

Single Use Flexible Bronchoscopy: An ex-vivo comparison of all commercially available scopes.

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Background

The development of single use flexible bronchoscopes (SUFB) has proceeded with pace over the last 3 years, with multiple vendors now competing in an evolving market once dominated by anaesthetics and critical care.

Concerns regarding infection related to reusable flexible bronchoscopes (RUFB) and the COVID-19 pandemic accelerated the global use and development of SUFB. Some vendors are preparing fifth generation devices with improved image quality and degrees of angulation.

Technical documentation does not always give a clear picture of device performance and there has been no ex-vivo comparison of SUFBs to date.

Methods

We obtained samples of all commercially available SUFBs (TSC Broncoflex®, BSCI® Exhalt, Ambu® and Vathin® SteriScope, & Pentax® ONE Pulmo SUFB).

We compared technical metrics from multiple vendors including turning diameter, range of movement and turning forces using a custom-built kit engineered to allow standardised measurements using a clamp assembly, force meter and camera (Figure 1.).

Angulation was analysed by a force meter to ascertain the force needed to flex the SUFB while empty and when accessed by a BSCI Radial Jaw 4 2mm forceps. To assess scope suction, two new SUFBs from each company were obtained and compared to a reusable 3.2 Pentax® EB1970TK™ bronchoscope. A “pseudo-mucus” solution was prepared using a 1% guar gum solution.

Captured images were imported into AutoCAD and analysed with standardised CAD generated images.

Comparison of Scopes (Forceps Range & Operating Force)

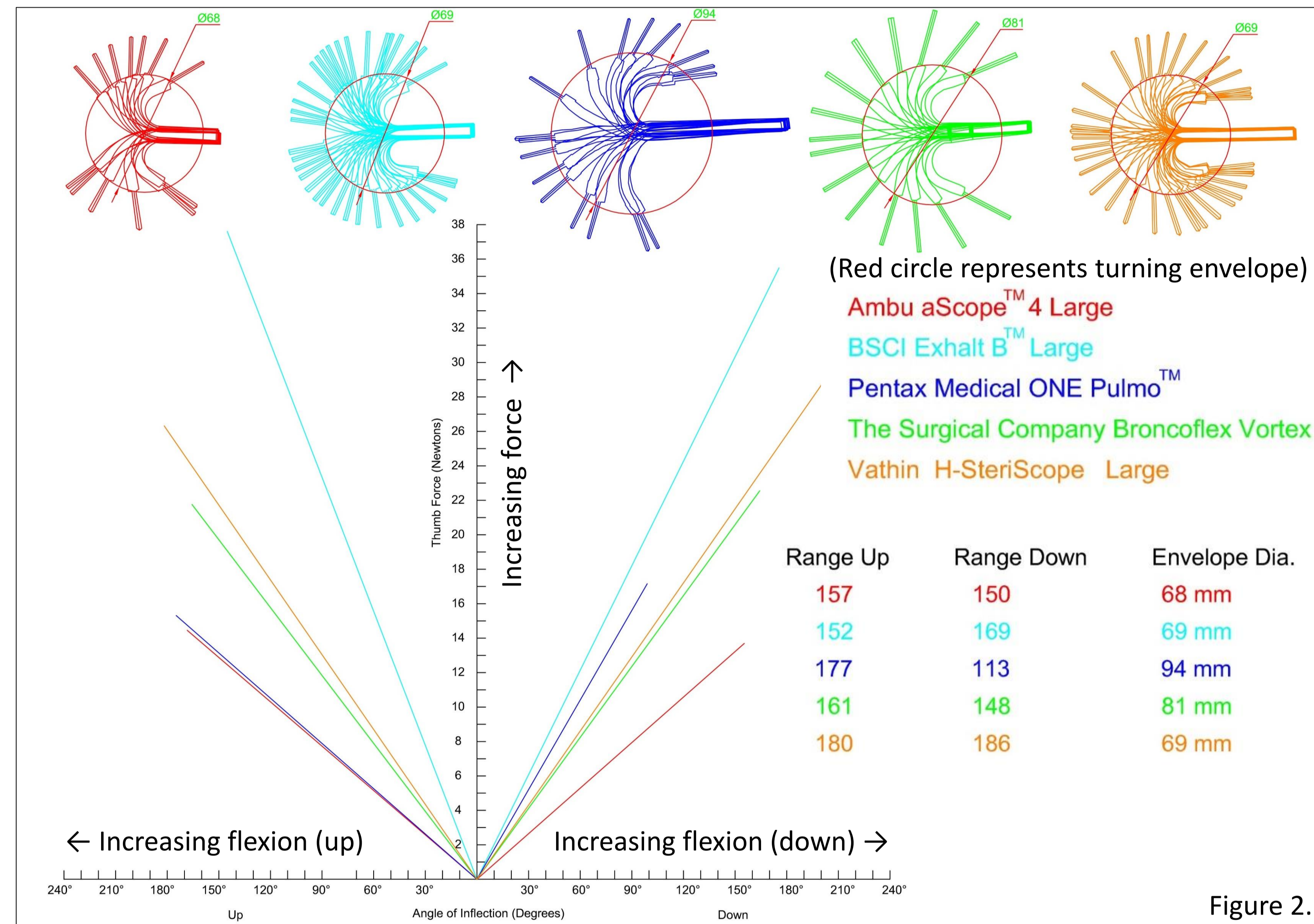


Figure 2.

SUFB Thumb Force Measurements

Table 1. Scope (ID)	Empty (N/100°)			Forceps (N/100°)		
	Up	Down	Mean	Up	Down	Mean
Ambu® aScope™ 4 Large (2.8mm)	4	4.3	4.2	8.5	8.8	8.7
BSCI® EXALT™ B Large (2.8mm)	11	8	9.5	25.9	20.2	23
PENTAX® Medical ONE Pulmo™ (3mm)	5.1	7.2	6.2	10.3	14	12.2
TSC Broncoflex™ Vortex (2.8mm)	5.6	4.8	5.2	13.1	13.7	13.4
Vathin® H-SteriScope™ Large (2.8mm)	5.6	6	5.8	14.2	14.2	14.2

SUFB Angulation Measurements (Empty & Forceps)

Table 2. Scope	Empty				Forceps			
	Up (°)	Down (°)	Total Angulation (°)	Turning Envelope (mm)	Up (°)	Down (°)	Total Angulation (°)	Total Loss of Angulation (°)
Ambu® aScope™ 4 Large	180 (180)	170 (160)	350	68	157 (-23)	150 (-20)	307	-43
BSCI® EXALT™ B Large	191 (180)	185 (180)	376	64	152 (-39)	169 (-16)	321	-55
PENTAX® Medical ONE Pulmo™	211 (210)	164 (180)	375	94	177 (-34)	113 (-51)	290	-85
TSC Broncoflex™ Vortex	215 (200)	202 (200)	417	77	161 (-54)	148 (-54)	309	-108
Vathin® H-SteriScope™ Large	209 (210)	212 (210)	421	66	180 (-29)	186(-26)	366	-55

Brackets, manufacturer specifications Brackets, measured loss of angulation
Turning Envelope - Represents total diameter (mm) of the turning circle of the articulating portion of the distal bronchoscope (smaller is better)

Comparison of Scopes (Suction)

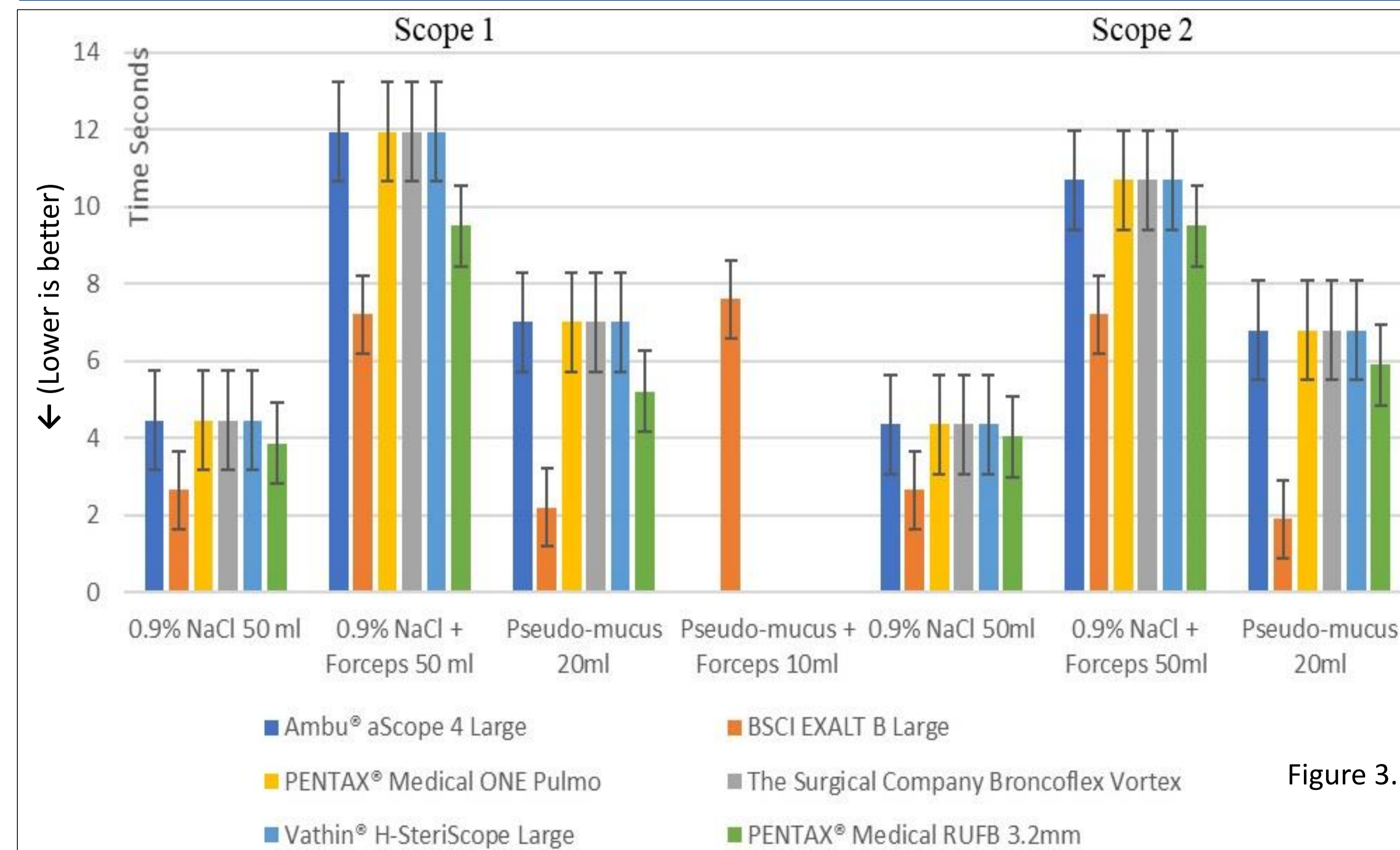


Figure 3.

Summary

The Ambu® aScope™ 4 Large had the best performance in terms of force (4.2, 8.7 N/100°) and the smallest turning envelope while instrumented (68mm).

Compared to other SUFB, The Vathin® Large and TSC® Broncoflex Vortex™ allow more total angulation (>40°) while empty, but required more thumb force compared to Ambu® aScope 4 Large (5.8, 14.2 & 5.2, 13.4 N/100°).

The Vathin® Large SUFB provided the most agility through preserved total flexion with a forceps (366°) while also being the only SUFB with rotational capabilities.

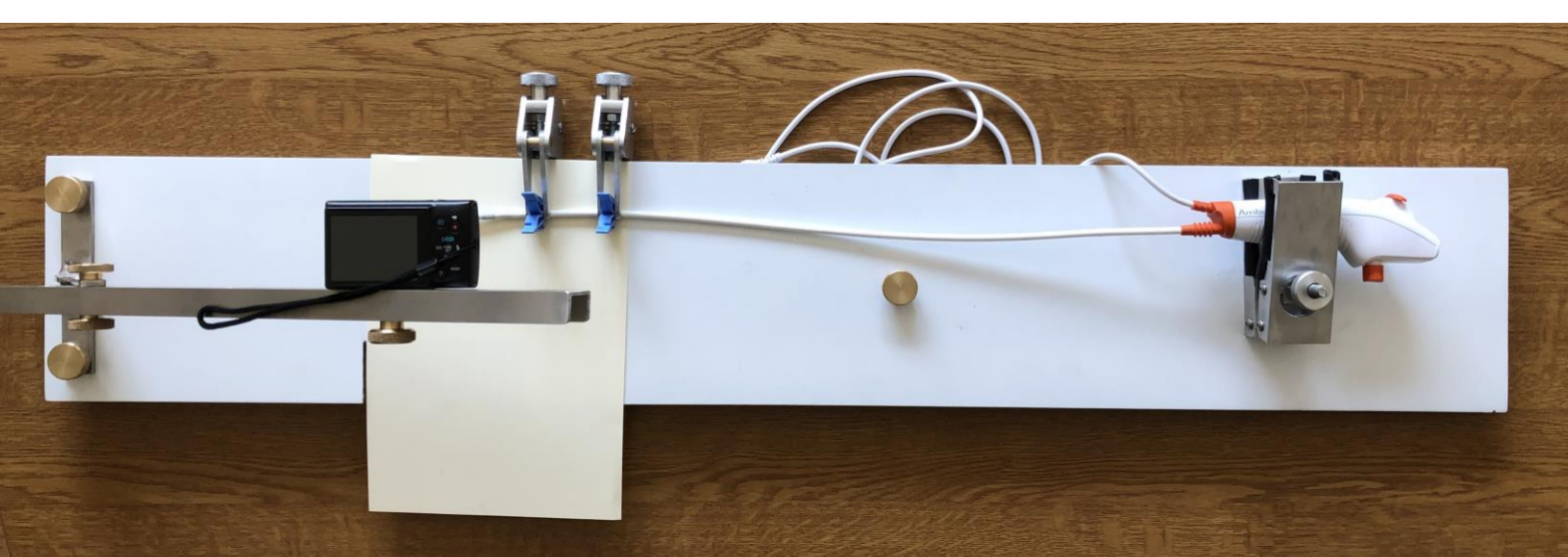
The BSCI® SUFB had the smallest turning envelope at 64mm, but was the stiffest for activating thumb force (9.5 N/100°). It did however outperform all other SUFBs in suction (p=0.0001 for both total group and Pentax® RUFB). It was the only scope capable of suctioning pseudo-mucus around a forceps in-situ. It was also noted that despite not pushing on the suction button, both tested Vathin® SUFBs had a low amounts of persistent suction.

The Pentax® ONE Pulmo™ deviated the most from its reported specification and lost a combined 108° of freedom when accessed with a forceps.

This research helps to inform the practical usability of each bronchoscope when deciding which SUFB is best for the physicians intended end use. Further research should look at perceived qualitative assessment of SUFB by clinicians.

Figure 1.

Left: Custom-built bench toolkit engineered to allow standardised measurement of SUFB



Disclosures: Prof. Marcus Kennedy has received speaker fees from The Surgical Company, Boston Scientific Ireland, Pentax Medical and Cook Medical

References: Please zoom in and scan this QR code for a complete list of references for this abstract and poster.

