)                        | 32/40 (80)   |
| Post-operative bleeding, n/N (%)  | 3/40 (7.5)   |
| Post-operative antibiotics administered, n/N (%)                              | 16/40 (40)   |
| <i>Reasons for antibiotics, n/N (%)</i>                                       |              |
| Pneumonia   | 7/24 (29)    |
| Operation wound infection   | 4/24 (17)    |
| Unknown focus of infection  | 5/24 (21)    |
| NRS for pain used, median (range)   | 2 (0-16)     |
| Bedridden patients, n/N (%)   | 4/39 (10)    |
| Pain adequately controlled for food intake, n/N (%)                           | 25/40 (62.5) |
| Dysphagia, n/N (%)  | 28/40 (70)   |
| <i>NGT</i>  |              |
| NGT, n/N (%)  | 28/40 (70)   |
| NGT unused <sup>b</sup> , n/N (%)   | 13/28 (46)   |
| NGT unused when pain inadequately controlled <sup>b</sup> , n/N (%)           | 2/28 (7)     |
| Patients without NGT and without adequate pain control <sup>c</sup> , n/N (%) | 5/15 (33.3)  |
| Time with NGT, median (range), days   | 2 (2-24)     |
| Ergotherapy <sup>d</sup> , n/N (%)  | 14/28 (50)   |
| Evaluation of swallowing function, n/N (%)                                    | 27/40 (67.5) |
| <i>Nutrition screening, n/N (%)</i>   |              |
| Nutrition screening   | 23/40 (57.5) |
| Secondary nutrition screening <sup>e</sup>                                    | 3/23 (13)    |
| Constipation, n/N (%)   | 27/40 (67.5) |
| <i>Laxatives, n/N (%)</i>   |              |
| Laxatives prescribed  | 22/40 (55)   |
| Laxatives plan changed  | 20/40 (50)   |

NGT = nasogastric tube; NRS = numerical rating scale.

a) Included infection, bleeding, uncontrolled pain or dysphagia.

b) Relative to the number of patients who had NGT.

c) Relative to the number of patients who did not have sufficient pain management for food intake.

d) Relative to the number of patients who had dysphagia.

e) Relative to the number of patients who had nutrition screening.

## Discussion

This study offers a comprehensive evaluation of post-operative outcomes following TORS-BOT for OSA, representing the first published data on post-operative complications due to this procedure in a Danish population. The cohort consisted predominantly of middle-aged overweight males, many of whom underwent additional procedures (e.g., pharyngoplasty and epiglottoplasty). Hospital stays were typically brief. However, the readmission rate was notable (20%); higher than rates of emergency department visits and readmissions

observed in other studies (7-15%) [13, 14]. Readmissions were primarily due to pain, infection or bleeding. Unscheduled outpatient follow-up was common, mainly driven by pain and medication-related concerns. Targeted interventions are needed to reduce the readmission rate, such as enhanced multimodal pain protocols with systematic pain evaluation, standardised early swallowing assessments, proactive opioid-sparing constipation management and early outpatient follow-up.

Post-operative complications were frequent, affecting over 80% of patients. Dysfunctional swallowing requiring NGT support occurred in 70% of cases, and pain management was often inadequate to maintain oral intake. While post-operative pain contributed to swallowing dysfunction, the surgical intervention itself may also have played a role. Subjective and objective swallowing impairments have been reported for up to six months after TORS-BOT in cancer patients, but typically resolve by 12 months [8], highlighting the need to consider both pain-related and surgery-induced dysphagia, acknowledging that previous studies primarily involved cancer-related procedures.

Antibiotics were administered to 40% of patients, mainly for pneumonia. Constipation was also common, yet laxatives were not consistently prescribed despite the routine use of opioids. Swallowing function was evaluated in most cases, but ergotherapy was initiated in only half of the patients with dysphagia.

Compared to findings from systematic reviews, our study's patient demographics [5-7] and hospital stay duration [7] were similar. However, our post-operative complication rate was higher. The post-operative bleeding rate (7.5%) was comparable to findings by Miller et al. (4.2-5.3%) [4, 6]. In contrast, dysphagia (70%) was notably more frequent than previously reported mean rates (12%) [7]. Baptista et al. [4] reported no dysphagia symptoms 14 days after TORS-BOT, further highlighting the variation in assessment methods. These discrepancies likely reflect differences in reporting criteria, as our study recorded dysphagia only during hospitalisation. Consequently, conclusions about long-term dysphagia cannot be drawn.

Post-operative infections were another concern, with 60% of patients receiving antibiotics, whereas a meta-analysis reported average pneumonia rates of only 2% [7]. Constipation (67.5%) was prevalent in our cohort but inconsistently documented in prior studies, limiting comparison.

Nutritional factors substantially contributed to post-operative complications. Proactive strategies should include systematic monitoring of pain, constipation and swallowing function to enable timely interventions. Ergotherapy, incorporating tailored exercises and swallowing techniques, offers a potential avenue for improving dysphagia and accelerating recovery [15]. Preoperative education by healthcare professionals is crucial for managing expectations, optimising pain control, promoting adherence to prescribed regimens and ensuring nutritional support, particularly when pain impacts oral intake. These strategies may positively influence short- and long-term outcomes.

In our cohort, most patients underwent multilevel surgery, consistent with prior TORS series, in which BOT reduction was often combined with palatal or nasal procedures [4]. For candidates considered for TORS-BOT, the extent and staging of surgery should be individualised according to DISE-verified sites of collapse, tonsillar phenotype, BMI and patient preferences [4, 16]. Single-level surgery may be sufficient in anatomically favourable phenotypes, as a previous study reported that modified uvulopalatopharyngoplasty (UPPP) was not more effective than tonsillectomy alone for adults with OSA and tonsillar hypertrophy [17]. When multilevel obstruction is present, a single-session multi-level approach can address concurrent retrolingual and retropalatal collapse and has been associated with surgical success, provided patients are carefully selected [4]. However, studies suggest that multi-level surgery may increase the risk of bleeding [18], whereas adding base-of-tongue procedures to UPPP prolongs hospital stay without increasing 30-day complications, readmissions, reoperations or mortality [19]. Given the additional perioperative burden with added procedures, a staged

approach may be appropriate in cases of diagnostic uncertainty or when the benefit of additional surgery is unclear. These decisions should be shared with patients to include individual preferences in procedure selection [16]. Our higher early post-operative morbidity relative to other studies may be related to the high frequency of multilevel procedures.

Our findings are limited to complications observed during hospitalisation, as long-term follow-up was beyond the scope of this study. The results, therefore, should not be interpreted as indicative of long-term complication rates. Further large-scale studies with long-term follow-up could help refine standardised post-operative care protocols and improve patient selection criteria for TORS-BOT.

Given the post-operative morbidity observed in this study, we have narrowed TORS-BOT indications to adults with AHI > 20, BMI < 32 kg/m<sup>2</sup>, lingual tonsil hypertrophy grade 3-4 and DISE-verified complete tongue-base collapse classified as T = 2 on the Velum–Oropharynx–Tongue base–Epiglottis (VOTE) system. These thresholds target tongue-base–predominant anatomical OSA phenotype with a more favourable perioperative risk profile, and staged surgery will be favoured when diagnostic uncertainty persists. Operative decisions will continue to be made jointly with patients.

## Strengths and limitations

A key strength is the detailed assessment of post-operative complications, particularly dysphagia, pain management, opioid-related constipation and nutritional deficits - outcomes often underreported in systematic reviews. No patients were lost to follow-up. However, the small cohort size limits generalisability and subgroup analysis. The frequent addition of other surgical procedures complicates the attribution of specific outcomes to TORS-BOT alone. Variability in post-operative care, particularly in pain and constipation management, may have influenced complication rates. Lastly, the absence of long-term follow-up restricts conclusions about long-term outcomes.

## Conclusions

This study highlights the high prevalence of dysphagia, pain-related issues and NGT use after TORS-BOT for OSA. Compared to systematic reviews, our findings suggest a greater burden of swallowing dysfunction, identifying areas needing quality optimisation and standardised rehabilitation plans. However, the small sample size may limit generalisability. Optimising post-operative care, particularly pain management and nutritional support, is important for improving outcomes. Future research should refine post-operative protocols and improve patient selection to identify predictors of better recovery.

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Supplementary material: [a05250396-supplementary.pdf](#)

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