

Endoscopic Balloon Dilation of Pediatric Subglottic and tracheal Stenosis

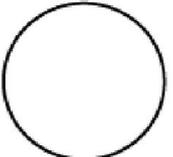
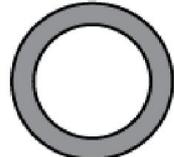
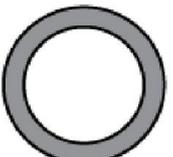
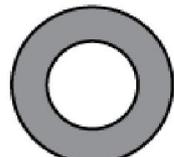
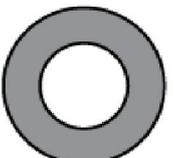
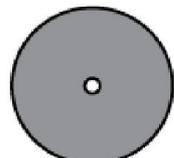


Respiratory Department 1
Dr Le Thi Thanh Thao

INTRODUCTION

- **Subglottic & tracheal stenosis:**
narrowing of the airway
- **congenital or acquired (after
endotracheal intubation)**
- **Hoarseness, stridor, exercise
intolerance and respiratory distress**

Cotton-Myers grade

Classification	From	To
Grade I	 No Obstruction	 50% Obstruction
Grade II	 51% Obstruction	 70% Obstruction
Grade III	 71% Obstruction	 99% Obstruction
Grade IV	No Detectable Lumen	



Grade 1
Stenosis 0-50%



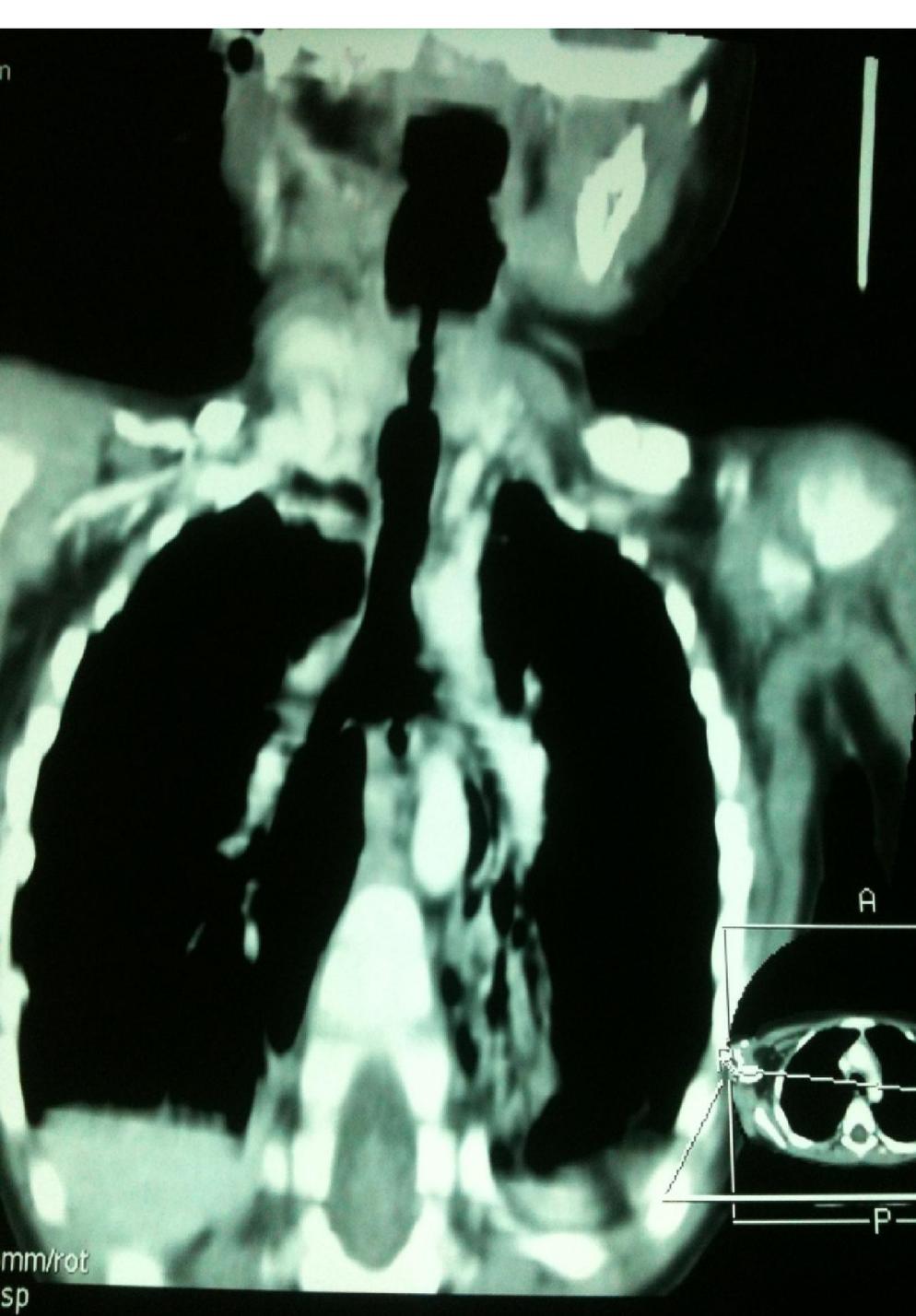
Grade 2
Stenosis 51-70%



Grade 3
Stenosis 71-99%



Grade 4
Stenosis 100%



Children hospital 2:

No	SEX	AGE	Diagnosis	GRADE	MANAGEMENT	FOLLOW UP
1	F	1/11/2011	Subglottic acquire	2	Rigit endoscopy 1	
2	M	19/6/2010	Subglottic acquire	2	Rigit endoscopy 2	
3	M	7/11/2004	Subglottic acquire	2	Rigit endoscopy 2	
4	F	17/8/2009	Subglottic acquire	2	Cho Ray	
5	F	12/10/2011	Subglottic congenit	2	Observation	
6	M	26/12/2010	Subglottic congenit	2	Observation	
7	M	24/10/2011	Subglottic acquire	3		death

SURGICAL TECHNIQUE

- 1 → 4 dilation procedures / 6 months
- Endoscopic high-pressure balloon catheter; general anesthesia, spontaneous ventilation
- Direct laryngoscopy or flexible endoscopy
- Balloon: Angioplasty catheter, esophageal, inspiratory air
- Inflated balloon pressure for 30 seconds → $SpO_2 \leq 92\%$ x 2 - 3 times
- The size and diameter of the balloon ([Table 1](#)) The minimum balloon diameter: 6 mm

Table 1. Age and Increasing Theoretical Airway Diameter, Tube Size, Grade II Stenosis, and Balloon Diameter

Age	Normal Larynx Tube Size, ID (OD), mm	Normal Larynx Imaging/Anatomic Measurement, mm	Grade II Stenosis, Myer-Cotton Classification ^a (Size, mm)	Balloon Diameter, mm
Premature infant	2.0-2.5 (3.4)	<4.0 ^b	<2.0 (2.9)	6
0-3 mo	3.0-3.5 (4.8)	4.0 ^a - 4.6 ^c	<2.5 (3.4)	6
>3-9 mo	4.0 (5.5)	4.6 ^c	<3.0 (4.2)	8
>9-12 mo	4.5 (6.2)	4.6 ^c	<3.5 (4.8)	8-10
2 y	5.0 (6.8)	6.3 ^d	<3.5 (4.8)	10
4 y	5.5 (7.6)	7.7 ^d	<4.0 (5.5)	12
>6 y	6.0 (8.2)	8.2 ^d	<4.5 (6.2)	12

Abbreviations: ID, inner diameter; OD, outer diameter.

^aSee Myer et al.⁵

^bFrom Fayoux et al.⁶

^cFrom Eckel et al.⁷; anatomical measurements of the cricoid.

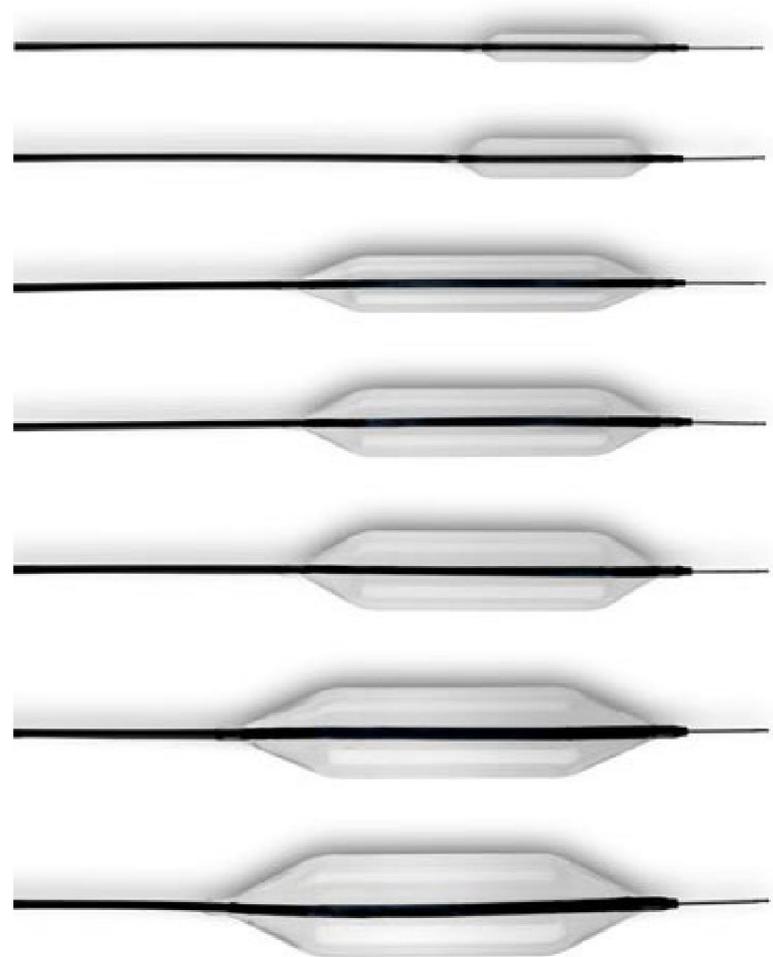
^dFrom Al-Mazrou et al.⁸; magnetic resonance imaging measurements of the cricoid.

- Videoclip

SURGICAL TECHNIQUE

- Topical application of cottonoid pledgets soaked with mitomycine, 1 mg/mL x 1-2 minutes
- Monitoring in the ICU: 24 → 48 hours
- SCS: 1-2 mg/kg/d x 3 to 10 days
- Proton pump inhibitors (esomeprazole, 2 mg/kg/d)
- Epinephrine nebulizers
- Follow-up endoscopy: every 3 weeks until complete healing, then every 6 months.

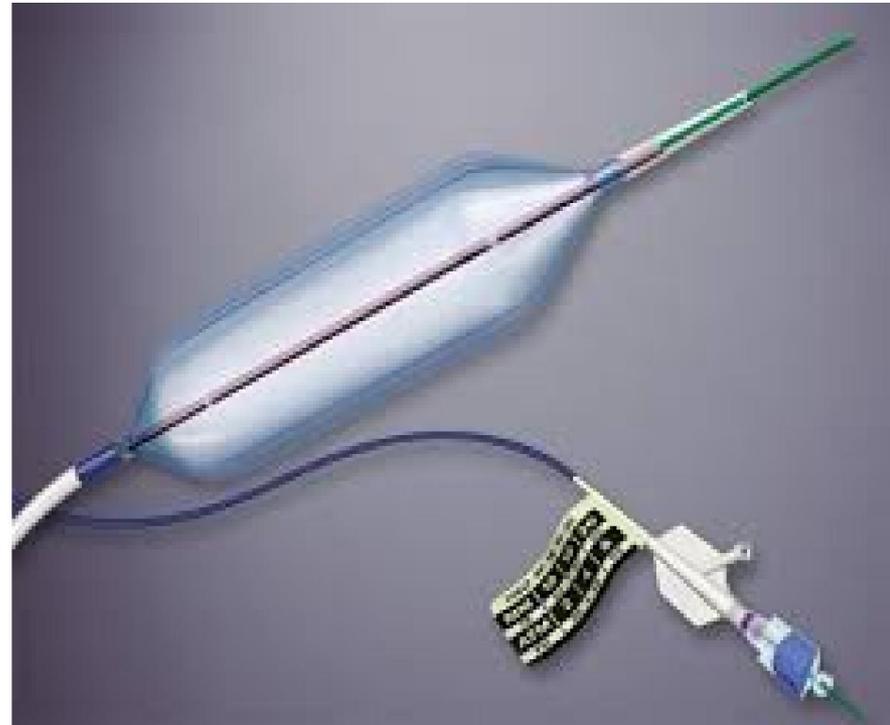
Acclarent Inspira AIR Balloon Dilation System



ANGIOPLASTY BALLOON CATHETER



ESOPHAGEAL BALLOON

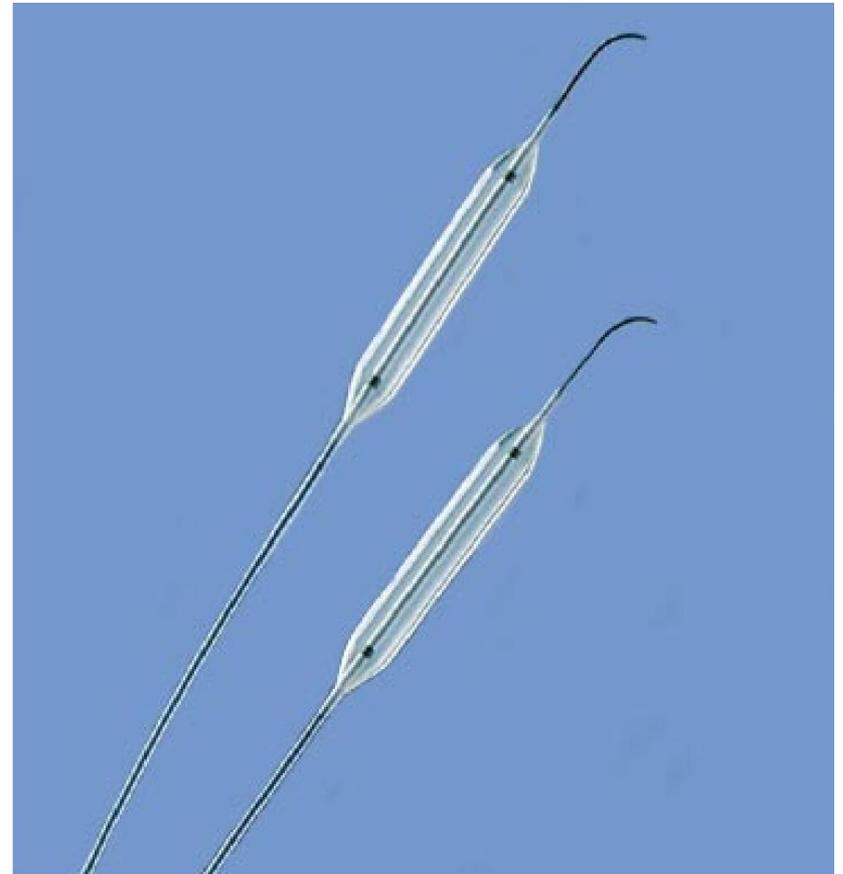


Angioplasty balloon catheter

20 FR FOGARTY BALLOON CATHETER (BAXTER, USA).



NEW BLUE MAX BALLOON CATHETERS (BOSTON SCIENTIFIC)



Endoscopic Balloon Dilatation of Pediatric Subglottic Stenosis: A Meta-Analysis

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METHODS AND MATERIALS

- **Cochrane databases: 1/2013**

- **Inclusion criteria:**

- 1) Sample size ≥ 5**

- 2) Use of EBD for pediatric patients (0-18 years)**

- 3) Use of EBD as the primary treatment of pediatric subglottic stenosis**

<u>Authors and Year</u>	<u>N</u>	<u>Mean Age (mos)</u>	<u>Treatment Success</u>	<u>Mean # Dilations</u>	<u>Dilation Technique</u>
Hebra A, et al. ³ 1991	37	60	20 of 37 (54%)	4.27	Pressure not reported, duration until desaturation Unknown number of patients had electrocautery of granulation tissue or stent placement x 72 hours
Durden and Sobol ⁴ 2007	10	4.8	7 of 10 (70%)	1.3	2 atmospheres, duration until desaturation, topical steroids, intubation x 24-48 hours
Bent JP, et al. ⁵ 2010	10	24.5	7 of 10 (70%)		10-12 cm H ₂ O for average of 40 sec, injected and topical steroids used after dilation
Primary EBD	4	17.8	4 of 4 (100%)	1.75	“
Secondary EBD	6	34.5	3 of 6 (50%)	2.17	“
Schweiger C., et al. ⁶ 2011	8	5.2	6 of 8 (75%)	1	2 atmospheres for 2 minutes or until desaturation, No topical steroids or Mitomycin C
Whigham et al. ⁷ 2012	28	42	16 of 28 (57%)		2 dilations per procedure, 8-16 atmospheres for 2 minutes or until desaturation, No topical steroids or Mitomycin C
Primary EBD	15	30	9 of 15 (60%)	1.5	“
Secondary EBD	13	60	7 of 13 (54%)	2.15	“
Hautefort C., et al. ⁸ 2012	44	26	31 of 44 (70%)		Pressure not reported, duration for 30 sec or until desaturation, 1 to 3 dilations per procedure, Mitomycin C (1mg/cc) applied x 2 minutes
Primary EBD	31	26	20 of 31 (64%)	2	“
Secondary EBD	21	27	17 of 21 (81%)	1.8	“
Collins WO, et al. ⁹ 2012	5	2.2	4 of 5 (80%)	2.2	4 atmospheres, duration until desaturation, no topical steroids or Mitomycin C use reported

Table 1: Evidence Table

OUTCOME MEASURES

- **Treatment success (%) defined as the avoidance of more invasive procedures**
- **Recorded complications.**
- **Effect modification by age and the severity of subglottic stenosis as measured by the Cotton-Myers grade (I-IV) was also assessed.**

RESULTS 1: Treatment success

- 7 studies: 150 subjects
- Case series (level 4 evidence).
- The mean sample size: 20 subjects (5–44)
- The grand mean age: 2.2 years (2.2-60 mons)
- Follow-up averaged 4.6 months (0.25-12.5)
- Treatment success: 65.3% (k= 6 studies, 95% CI=60.1- 70.6%, $p < 0.001$, Q test, heterogeneity=3.98, $p = 0.552$, I squared=0%).

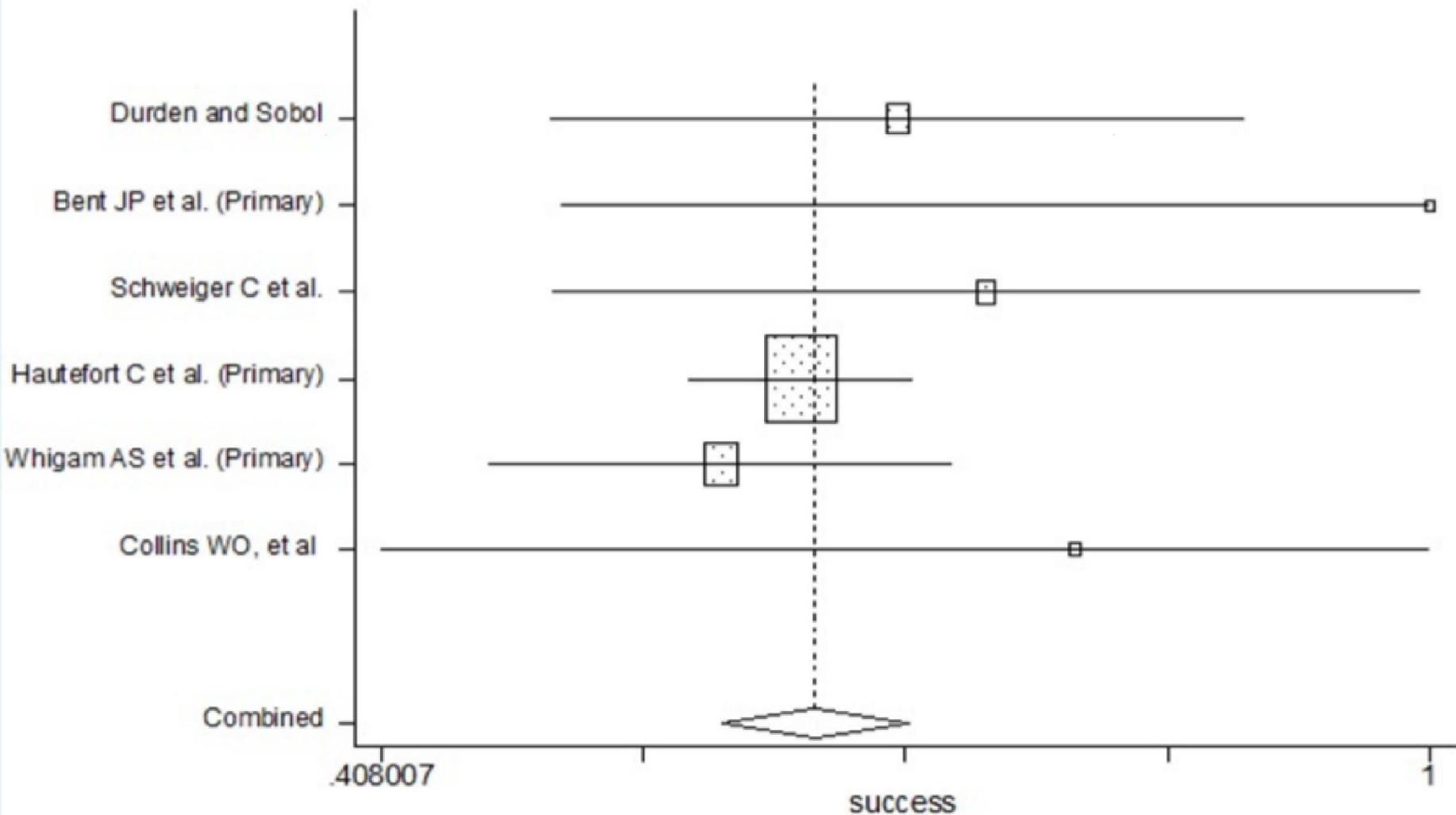


Figure 2: Forest plot of treatment success of using endoscopic balloon dilation. The summary estimate of success is 65.3% (95% CI=60.1-70.6%, $p < 0.001$, Q test for heterogeneity=3.98, $p = 0.552$, I squared=0%).

RESULTS 2: reported complications

- One study: atelectasis (3 patients), tracheitis (2 patients), pneumomediastinum (asymptomatic, 1 patient), tracheal laceration (2 patients), death (1 patient, from tracheal laceration)

RESULT 3: effect – age/ stenosis grade

- Pooled data multivariate regression indicated increasing Cotton-Meyers grade was associated with decreased odds of success (OR=0.198, 95% CI=0.0451- 0.870, $p=0.032$)
- Funnel plot analysis suggested the possibility of publication bias
- Age does not appear to be predictive of treatment outcomes

Treatment Success (%) by Subglottic Stenosis Severity

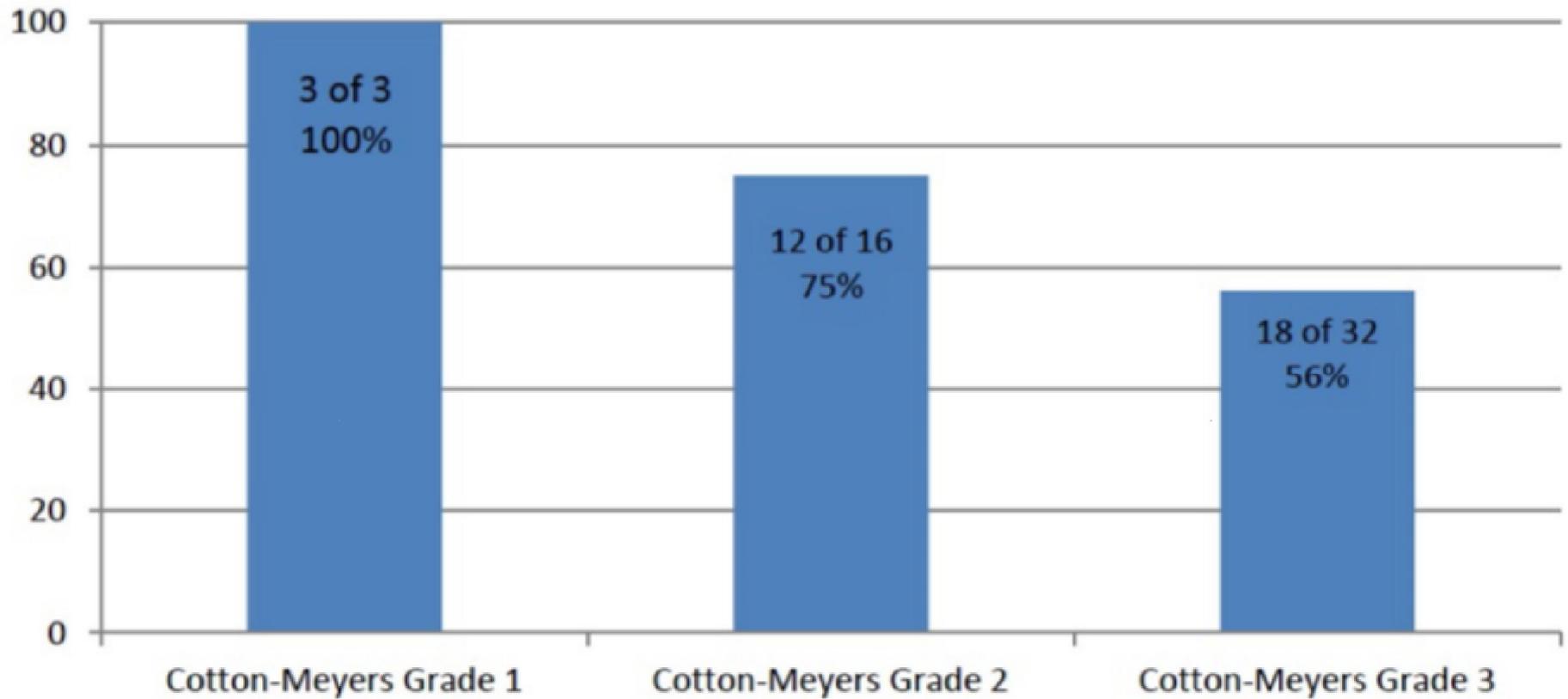


Figure 3: Success rate of primary EBD based on the initial Cotton Myers Stage (Odds ratio of failure with increasing stage=3.387, 95% CI=0.997-11.51, p=0.051)

Funnel plot with pseudo 95% confidence limits

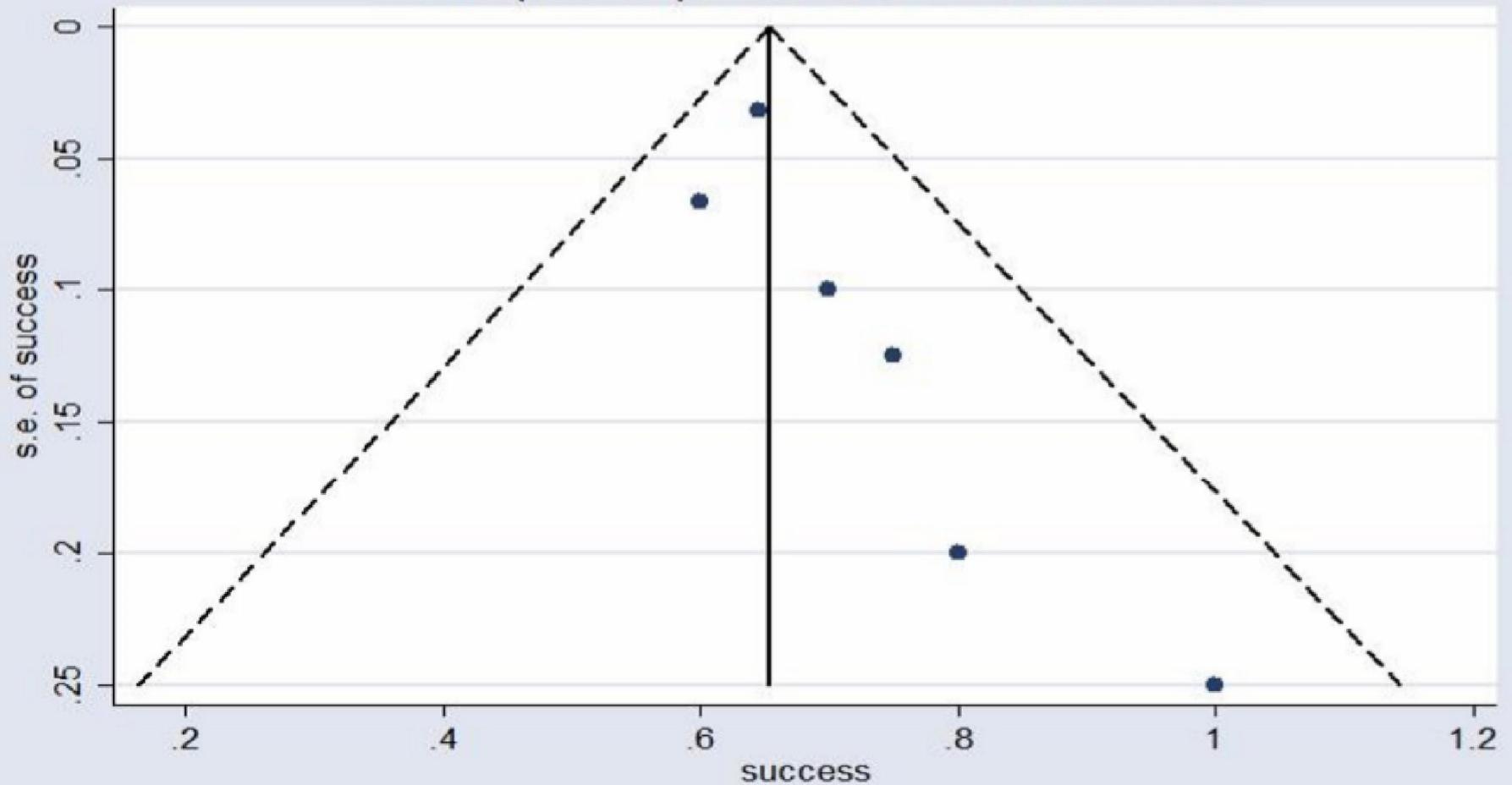


Figure 4: Funnel plot of EBD treatment success. The sparsely filled left lower side of the funnel suggests a possibility of publication bias.

DISCUSSION

- Limitations: the heterogeneity of the data. the included studies were case series.
- Nonetheless, EBD is unquestionably simpler and less invasive than tracheostomy and LTR to which it might be compared. As a result, any measurable success of EBD can still be considered important and useful.

CONCLUSION

- Successful EBD # 2/3 patients / over follow 4 months.
- Successful secondary treatment by EBD after tracheostomy and/or LTR: # 2/3 patients.
- Complications: rarely reported but severe (death by tracheal laceration)
- Increasing severity of subglottic stenosis may be associated with increasing odds of treatment failure.
- Age does not appear to be predictive of treatment outcomes

Balloon Laryngoplasty for Pediatric Laryngeal Stenosis

Case Series and Systematic Review

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This Study	36.4 months (4 days – 17 years)	Congenital or acquired laryngotracheal stenosis	N=60 144 dilations Retrospective F/U 0.8-69 mo average=21.7	1) Avoidance of open reconstruction or tracheostomy 2) Decannulation	<ul style="list-style-type: none">• 46/60 (77%) successful• No association of dilation failure with age, gender, Cotton-Myer stenosis primary versus adjunct• No complications
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Conclusions

BLP is a highly effective, low-risk alternative or adjunct to traditional reconstructive procedures in children with subglottic or laryngeal stenosis, and can serve to avoid the potential morbidities associated with open surgical procedures. Early identification and treatment of laryngotracheal stenoses is crucial to the success of the procedure. Additional prospective studies are required in order to identify confounding factors that may affect BLP success.

Endoscopic balloon dilatation for subglottic or tracheal stenosis

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NICE interventional procedure guidance 425

guidance.nice.org.uk/ipg425

1 Guidance

- 1.1 Current evidence on the safety and efficacy of endoscopic balloon dilatation for subglottic or tracheal stenosis is inadequate in quantity and quality. Therefore this procedure should only be used with special arrangements for clinical governance, consent and audit or research.
- 1.2 Clinicians wishing to undertake endoscopic balloon dilatation for subglottic or tracheal stenosis should take the following actions.
- Inform the clinical governance leads in their Trusts.
 - Ensure that patients and their carers or parents understand the uncertainty about the procedure's safety and efficacy, and provide them with clear written information. In addition, the use of NICE's information for patients ('[Understanding NICE guidance](#)') is recommended.
 - Clinicians should submit details of all patients undergoing this procedure to the [International Registry for Airway Stenosis \(IRAS\)](#).
- 1.3 Further information from research and collaborative data collection would be useful. This should include clearly defined patient selection criteria and long-term outcomes. NICE may review this procedure on publication of further evidence.