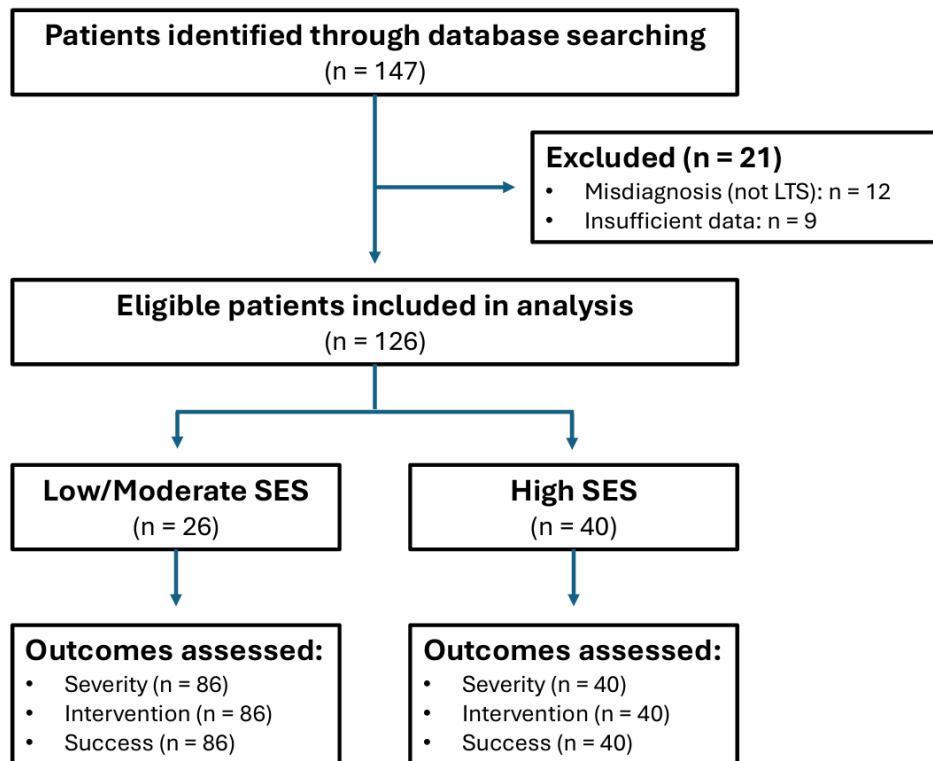


Supplementary material – Table of contents

Item	Title	Page
Supplementary material 1	STROBE-compliant participant flow diagram	2
Supplementary material 2	Adapted Social Capital Assessment Tool (A-SCAT) items and scoring (baseline-constrained version)	3-4
Supplementary material 3	Detailed composition of the non-open intervention category (procedure-level summary – for descriptive purposes only)	5
Supplementary material 4	Definitions and coding of all study variables	6 - 7
Supplementary material 5	Detailed cohort characteristics stratified by socioeconomic status and cause of disease	8 - 11
Supplementary material 6	Comparison of conventional logistic regression and Firth's penalised likelihood estimates for sparse pathways (SES → traumatic aetiology)	12



Supplementary material 1: STROBE-compliant participant flow diagram.

Of 147 patients identified through database searching, 126 met the inclusion criteria and were included in the analysis. Twelve patients were excluded due to misdiagnosis (conditions mimicking LTS but pathologically distinct), and nine were excluded owing to insufficient data (missing critical variables such as primary cause of disease, key dates, or outcome status).

Supplementary material 2. Adapted social capital assessment tool (A-SCAT) items and scoring (baseline-constrained version)

Domain	Item	Scoring Criteria	Points
Social Support	Next of Kin/Support Person	2: Named local contact involved in care	0–2
		1: Next of Kin listed but involvement not documented	
		0: "No known kin," "unaccompanied," or "homeless"	
	Social Work Involvement	1: Formal referral OR social worker note (baseline only)	0–1
		0: No documentation	
Financial & Structural Capital	Funding Source	2: Medical aid/private insurance	0–2
		1: Government grant or documented financial support	
		0: Self-pay, unemployed, undocumented distress	
	Accommodation Stability	1: Documented fixed address	0–1
		0: Informal settlement, homeless, no fixed abode	
	Employment Status	1: Documented employed or pensioner (baseline)	0–1
		0: Unemployed, disabled (without grant), informal	
Health System Navigation	Travel Burden	1: Same district as hospital OR local referral	0–1
		0: Distant rural district	

Domain	Item	Scoring Criteria	Points
Total Score (Baseline-constrained)			0–7

*A-SCAT, Adapted Social Capital Assessment Tool; e.g., *exempli gratia* (for example); vs., versus.*

The baseline-constrained version includes only items documented at presentation (social support, financial capital, travel burden) and excludes post-presentation adherence items. Total score range: 0–7. Higher scores indicate higher socioeconomic status.

Supplementary material 3. Detailed composition of the non-open intervention category
(procedure-level summary)

Intervention Category	N (%)	Treatment Success* N (%)
Open surgical reconstruction (laryngotracheal reconstruction, tracheal resection with anastomosis, or permanent tracheostomy)	148 (84.1)	80 (54.1)
Non-open management (combined)	28 (15.9)	27 (96.4)†
^L Endoscopic procedures (laser, dilatation, cold-steel excision)	6 (3.4)	6 (100)
^L Conservative management (observation or medical therapy alone)	17 (9.7)	16 (94.1)
^L Airway management procedure (e.g., emergency tracheostomy without reconstruction)‡	5 (2.8)	5 (100)
Total	176 (100)	107 (60.8)

N, number of interventions (total procedures across all patients); %, percentage; e.g., *exempli gratia* (for example); vs., versus.

Treatment success = successful decannulation with patent airway maintained for >6 months.

†The high success rate in the non-open group reflects selection of less severe stenoses amenable to endoscopic or medical management.

‡These five patients underwent emergency tracheostomy only, without formal open reconstruction; they are included in the non-open group for the primary analysis because they did not receive open airway reconstruction.

Note: This table presents procedure-level counts (176 total interventions across 126 patients). The primary patient-level analysis used a binary (open vs. non-open) classification. No statistical comparisons were performed between subcategories due to small cell sizes.

Supplementary material 4. Definitions and coding of all study variables

Variable	Domain	Description / Definition	Type / Coding
Demographic and Socioeconomic (PROGRESS-Plus)			
Age	Sociodemographic	Age at first clinical milestone (presentation or diagnosis)	Continuous; years
Sex	Sociodemographic	Biological sex	0 = Female, 1 = Male
Race	Sociodemographic	Self-reported racial category	1 = Black, 2 = Coloured, 3 = White
Residential geography	Sociodemographic	Urban vs rural residence	0 = Rural, 1 = Urban
Residential typology	Sociodemographic	Formal vs informal housing	0 = Informal, 1 = Formal
Employment status	Sociodemographic	Economic activity and employment	1 = Employed, 2 = Unemployed, 3 = Economically inactive
Social Capital Index (baseline-constrained)	Sociodemographic	Adapted Social Capital Assessment Tool (A-SCAT) score (0–7)	Continuous; dichotomised: 0 = Low/Moderate (0–5), 1 = High (6–7)
Clinical Severity at Presentation			
Cotton-Myer grade	Clinical severity	Endoscopic grading of stenosis	Ordinal I–IV; dichotomised: 0 = Low (I–II), 1 = High (III–IV)
Objective oxygen requirement	Clinical severity	Need for supplemental oxygen at presentation	0 = No, 1 = Yes
Tracheostomy at presentation	Clinical severity	Presence of tracheostomy at initial evaluation	0 = No, 1 = Yes

Variable	Domain	Description / Definition	Type / Coding
Cause of Disease			
<i>Recoded cause of disease</i>	<i>Cause of Disease</i>	<i>Simplified categories for analysis</i>	1 = Iatrogenic, 2 = Post-Traumatic, 3 = Infectious, 4 = Other
Comorbidities			
<i>Total comorbidity count</i>	<i>Comorbidity</i>	<i>Sum of all individual comorbidities present</i>	<i>Continuous</i>
Outcomes			
<i>Disease severity (dichotomised)</i>	<i>Outcome</i>	<i>High-grade stenosis (Cotton-Myer III–IV) vs low-grade (I–II)</i>	0 = Low, 1 = High
<i>Intervention complexity</i>	<i>Outcome</i>	<i>Highest level of intervention required</i>	0 = Endoscopic/conservative, 1 = Open surgical reconstruction
<i>Primary treatment success</i>	<i>Outcome</i>	<i>Successful decannulation with patent airway >6 months</i>	0 = No, 1 = Yes

A-SCAT, Adapted Social Capital Assessment Tool; *PROGRESS-Plus*, Place, Race, Occupation, Gender, Religion, Education, Socioeconomic status, Social capital, plus other factors (health equity framework); *I–IV*, Cotton-Myer grades I to IV (I = least severe, IV = most severe); *vs.*, versus.

The Social Capital Index (baseline-constrained) is dichotomised as Low/Moderate SES (score 0–5) and High SES (score 6–7). Total comorbidity count is the sum of individual comorbidities present. Intervention complexity: 0 = endoscopic or conservative management, 1 = open surgical reconstruction. Treatment success defined as successful decannulation with patent airway for >6 months.

Supplementary material 5. Detailed cohort characteristics stratified by socioeconomic status and cause of disease

Race		Sex	Age (Years)	Demographics	Variable
Other, n (%)	Black African, n (%)	Female, n (%)	Male, n (%)	Median (IQR)	Category / Statistic
6 (4.8)	120 (95.2)	46 (36.5)	80 (63.5)	30 (23–42)	Total Cohort (N=126)
5 (5.8)	81 (94.2)	31 (36.0)	55 (64.0)	26.5 (22–43)	Low/Moderate Ses (N=86)
1 (2.5)	39 (97.5)	15 (37.5)	25 (62.5)	33 (27.5–40.5)	High Ses (N=40)
1.000†		0.875†		0.107*	P-Value (Ses)
5 (5.8)	81 (94.2)	30 (34.9)	56 (65.1)	31 (24–43)	Iatrogenic (N=86)
0 (0)	12 (100)	4 (33.3)	8 (66.7)	25 (19–32)	Post-Traumatic (N=12)
1 (4.5)	21 (95.5)	10 (45.5)	12 (54.5)	29 (22–38)	Infectious (N=22)
0 (0)	6 (100)	2 (33.3)	4 (66.7)	39 (28–49)	Other (N=6)
0.879†		0.786†		0.089*	P-Value (Cause)

Clinical Characteristics	A-SCAT Score (Baseline)	Employed	Formal Housing	Urban Residence	Socioeconomic Indicators	Variable
	Median (IQR)	n (%)	n (%)	n (%)		Category / Statistic
	5 (3-7)	56 (44.4)	101 (80.2)	84 (66.7)		Total Cohort (N=126)
	4 (2-5)	18 (20.9)	61 (70.9)	50 (58.1)		Low/Moderate Ses (N=86)
	8 (7-8)	38 (95.0)	40 (100)	34 (85.0)		High Ses (N=40)
	<0.001*	<0.001†	<0.001†	0.003†		P-Value (Ses)
	5 (3-7)	35 (40.7)	68 (79.1)	56 (65.1)		Iatrogenic (N=86)
	4 (3-5)	5 (41.7)	9 (75.0)	7 (58.3)		Post-Traumatic (N=12)
	6 (4-7)	11 (50.0)	18 (81.8)	17 (77.3)		Infectious (N=22)
	7 (5-8)	5 (83.3)	6 (100)	4 (66.7)		Other (N=6)
	0.008*	0.238†	0.664†	0.597†		P-Value (Cause)

Highest Intervention Level		Outcomes	Total Comorbidity Count	LPR	Variable
Endoscopic/Medical, n (%)	Open Reconstruction, n (%)		Median (IQR)	n (%)	Category / Statistic
19 (15.1)	107 (84.9)		2 (1-3)	34 (27.0)	Total Cohort (N=126)
10 (11.6)	76 (88.4)		2 (1-3)	23 (26.7)	Low/Moderate Ses (N=86)
9 (22.5)	31 (77.5)		2 (1-3)	11 (27.5)	High Ses (N=40)
	0.112		0.412*	0.928†	P-Value (Ses)
8 (9.3)	78 (90.7)		2 (1-3)	23 (26.7)	Iatrogenic (N=86)
0 (0)	12 (100)		1 (0-2)	2 (16.7)	Post-Traumatic (N=12)
10 (45.5)	12 (54.5)		2 (2-3)	6 (27.3)	Infectious (N=22)
1 (16.7)	5 (83.3)		3 (2-4)	3 (50.0)	Other (N=6)
	<0.001†		0.048*	0.538†	P-Value (Cause)

Primary Treatment	Variable
Success	
Success (Decannulated), n (%)	Category / Statistic
69 (54.8)	Total Cohort (N=126)
47 (54.7)	Low/Moderate Ses (N=86)
22 (55.0)	High Ses (N=40)
0.971	P-Value (Ses)
44 (51.2)	Iatrogenic (N=86)
10 (83.3)	Post-Traumatic (N=12)
12 (54.5)	Infectious (N=22)
3 (50.0)	Other (N=6)
0.182†	P-Value (Cause)

A-SCAT, Adapted Social Capital Assessment Tool (baseline-constrained version); *IQR*, interquartile range; *LPR*, laryngopharyngeal reflux; n, number of patients in a subgroup; *N*, total number of patients in a group; p, probability value (statistical significance); *SES*, socioeconomic status.

Kruskal-Wallis equality-of-populations rank test.

†Fisher's exact test.

Percentages may not sum to 100 due to rounding. The A-SCAT score range is 0–7 (higher score indicates higher SES).

Total comorbidity count is the sum of individual comorbidities present.

Supplementary material 6. Comparison of conventional logistic regression and Firth's penalised likelihood estimates for sparse pathways (SES → traumatic aetiology)

Pathway	Model	Odds Ratio (Or)	95% Confidence Interval	P-Value	Notes
SES (High vs Low/Moderate) → Traumatic cause	Conventional logistic	0.13	0.01 – 0.92	0.042*	Unstable due to zero events in High SES group
SES (High vs Low/Moderate) → Traumatic cause	Firth's penalised likelihood	0.14	0.01 – 0.89	—	Bias-corrected; confirms direction and magnitude

CI, confidence interval; *OR*, odds ratio; *p*, probability value (statistical significance); *SES*, socioeconomic status; *vs.*, versus.

*Conventional p-value is unreliable due to sparse data (zero events in the High SES group). Firth's penalised likelihood provides more stable estimates. '—' indicates that a p-value is not directly applicable for the penalised likelihood method.