
"Sucking Wind"
/ STRONG SELL OPINION /
Penumbra, Inc. | NYSE:PEN
SPRUCE POINT
CAPITAL MANAGEMENT
INVESTMENT RESEARCH REPORT
report
MARKET SHARE

SPRUCE POINT CAPITAL MANAGEMENT

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Spruce Point's Activist Successes With Companies Experiencing Revenue Inflections

Spruce Point Capital Is A Globally Recognized Research Activist Investment Firm Founded In 2009

- Founded by Ben Axler, a former investment banker with 18 years experience on Wall Street
- Ranked the #1 Short-Seller by Sumzero after a study of 12,000 analyst recommendations dating to 2008 (March 2015)
- Ranked the #13 Most Influential FinTweeter on Twitter according to Sentieo (Dec 2016)

Spruce Point's Activist Successes With Companies Experiencing Revenue Inflections

	iRobot	MAXAR TECHNOLOGIES	bazaarvoice
Report	Nov 2018, Mar 2019	Aug 2018	May 2012
Enterprise Value	$2.0 billion	$6.3 billion	$1.2 billion
Company Promotion / Situation Overview	Premium robot vacuum protected against cheap, low-end competition. New revenue streams from robotic mop and robotic lawnmower will continue to drive high-teens sales growth.	Satellite cycle expected to improve in H2 FY18 while $60-120M of M&A synergies provide tailwind. Expanding commercial business opportunity combined with increasing ability to compete for U.S. government business.	Disruptive provider of social commerce solutions that help clients capture, display and analyze online word-of-mouth, including consumer-generated ratings and reviews
Our Criticism	Increasingly high-end competitors taking share in robot vacuum space and pressuring ASPs. History of failures in non-vacuum products suggests inability to grow mop sales or successfully launch lawnmower. Rising DSIs suggest financial strain. Distributor acquisitions obscure underlying sales declines.	MDA's acquisition of DigitalGlobe driven by need to cover problems in satellite business. Brazen accounting scheme including inflation of intangible assets and overstatement of non-FIRS EPS. Dangerously levered at 5.8x when off-balance sheet liabilities are taken into account. Impending asset impairments.	Our research revealed that BV's solution was nothing more than a money losing, rapidly commoditized service that would not scale. Its IPO prospectus was littered with social media buzz words at a time when Facebook was being taken public, and $25 analyst price targets would prove unrealistic.
Successful Outcome	Disappointing sales growth due to slower-than-projected robotic mop sales. Gross margins continue to decline due to increasing competition at both the low and high end of the market. FY outlook lowered.	Maxar made several attempts to "refute" our conclusions, yet share prices have fallen 90% since our report on impairment losses (validating our concerns), significant revenue misses, and dividend cuts.	BV's CFO and CEO eventually resigned and its share price fizzled to low single digits before ultimately being acquired for just $5.50/sh, 54% below its $12 IPO price and 70% below our initiation price.

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Executive Summary

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CAPITAL MANAGEMENT

Spruce Point Sees 40-55% Downside Risk ($85-$110 Per Share) In Penumbra (PEN) Shares

Penumbra, Inc. ("PEN" or "the Company") is a one-trick-pony surgical instrument company which, in our opinion, produces a low-tech and undifferentiated product in an increasingly competitive space. Penumbra was first to market with an aspiration catheter ("AC") FDA-approved to treat acute ischemic stroke ("AIS"). Major medtech companies have entered the space within the last 9 months and, per the medical community, offer neurovascular ACs at least as good as Penumbra's at far superior economic terms, often as part of discounted bundles. While analysts are aware of the new competition, they seem blind to the pace of Penumbra's market share losses: IQVIA transaction data reveals that its U.S. neuro AC sales growth has *contracted* in recent months. Heavy competition and a limited TAM will also curtail peripheral AC sales – a revenue stream which analysts see as a major growth engine for Penumbra. Non-core M&A, distributor acquisitions, and rising DSOs suggest that management – which has a history of promotional activity – may be reaching to defend its medtech hype train as competitors eat at Penumbra market share. We believe that underestimated competition could cut Penumbra's expected sales growth by nearly half in FY20, from 20% to close to 10%.

- **Wave Of Competition Entering Penumbra's Vertical For The First Time**: Penumbra was the first to market with an AC cleared by the FDA for treatment of acute ischemic stroke. Major medical device companies left the space alone for most of the 2010s, instead focusing their efforts on stent retrievers – the standard of care in mechanical thrombectomy until recently. However, now that aspiration thrombectomy for ischemic stroke has gained wider acceptance as a cheaper (by 30-50%) and sufficiently-effective approach, four major device companies have entered the space within the last two quarters.
- **Rapid Pace Of Market Share Loss Deeply Misunderstood By Market**: Analysts have grown to understand Penumbra as a dominant player in its vertical, with ~90% share. While they recognize that competition is coming, they have no historical basis for modeling the pace of market share loss, and appear to assume only low-to-mid single-digit annual losses through the coming years. IQVIA Medical Device and Supply Audit (MDSA) data, which project nation-wide sales for individual medical devices from a panel of 650 U.S. hospitals, indicate that, even as the mechanical thrombectomy market grows, Penumbra is losing U.S. share so rapidly that monthly unit sales have been DOWN through 5 of the last 6 months, with monthly declines of up to 28%. Our conversations with doctors corroborate this data, with many neurosurgeons indicating that, over just the last 6 to 9 months, they have shifted from using Penumbra in 70-90% of neuro aspiration therapy procedures to just 10-30% of these procedures.
- **Penumbra's Core "Device" A Commoditized Plastic Consumable Sold Cheaply By Competitors**: While Penumbra has had the only AC approved for acute ischemic stroke treatment through most of the 2010s, ACs are functionally little different from intermediate guide catheters, mechanical thrombectomy accessories priced 75% or more below ACs. Many doctors have used these catheters as "off-label" ACs due to price differences or product preferences. Large medical device companies will have, and have had, little trouble entering the market with products already equivalent or superior to Penumbra's. They also sell their ACs in bundles with SRs and other adjacent products, which support per-item savings of up to 33%. Penumbra – an almost purely AC-driven company with a poorly-rated "3D separator" SR and few other products – cannot offer similar bundles and is likely to experience significant pricing pressure as the sector migrates to this purchasing model.
- **Promotional And Aggressive Management Playing Defense Against Slowing Growth?**: Industry contacts indicate that management is highly promotional and liberal in their spending on medical professionals. Open Payments data from the Centers for Medicare & Medicaid Services reveal that Company spending on doctor travel reimbursement – often to sites like Las Vegas and Miami – is unusually high. They have also granted an unusually large quantity of stock to non-employee doctors, which we find suspicious for a young medical device company which has been eager to find clinical support for its products. Further, we observe hallmark executive actions which may signal a coming sales slowdown: rising DSOs, non-core M&A / distributor acquisitions, hyping up secondary businesses, and aggressive stock sales.
- **A Commoditized, One-Product Company Valued As A Growth Story**: PEN is valued on par with high-tech medical device companies with significant IP protection. PEN's products are far more commoditized and subject to competition, which it is now experiencing for the first time. Valuing PEN in-line with a more appropriate peer universe of commodity producers would reduce PEN's multiple from 10x to 5-6.5x FY20 sales. Even bullish sell-side analysts have an average price target 7% below current levels as valuations have climbed to nosebleed levels through the past several weeks. Spruce Point sees 40-55% downside ($85-$110) in the stock after adjusting future sales growth to reflect the onset of competition and applying a more reasonable 5-6.5x FY20 sales multiple.

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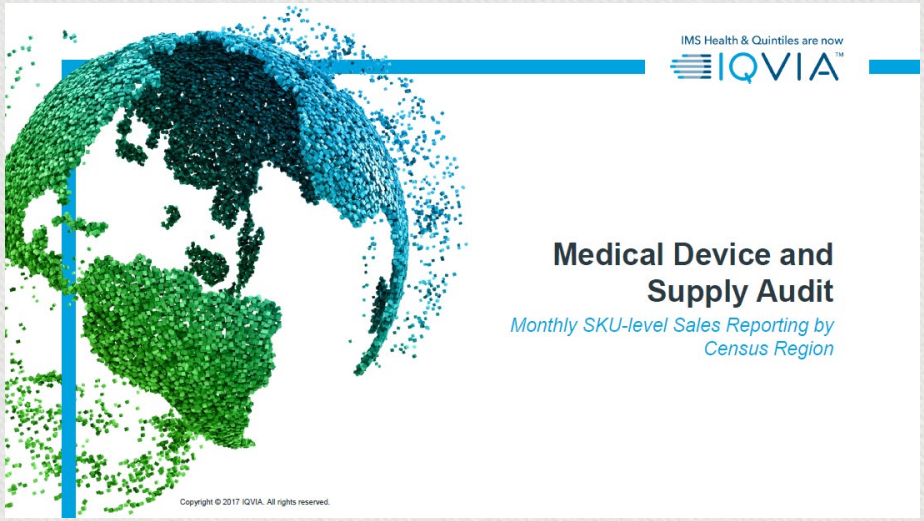
IQVIA: Evaluating Shifting Market Share With Hospital Transaction Data

In order to evaluate recent changes in aspiration catheter market share, Spruce Point obtained recent hospital transaction data from IQVIA. IQVIA – formerly IMS Health and Quintiles – is a publicly-traded healthcare data analytics and technology services company which serves the life sciences sector. It collects and analyzes data on pharmaceuticals, medical equipment, electronic medical records, and a wide range of other life sciences topics to provide medical professionals, researchers, salespeople, executives, and others with relevant insights on healthcare-related topics. Using IQVIA's Medical Device and Supply Audit (MDSA), we were able to evaluate sales trends for all neurovascular mechanical thrombectomy devices through May 2019. The MDSA records 100% of medical device purchases by 650 non-federal, short-term acute care hospitals in the U.S. and, from this, projects nation-wide sales (in both units and dollars) on a SKU-level basis for nearly 3,000 medical device companies. This allowed us to study shifts in aspiration catheter market share on just a two-month lag.



It is important to note that, to our knowledge, this data is known to very few market participants: it is designed for and provided primarily to the health care industry. Our understanding is that it is known to few, if any, sell-side brokerage firms. It is also priced to a corporate end market and, as such, is likely too expensive for all but the largest of buy-side firms. We believe that the market is generally blind to this data, and that prices of Penumbra shares must adjust to reflect this powerful, credible, and compelling information.

Source: Medical Device & Supply Audit, June 2013 – May 2018, IQVIA Inc. All Rights Reserved.

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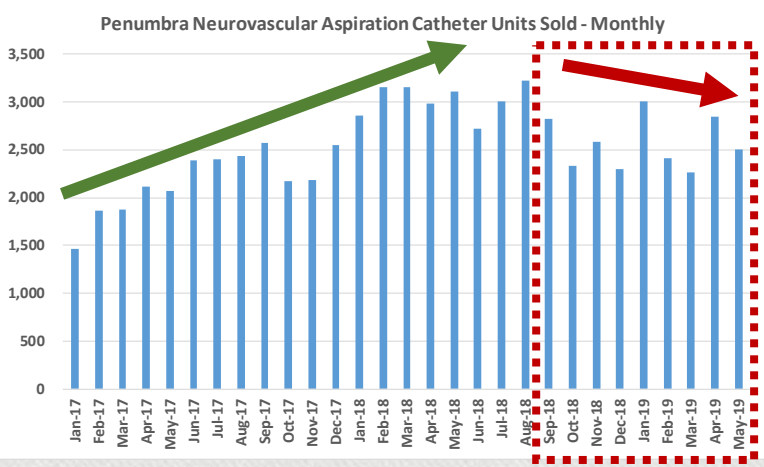
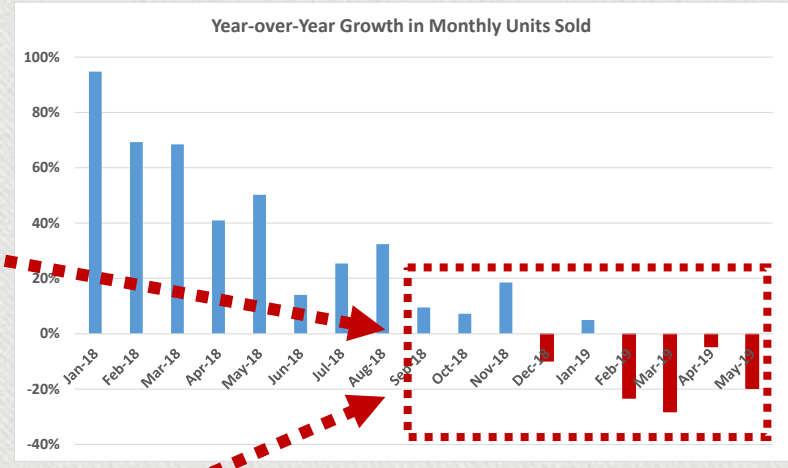
Market Data Corroborates Penumbra's Dramatic Market Share Loss

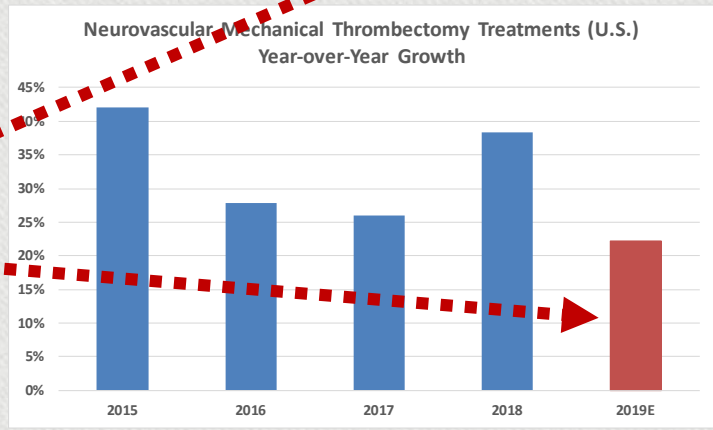
Spruce Point's analysis of recent market data confirms that Penumbra is, in fact, rapidly losing share in real time. IQVIA MDSA data show that, as of May – the last month for which data is currently available – monthly sales of Penumbra's neurovascular aspiration catheters have declined year-over-year for five of the last six months. Penumbra's growth trajectory appears to be losing steam so rapidly that its rate of growth has not only slowed, but has turned *negative* in a neurovascular mechanical thrombectomy market which is itself growing at 20-40% per year.





Source: Medical Device & Supply Audit, June 2013 – May 2018, IQVIA Inc. All Rights Reserved.

We find it striking that Penumbra's apparent unit sales growth in the neurovascular aspirator vertical has been *negative* even as the mechanical thrombectomy market grows at a brisk rate



Source: Blended Sell-Side Estimate

While prior declines indicated by IQVIA did not translate into *negative* sales growth, it does appear to reflect recent sales growth decelerations directionally, and could provide context for the recent pickup in DSOs. Do stretched receivables suggest that the indicated decline in AC transactions could translate to observable trends in Penumbra's financial statements on a lag? Did international sales cover up U.S. declines?

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Apparent Sales Decline Coincides With Wave Of Competitive Entry

We note that the sales decline indicated by the transaction data coincides with the H2 2018 FDA approval of multiple neurovascular aspiration catheters by competitors. Importantly, the accompanying onset of new competition is also visible in the transaction data. IQVIA began to capture sales of Medtronic's React 68 neurovascular aspiration catheter in Sep 2018, the first quarter during which Penumbra sales began to show hints of slowing down in the data set. This strengthens our belief that the observed slowdown in Penumbra sales in the transaction data is in fact a realistic representation of real-time market dynamics, and makes us more confident that the onset of new competition will continue to eat away at Penumbra sales.

Penumbra Unit Sales Declines Coincide With Emergence Of New Competitors

	MM/YY	1/18	2/18	3/18	4/18	5/18	6/18	7/18	8/18	9/18	10/18	11/18	12/18	1/19	2/19	3/19	4/19	5/19	Since 9/18
PENUMBRA	Total Neuro AC Units Sold	2,859	3,151	3,155	2,980	3,111	2,721	3,005	3,228	2,817	2,334	2,586	2,299	3,001	2,416	2,265	2,840	2,498	24,678
	Total Neuro AC Units Sold, % Growth (YoY)	95%	69%	68%	41%	50%	14%	25%	32%	10%	7%	19%	--10%	5%	-23%	-28%	-5%	-20%	-
MEDTRONIC	React 68 Units Sold	-	-	-	-	-	-	-	-	21	230	199	238	250	347	261	182	151	2,329
	React 71 Units Sold	-	-	-	-	-	-	-	-	-	-	?	?	?	?	?	?	?	?
RELATIVE INCREMENTAL SHARE	PENUMBRA	100%	100%	100%	100%	100%	100%	100%	100%	99%	91%	93%	91%	92%	87%	90%	94%	94%	91%
	MEDTRONIC	-	-	-	-	-	-	-	-	1%	9%	7%	9%	8%	13%	10%	6%	6%	9%

Source: Medical Device & Supply Audit, June 2013 – May 2018, IQVIA Inc. All Rights Reserved.

Importantly, note that Medtronic's React 71 – its newest and, per doctors with whom we've spoken, most popular neurovascular aspiration catheter – is not yet captured in the IQVIA data. Therefore, the above data represents Medtronic's *minimum* relative incremental market share vs. Penumbra. From our conversation with doctors, we are confident that the recent decline in React 68 sales reflects cannibalization by the React 71.

IQVIA has informed us that sales data for the React 71 will be available as of mid-August, in just several weeks. We anticipate that the data could show sales of over 1,600 React 71 catheters since Sep 2018, which would put Medtronic's cumulative relative incremental share at 15%, where management claimed it to be.

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Tracking Data Corroborated By Doctors

In the course of our research, we spoke with numerous neurosurgeons at institutions of a wide range of sizes, including practices which conduct anywhere from 60 to 200 mechanical thrombectomies per year. The trend among them was almost universal: whereas most used Penumbra almost exclusively until only recently, they now purchase only 0-30% of their neurovascular aspiration catheters from Penumbra. This shift among neurosurgeons from ~100% to 0-30% reliance on Penumbra has occurred over the course of just six to nine months.

Neurosurgeons Rapidly Switching From Penumbra To Competitors

		Mechanical Thrombectomies per Year		Aspiration Catheter Usage Share: 2018		Aspiration Catheter Usage Share: 2019			
	Region	Individually	Practice-Wide	Penumbra	Other	Penumbra	Medtronic	Terumo	Other
Doctor 1	Midwest	80-100	200	**100%**	-	**15%**	15%	70%	-
Doctor 2	Southeast	75	75	**90%**	10%	**30%**	70%	-	-
Doctor 3	Northeast	30	150-180	**~40%**	60%	**-**	100%	-	-
Doctor 4	West Coast	25-35	120	**90%**	10%	**30%**	70%	-	-
Doctor 5	Southwest	?	?	**100%**	-	**50%**	50%	-	-

*"**I am 70% Sofia [Terumo], probably 15% Medtronic React 71, and 15% Penumbra. It used to be that we were 100% Penumbra when they were the only thing out there**. In 2017, I got a partner who had in his training, had used Sofia for this purpose even though it did not have an indication for thrombectomy… And then Medtronic came out, and then Vecta [Stryker] came out. **Sofia was way better than Penumbra's and so we pretty much switched**. It took me a month or two to agree to that, but we switched… **Their Jet7 catheter sucks and they know it.**"*

- Neurosurgeon
Individually: 80-100 mechanical thrombectomies per year
Practice: ~200 mechanical thrombectomies per year

*"Penumbra used to always beat itself. Once something new came out, Penumbra would come out with something better. **But now Medtronic has the React 71, and that is kicking ass. In our shop, we have shifted 40-50% of our business from the Penumbra Jet to Medtronic** – and now it is backordered. Medtronic never expected it to be this successful. And **Cerenovus [Johnson & Johnson] is coming out with some interesting stuff too in the next six months. I think they are going to be even bigger than the React 71.**"*

- Neurosurgeon

Between the transaction data and our conversations with doctors and other industry experts, the evidence overwhelmingly suggests that Penumbra is losing tremendous market share at an extremely rapid pace.

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Discounted Bundling By Deep-Pocketed Mega-Cap Competitors Threatens Industry Pricing

We estimate that, even if it were to give its stent retrievers away for free as part of its mechanical thrombectomy bundles, Medtronic would be able to grow its mechanical thrombectomy profit dollars through 2019, even when assuming no stent retriever share gains.

$M		2018	2019E			
Stent Retriever Market Share	Medtronic	60%	60%	60%	60%	60%
	Penumbra	5%	5%	5%	5%	5%
Stent Retriever Procedures	Medtronic	16,178	18,664	18,664	18,664	18,664
	Penumbra	1,348	1,555	1,555	1,555	1,555
Aspiration Market Share	Medtronic	10%	25%	25%	25%	25%
	Penumbra	90%	75%	75%	75%	75%
Aspiration Procedures	Medtronic	2,741	8,585	8,585	8,585	8,585
	Penumbra	24,669	25,754	25,754	25,754	25,754
Accessories[1]	Medtronic	18,919	27,249	27,249	27,249	27,249
Average Selling Price (Medtronic)	Stent Retriever	$8,000	$8,000	$8,000	$8,000	$8,000
	Aspiration	$4,000	**$3,000**	**$2,000**	**$1,000**	**$0**
	Accessories	$3,000	$3,000	$3,000	$3,000	$3,000
	TOTAL	**$15,000**	**$14,000**	**$13,000**	**$12,000**	**$11,000**
COGS (Medtronic)[1]	Stent Retriever	$1,600	$1,600	$1,600	$1,600	$1,600
	Aspiration	$800	$800	$800	$800	$800
	Accessories	$600	$600	$600	$600	$600
	TOTAL	**$3,000**	**$3,000**	**$3,000**	**$3,000**	**$3,000**
Revenue	**Total**	**$197.1**	**$256.8**	**$248.2**	**$239.6**	**$231.1**
	Growth %	-	30%	26%	22%	17%
Gross Profit	**Total**	**$157.7**	**$203.7**	**$195.1**	**$186.6**	**$178.0**
	Growth %	-	**29%**	**24%**	**18%**	**13%**
	Margin %	80%	**79%**	**79%**	**78%**	**77%**

With the market-leading stent retriever and well-received aspiration catheters, Medtronic could likely take aspiration share extremely rapidly (as it has been) by temporarily giving away its aspiration catheters for free, or selling it at a steep discount. It would not sacrifice near-term gross profit growth by doing so, and could position itself for longer-term segment growth by establishing itself as the dominant player in neurovascular mechanical thrombectomy.

With limited ability to bundle on its own, Penumbra could face significant price compression in its core aspiration vertical without an opportunity to compensate by growing share in its relatively underpenetrated stent retriever vertical.

1. Assumes slightly above company-wide gross margin, per conversations with industry experts. Accessory quantities equal to sum of aspiration and stent retriever units.

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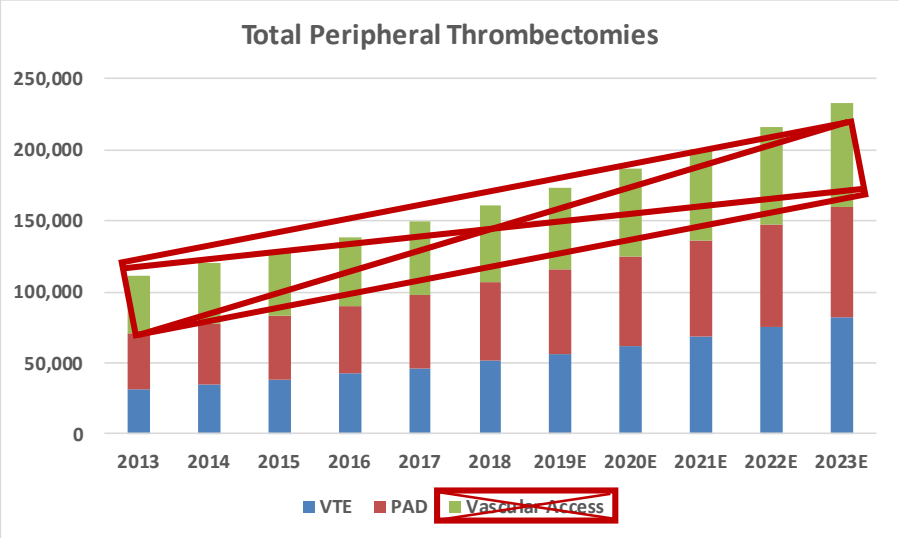
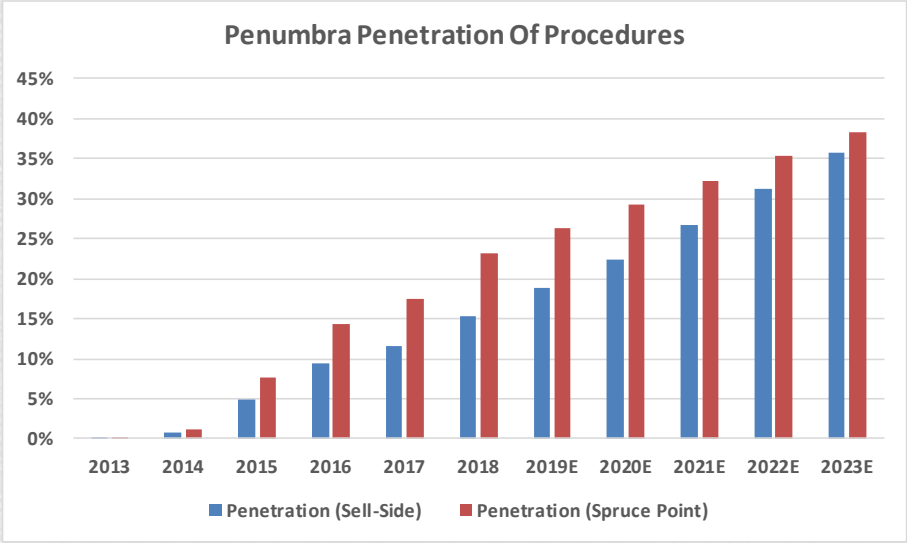
Diverting Attention Away From Bad News? Management Promoting A New Growth Engine Just As The Old One Is Set To Peter Out

Management has recently begun to promote its peripheral thrombectomy business, which sells catheters and accessories for use in treating clots outside of the brain and heart. We find it interesting that management has chosen to promote this business just as we observe the Company experience serious competitive pressure in its core neurovascular business. We also believe that sell-side growth expectations are excessive for this segment: many analysts include "vascular access" patients as part of Penumbra's vascular TAM, but doctors have told us that the TAM for Penumbra's vascular Indigo System is likely restricted to peripheral artery disease (PTE) and venous thromboembolism (VTE) patients, among whom there were ~110K thrombectomies in 2018. A fraction of these patients are also on Medicare and not candidates for a more expensive thrombectomy procedure. Spruce Point estimates that, in FY18, Penumbra achieved ~25% penetration among this universe of thrombectomy patients. While procedures are expected to continue to grow at a high single-digit rate, we do not expect Penumbra to be able to take significantly more share than it already has in what is a highly competitive market – already more competitive than the neuro vertical.



Source: Blended Sell-Side Estimate

By ruling vascular access patients out of Penumbra's target market, we believe that the TAM for Penumbra's peripheral thrombectomy business is 33% lower than the Street believes



Source: Blended Sell-Side Estimate

As of FYE 2018, we believe that Penumbra is 10% more penetrated than the sell side believes

With Penumbra more penetrated than the sell side believes in the peripheral thrombectomy market – a market which is already more crowded and competitive than the neuro market – we believe the Company's runway for growth is far more limited than is generally perceived.

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Summarizing The Sales Decline: Sales Growth Set To Be Cut Almost In Half

Spruce Point believes that, with Penumbra U.S. Stroke revenue growth set to slow in the face of heavy competition, and with consensus peripheral thrombectomy sales expectations far too aggressive, company-wide sales growth is set to be cut almost in half from Street estimates, from FY19 through FY21.

($M)	Blended Sell-Side Estimate			Spruce Point		
	FY19E	FY20E	FY21E	FY19E	FY20E	FY21E
U.S. Stroke – Aspiration Procedure Share	88.8%	84.4%	81.1%	75.8%	64.4%	55.0%
(A) U.S. Stroke – Aspiration Revenue	$125.1	$144.7	$163.4	**$110.5**	**$107.2**	**$103.5**
U.S. Stroke – Stent Retriever Procedure Share	11.7%	14.9%	18.0%	10.7%	12.6%	13.7%
(B) U.S. Stroke – Stent Retriever Revenue	$13.5	$20.9	$28.9	$12.8	$16.3	$19.5
(C) Total U.S. Stroke Sales ((A) + (B))	**$138.6**	**$165.6**	**$192.3**	**$123.3**	**$123.5**	**$123.0**
U.S. Peripheral Thromb. Penetration (of PAD and VTE)	28.4%	33.3%	39.3%	26.2%	29.2%	32.2%
(D) U.S. Peripheral Thromb. Revenue	**$87.1**	**$109.9**	**$139.2**	**$75.8**	**$84.5**	**$93.9**
(E) Remaining Penumbra Revenue	$305.7	$359.2	$407.4	$305.7	$359.2	$407.4
Total Penumbra Revenue ((C) + (D) + (E))	**$531.3**	**$634.7**	**$738.8**	**$504.8**	**$567.2**	**$624.3**
Revenue Growth, YoY	***19.4%***	***19.4%***	***16.4%***	***13.4%***	***12.4%***	***10.1%***

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Valuation Exceeds Appropriate Peer Group

Medtech companies which produce devices cleared under PMAs (as opposed to the 510(k) pathway) are generally deemed to be protected from competition by stronger barriers to entry and, naturally, tend to trade at relatively higher multiples. So why does Penumbra trade in line with producers of devices cleared under the PMA pathway?

				EV / Sales		Expected Sales Growth	
Company	Ticker	FDA Pathway	R&D as a % of Sales	FY19	FY20	FY19	FY20
Glaukos Corp	GKOS	PMA	27.4%	11.9x	10.0x	27.3%	18.9%
ABIOMED, Inc.	ABMD	PMA	12.2%	15.5x	13.1x	1.5%	18.7%
Tandem Diabetes Care Inc	TNDM	PMA	15.9%	11.6x	9.3x	69.9%	24.8%
Insulet Corporation	PODD	510(k)	15.7%	11.4x	9.6x	21.4%	18.7%
DexCom, Inc.	DXCM	PMA	19.4%	10.9x	9.2x	24.5%	18.2%
Penumbra Inc	**PEN**	**510(k)**	**8.1%**	**11.3x**	**9.5x**	**20.6%**	**19.9%**
Edwards Lifesciences Corp	EW	PMA	16.7%	10.6x	9.5x	11.1%	10.9%
iRhythm Technologies Inc	IRTC	510(k)	14.1%	9.7x	7.4x	42.8%	31.5%
ResMed Inc.	RMD	510(k)	6.9%	7.6x	6.9x	-0.1%	10.7%
Cardiovascular System, Inc.	CSII	510(k)	12.3%	6.1x	5.4x	13.3%	12.8%
Wright Medical Group, Inc.	WMGI	510(k)	7.1%	5.1x	4.7x	15.0%	11.1%
Nevro Corp	NVRO	PMA	12.5%	5.4x	4.9x	-5.3%	10.6%
Globus Medical Inc	GMED	510(k)	7.8%	5.1x	4.7x	7.8%	9.0%
NuVasive, Inc.	NUVA	510(k)	5.6%	3.2x	3.0x	4.8%	5.1%
PMA Average			**17.3%**	**11.0x**	**9.3x**	**21.5%**	**17.0%**
510(k) Average (Ex-PEN)			**9.9%**	**6.8x**	**5.9x**	**15.0%**	**14.1%**

SPRUCE POINT CAPITAL MANAGEMENT

Capitalization And Valuation

($ in millions, except per share figures)

Stock Price	$179.49
Diluted Shares	36.6
Market Capitalization	**$6,561.1**
Present Value of Lease Payme	$49.8
Contingent Consideration	5.6
Minority Interest	(0.1)
Less: Cash and Equivalents	194.8
Net Debt (Cash)	($139.5)
Total Enterprise Value	**$6,421.6**

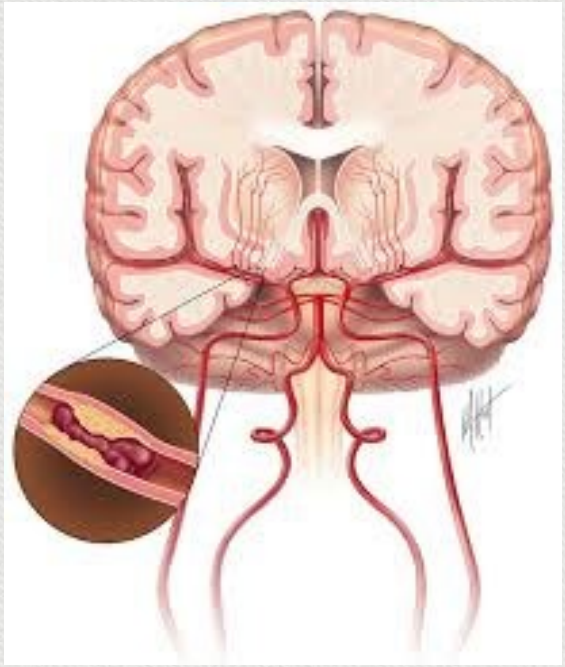
Street Valuation	FY18	FY19E	FY20E
EV / Sales	14.4x	12.0x	10.0x
Price / Adj. EPS	351.9x	208.5x	141.2x
Price / FCF	341.6x	410.1x	160.0x
Growth and Margins			
Sales Growth	33.3%	20.6%	19.9%
Adj. EBITDA Margin	NA	9.5%	11.0%

Surgical Thrombectomy And Aspiration Catheters: A Primer

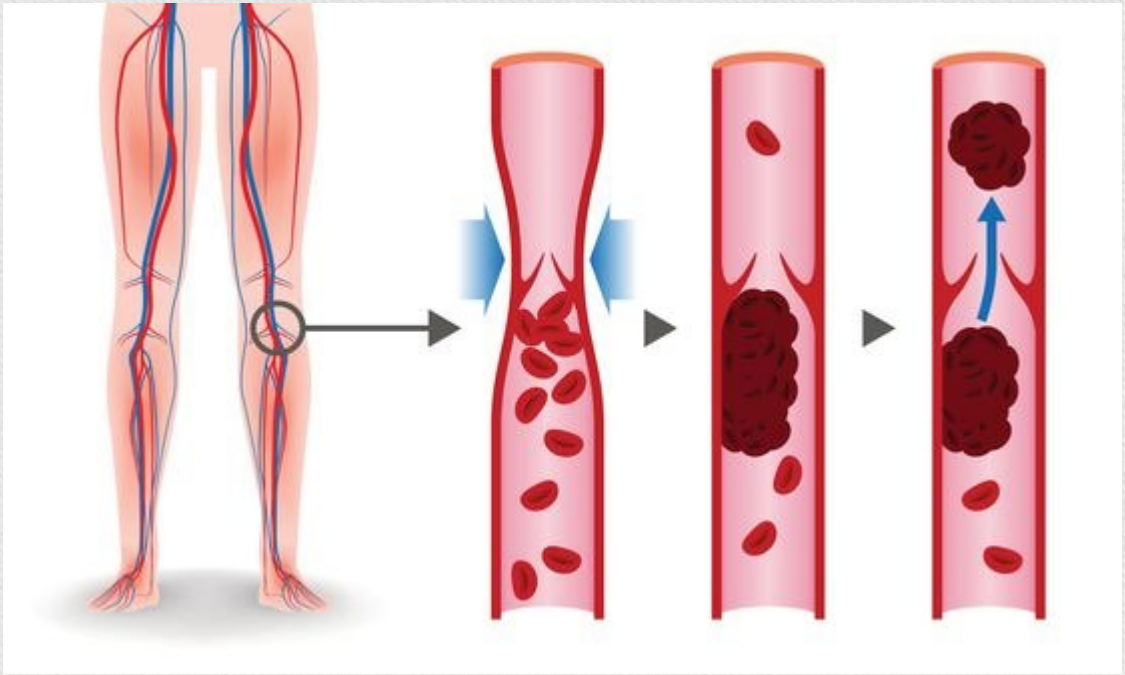
Background On Thrombosis

Penumbra develops and produces devices designed to treat thrombosis, the formation of a blood clot obstructing blood flow through the circulatory system. Thrombosis includes both ischemic strokes and various types "peripheral" or "vascular" clots. Ischemic strokes occur when a clot blocks blood flow through a vein or artery in the brain. Peripheral or vascular clots, meanwhile, occur elsewhere throughout the body.

Acute Ischemic Stroke



Peripheral Vascular Thrombosis



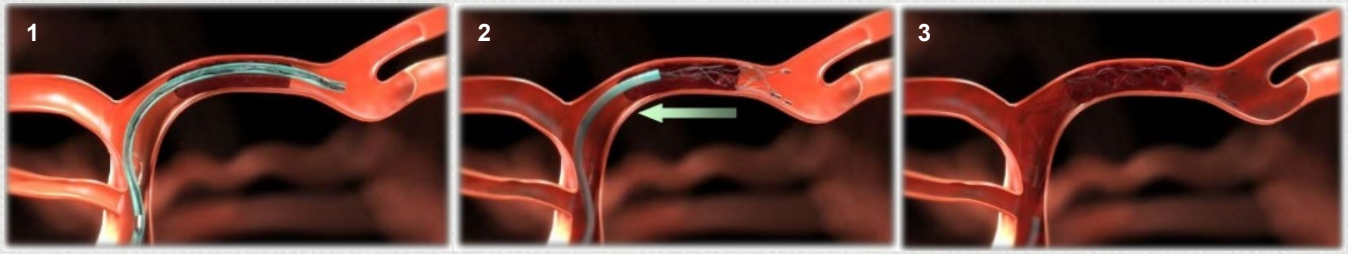
SPRUCE POINT CAPITAL MANAGEMENT

Mechanical Thrombectomy: A Novel Treatment For Blood Clots

Until recently, acute ischemic strokes (AISs) were most commonly treated with the intravenous (IV) application of tissue plasminogen activator (tPA) (or "alteplase"), a blood-thinning agent. This treatment, however, has a number of major shortcomings. tPA must be administered within 3 to 4.5 hours of the stroke to be effective, yet many patients fail to make it to the hospital within this timeframe, whether due to a failure to detect stroke symptoms (in the case of a mild stroke) or other logistical constraints. Further, tPA interferes with the natural formation of clots, which can cause intracranial hemorrhage or secondary bleeding, or otherwise inhibit blood flow restoration. Since the late 2000s, this treatment has increasingly been replaced by endovascular mechanical thrombectomy, a set of minimally-invasive procedures using tools designed to remove clots. One such tool is the stent retriever ("SR"), which traps the clot within a small wire device and removes it into a microcatheter at the base of the wire. Aspiration catheters ("ACs"), meanwhile, remove the clot using suction, "vacuuming" the clot into a "reperfusion catheter." Penumbra was the commercial pioneer behind the neurovascular AC and was the first to launch an AC cleared by the FDA for ischemic stroke treatment.

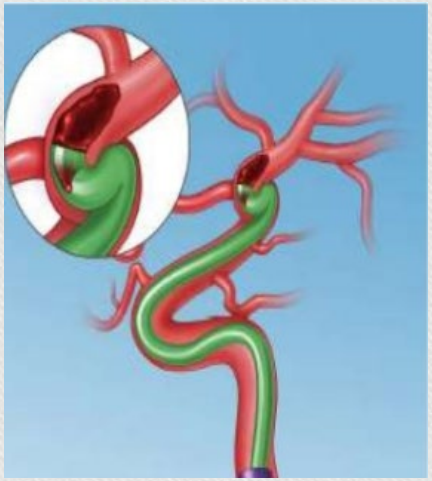
Stent Retriever

1. Guide catheter/microcatheter positioned over clot
2. Catheter retracted, stent retriever deployed into clot
3. Clot trapped within wire



Aspiration Catheter

Catheter navigated to base of thrombus, which is then extracted using suction



"Solumbra"

Combined stent retriever and aspiration thrombectomy

Source

SPRUCE POINT CAPITAL MANAGEMENT

Early Clinical Support For Mechanical Thrombectomy Favors Stent Retrievers

While both the stent retriever and aspiration catheter won support from – and adoption by – physicians through the 2010s, the stent retriever saw stronger support from early clinical trials. The first randomized controlled trial (RCT) to show superior outcomes among stroke patients treated with mechanical thrombectomy versus the established standard of care was the landmark MR CLEAN study, published Jan 2015.[1] While formally providing support for mechanical thrombectomy in general (when used in conjunction with tPA), the study itself focused primarily on stent retrievers, which were used on 190 of the 195 subjects treated with mechanical thrombectomy.[1] Just one was treated with thromboaspiration alone.[2] With early trials focused on the stent retriever method, this treatment gained traction among neurosurgeons more quickly than did thromboaspiration, leading medical device companies in the space to concentrate their R&D and marketing efforts on stent retrievers.

MR CLEAN Study (Jan 2015)

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Randomized Trial of Intraarterial Treatment for Acute Ischemic Stroke

BACKGROUND

In patients with acute ischemic stroke caused by a proximal intracranial arterial occlusion, intraarterial treatment is highly effective for emergency revascularization. However, proof of a beneficial effect on functional outcome is lacking.

CONCLUSIONS

In patients with acute ischemic stroke caused by a proximal intracranial occlusion of the anterior circulation, intraarterial treatment administered within 6 hours after stroke onset was effective and safe. (Funded by the Dutch Heart Foundation and others; MR CLEAN Netherlands Trial Registry number, NTR1804, and Current Controlled Trials number, ISRCTN10888758.)

Source

MR CLEAN Study Supplementary Appendix

Table S2. Number of patients treated and treatment details by center.

Center:	Included	Allocated to intervention	Mechanical treatment	Retrievable stent	Intra-arterial thrombolytics*	No IAT treatment[%]
Academic Medical Center / VU Medical Center, Amsterdam	74	34	30	30	0	4
Sint Antonius Hospital, Nieuwegein	80	40	35	35	1	4
Atrium MC, Heerlen	1	0	0	0	0	0
Maastricht University Medical Center	58	30	27	27	0	3
Erasmus University Medical Center, Rotterdam	26	15	10	10	0	5
Elisabeth Hospital, Tilburg	16	7	7	7	0	0
HAGA, the Hague	25	11	7	7	0	4
Isala Klinieken, Zwolle	10	6	5[&]	3	0	0
Leiden University Medical Center	60	25	19	19	0	6
MC Haaglanden, the Hague	50	24	24	24	0	0
St. Radboud University Medical Center, Nijmegen	18	7	6[#]	4	0	1
Reinier de Graaff Groep, Delft	7	3	3	3	0	0
Rijnstate Hospital, Arnhem	53	21	14	14	0	7
University Medical Center Groningen	3	1	1[^]	0	0	0
University Medical Center Utrecht	19	9	7	7	0	2
Total	500	233	195	190	1	37

*Given as exclusive therapy. [&]Merci retriever was used as exclusive therapy in 2 patients. [#]In 1 patient wire disruption was used. Navigation with the guidewire beyond the thrombus was impossible in the other patient. [^]Thromboaspiration through guiding catheter as exclusive treatment. [%]In 17 of 37 patients IAT was never started and no DSAs performed. In the other 20/37 the procedure was prematurely aborted (see Figure S1 for detailed overview).

Source

While helping to establish mechanical thrombectomy as the new standard of care for acute ischemic stroke, the MR CLEAN study did much more to justify the use of stent retrievers than it did any other method of intraarterial acute ischemic stroke treatment.

1. Source
2. Source

SPRUCE POINT CAPITAL MANAGEMENT

Clinical Studies Encourage Adoption Of Stent Retrievers By Neurosurgeons

Including the MR CLEAN study, a total of five major trials studying the efficacy and safety of mechanical thrombectomy in the treatment of acute ischemic stroke were published in the *New England Journal of Medicine* in 2015. Each of them focused either primarily or exclusively on stent retrievers over thromboaspiration.

ESCAPE Study (Mar 2015)

ORIGINAL ARTICLE

Randomized Assessment of Rapid Endovascular Treatment of Ischemic Stroke

Of 165 participants assigned to the intervention group, 151 (91.5%) underwent endovascular treatment, and 120 (72.7%) received intravenous alteplase. General anesthesia was used in 15 participants (9.1%). Retrievable stents were used in 130 of the 151 participants (86.1%) who underwent an endovascular procedure; 100 of these 130 participants (77.0%) received a Solitaire stent (Covidien). In the intervention group, the median time from symptom onset to first reperfusion

CONCLUSIONS

Among patients with acute ischemic stroke with a proximal vessel occlusion, a small infarct core, and moderate-to-good collateral circulation, rapid endovascular treatment improved functional outcomes and reduced mortality. (Funded by Covidien and others; ESCAPE ClinicalTrials.gov number, NCT01778335.)

Source

SWIFT PRIME Study (Jun 2015)

ORIGINAL ARTICLE

Stent-Retriever Thrombectomy after Intravenous t-PA vs. t-PA Alone in Stroke

CONCLUSIONS

In patients receiving intravenous t-PA for acute ischemic stroke due to occlusions in the proximal anterior intracranial circulation, thrombectomy with a stent retriever within 6 hours after onset improved functional outcomes at 90 days. (Funded by Covidien; SWIFT PRIME ClinicalTrials.gov number, NCT01657461.)

Source

EXTEND-IA Study (Mar 2015)

ORIGINAL ARTICLE

Endovascular Therapy for Ischemic Stroke with Perfusion-Imaging Selection

CONCLUSIONS

In patients with ischemic stroke with a proximal cerebral arterial occlusion and salvageable tissue on CT perfusion imaging, early thrombectomy with the Solitaire FR stent retriever, as compared with alteplase alone, improved reperfusion, early neurologic recovery, and functional outcome. (Funded by the Australian National Health and Medical Research Council and others; EXTEND-IA ClinicalTrials.gov number, NCT01492725, and Australian New Zealand Clinical Trials Registry number, ACTRN12611000969965.)

Source

REVASCAT Study (Jun 2015)

ORIGINAL ARTICLE

Thrombectomy within 8 Hours after Symptom Onset in Ischemic Stroke

CONCLUSIONS

Among patients with anterior circulation stroke who could be treated within 8 hours after symptom onset, stent retriever thrombectomy reduced the severity of post-stroke disability and increased the rate of functional independence. (Funded by Fundació Ictus Malaltia Vascular through an unrestricted grant from Covidien and others; REVASCAT ClinicalTrials.gov number, NCT01692379.)

Source

Initial clinical trials were overwhelmingly centered on stent retrievers over aspiration catheters for the treatment of acute ischemic stroke, driving faster adoption of the stent retrievers among neurosurgeons.

SPRUCE POINT CAPITAL MANAGEMENT

Aspiration Thrombectomy Studies Produce Fewer Resounding Successes

While numerous studies provided evidence that the stent retriever method was safe, effective, and superior to the prevailing standard of care, concurrent studies which focused on aspiration thrombectomy were less successful. Concurrent with the MR CLEAN study, another group of researchers conducted the THERAPY study, an RCT designed to examine the safety and efficacy of aspiration thrombectomy. On a truncated sample,[1] the THERAPY study found that treating acute ischemic stroke with aspiration thrombectomy plus tPA was neither more effective nor safer than tPA alone. A year later, the ASTER study – another RCT – failed to show that aspiration thrombectomy was more effective in inducing revascularization than the stent retriever method. Not until the COMPASS trial, the results of which were first presented in 2018, was there RCT-supported evidence for the "non-inferiority" of aspiration thrombectomy to the stent retriever method.

Details And Results Of Aspiration Therapy Studies

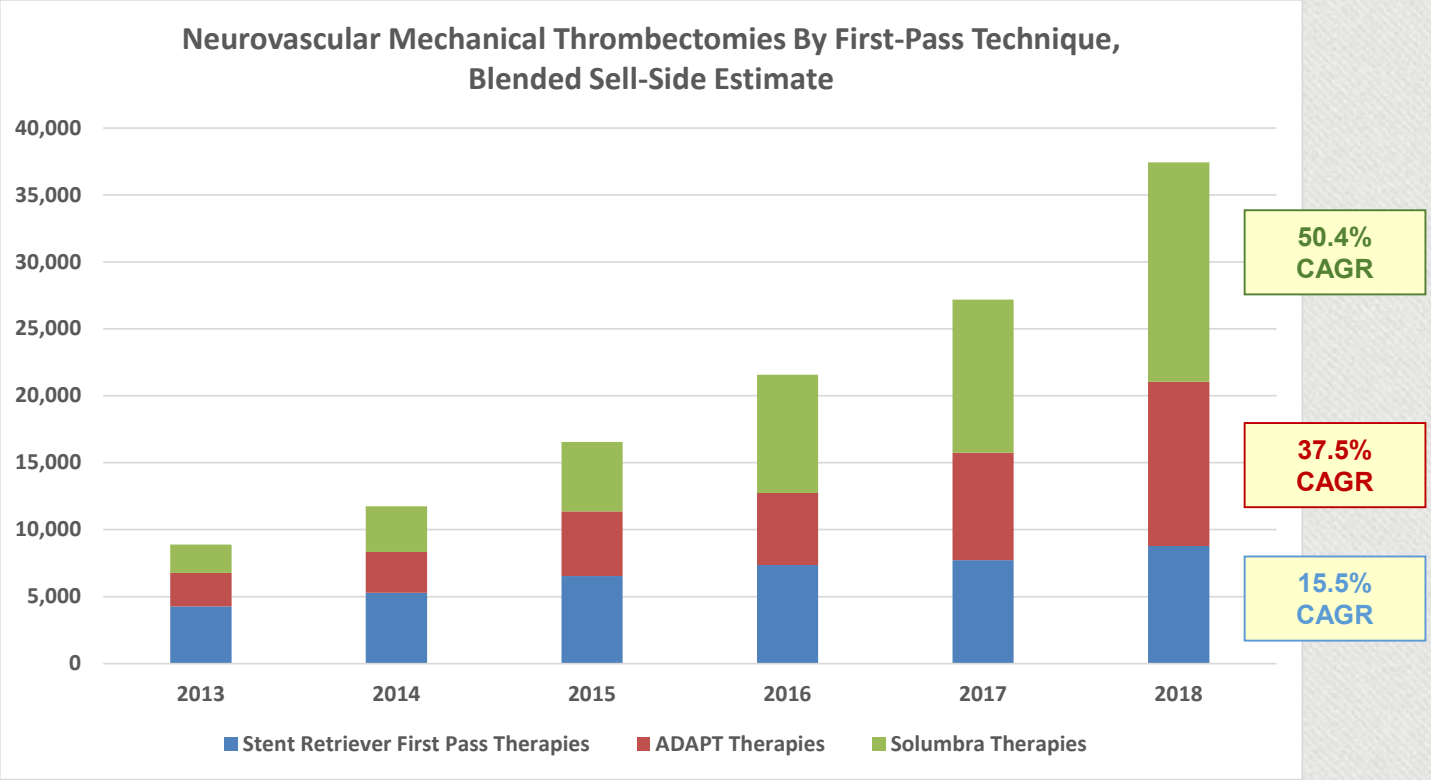
Study	ADAPT FAST (Link)	THERAPY (Link)	ASTER (Link)	PROMISE (Link)	COMPASS (Link)
Study Dates	-	3/12-10/14	10/15-10/16	2/16-5/17	6/15-7-17
Publication Date	2/14	9/16	8/17	7/18	3/19
Randomized Controlled Trial?	**NO**	YES	YES	**NO**	**YES**
Treatment(s) Evaluated	Thromboaspiration	Thromboaspiration & IV tPA vs. IV tPA	Thromboaspiration vs. Stent Retriever Thrombectomy	Thromboaspiration	Thromboaspiration vs. Stent Retriever Thrombectomy
Primary Efficacy End-Point Measure	Revascularization, Functional Outcome	Functional Outcome	Revascularization	Revascularization, Functional Outcome	Functional Outcome
Result	Thromboaspiration as first-pass technique has similar revascularization and functional outcome results vs. outcomes of stent retriever RCTs	**Thromboaspiration neither more effective nor safer than IV tPA[1]**	**Thromboaspiration as first-pass technique not superior to stent retriever method as first-line therapy**	Thromboaspiration as first-pass technique safe, similar efficacy to randomized trials using other revascularization techniques	**Thromboaspiration as first-pass technique shows non-inferior functional outcomes vs. stent retriever as first-line therapy**
Penumbra Funding	-	✓	✓	✓	✓

1. The THERAPY study was cut short after the MR CLEAN study concluded that treating acute ischemic stroke with tPA alone – the control treatment in both studies – was inferior to tPA plus mechanical thrombectomy and, therefore, unethical.

SPRUCE POINT CAPITAL MANAGEMENT

Aspiration Thrombectomy Studies Produce Fewer Resounding Successes

Thromboaspiration as a treatment option for acute ischemic stroke has gained increasing interest with more recent clinical successes. Importantly, the aspiration method costs approximately 30-50% less per procedure than the stent retriever method. Further, "solumbra" – a treatment method which combines stent retrievers with aspiration – is already estimated to be the most popular first-line approach to neurovascular mechanical thrombectomy, and continues to be the fastest-growing. Thromboaspiration may also be employed in the case that a first-pass stent retriever attempt fails (just as a stent retriever may be employed if a first-pass thromboaspiration attempt – or "ADAPT" – fails).



Source: Blended sell-side estimate

Solumbra has been the fastest-growing category of first-pass mechanical thrombectomy techniques, and it is currently the largest. Accordingly, most neurovascular thrombectomies which include aspiration also include stent retrievers, meaning that doctors and purchasing officers may prefer to source from vendors which can supply both high-quality aspiration catheters AND high-quality stent-retrievers.

SPRUCE POINT CAPITAL MANAGEMENT

Major Medical Device Players Finally Enter The Aspiration Catheter Market

With aspiration thrombectomy now gaining traction as a clinically-proven approach to acute ischemic stroke treatment – and one which is cheaper than the stent retriever method – major medical device players outside of Penumbra have finally entered the space with their own aspiration catheters FDA-approved for acute ischemic stroke treatment.[1] While Penumbra was the only player with an FDA-approved aspiration catheter through much of the 2010s, others have rapidly entered the space through the past twelve months, and the Company now competes with large-scale medical device companies in a space which it had to itself for almost ten years. Analysts and investors are both well-aware of the recent influx of competition and generally remain bullish nonetheless. However, we believe – and will demonstrate – that the Street is severely underestimating the pace with which competitors are taking share from Penumbra.

Date Of FDA Approval For Aspiration Catheter Cleared For Acute Ischemic Stroke Treatment

Company	Device	FDA Approval Date	Source
Penumbra	Penumbra System	12/28/07	FDA
Stryker	AXS Vecta Aspiration System	3/18/18	FDA
MicroVention (Terumo)	SOFIA Catheter	6/11/18	FDA
Micro Theraputics (Medtronic)	Riptide Aspiration System (React 68 Catheter)	7/4/18	FDA
Micro Theraputics (Medtronic)	Riptide Aspiration System (React 71 Catheter)	11/14/18	FDA
Imperative Care	MantaRay Reperfusion Catheter	4/17/19	FDA

1. As discussed later in this report, while only Penumbra offered catheters approved by the FDA for use in aspiration thrombectomy until recently, many neurosurgeons frequently used other companies' guide catheters "off label" as aspiration catheters. This perhaps contributed to competitors' delayed entry into the "FDA-approved" aspiration catheter space.

Evidence Of Significant Growth Slowdown And Market Share Loss

SPRUCE POINT CAPITAL MANAGEMENT

Consensus Estimates Imply Sustained Market Share Dominance By Penumbra

As the first player to come to market with an FDA-approved aspiration catheter for the treatment of acute ischemic strokes, Penumbra has maintained commanding market share through its brief history as a public company. Spruce Point observes that, while the sell side does appear to assume some level of market share attrition with increasing competition, some analysts appear to believe that the Company can continue to dominate the neurovascular aspiration catheter space across each of its geographic markets for years to come. Is this assumption realistic?

Aspiration Catheter Market Share By Procedure Count – Blend Of Sell-Side Estimates (Implied)

		2015	2016	2017	2018	*2019E*	*2020E*	*2021E*	*2022E*	*2023E*
U.S. Market	Penumbra	10,126	12,886	17,267	25,486	*31,278*	*37,842*	*43,250*	*46,495*	*48,903*
	Total	11,251	14,577	18,680	27,790	*35,236*	*44,827*	*53,326*	*60,097*	*66,350*
	Market Share	**90.0%**	**88.4%**	**92.4%**	**91.7%**	***88.8%***	***84.4%***	***81.1%***	***77.4%***	***73.7%***
Global Market	Penumbra	31,918	47,572	60,986	76,487	*91,939*	*109,468*	*124,926*	*138,081*	*150,503*
	Total	43,088	59,975	76,826	98,353	*123,769*	*152,984*	*181,101*	*208,698*	*237,845*
	Market Share	**74.1%**	**79.3%**	**79.4%**	**77.8%**	***74.3%***	***71.6%***	***69.0%***	***66.2%***	***63.3%***

Aspiration Catheter Market Share By Dollar Value – Blend Of Sell-Side Estimates

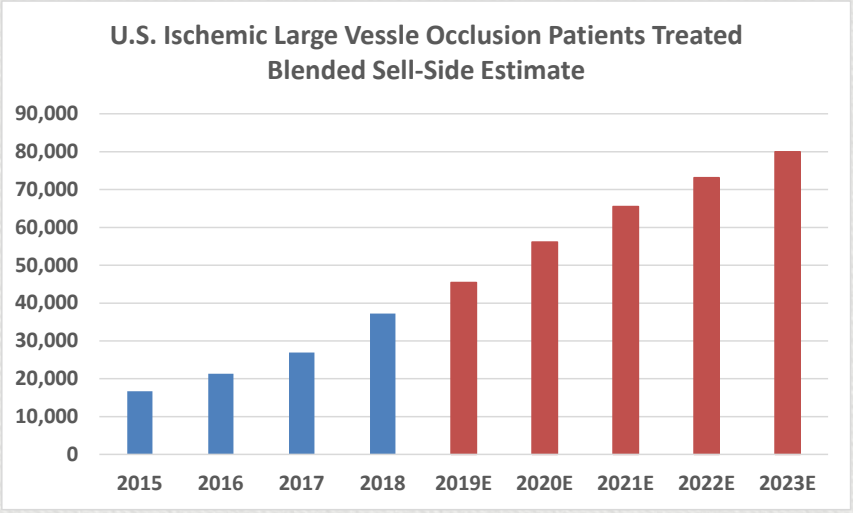
($M)		2015	2016	2017	2018	*2019E*	*2020E*	*2021E*	*2022E*	*2023E*
U.S. Market	Penumbra	$50.1	$59.3	$73.1	$105.8	*$128.5*	*$153.9*	*$174.2*	*$185.4*	*$193.0*
	Total	$55.7	$68.2	$82.2	$118.5	*$146.5*	*$181.6*	*$211.8*	*$233.9*	*$253.1*
	Market Share	**90.0%**	**87.0%**	**89.0%**	**89.3%**	***87.8%***	***84.8%***	***82.3%***	***79.3%***	***76.3%***
Global Market	Penumbra	$86.9	$107.8	$135.4	$181.1	*$213.8*	*$251.5*	*$282.2*	*$302.9*	*$320.2*
	Total	$123.2	$162.2	$204.1	$271.1	*$328.1*	*$399.2*	*$464.2*	*$522.3*	*$580.5*
	Market Share	**81.5%**	**77.8%**	**78.1%**	**76.8%**	***74.2%***	***71.5%***	***69.0%***	***66.1%***	***63.2%***

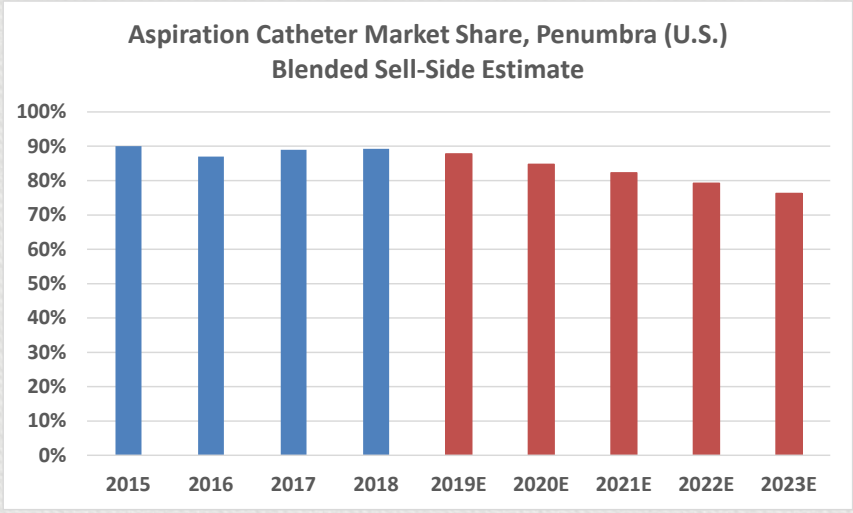
Can Penumbra really continue to command ~63% of the global market, and ~75% of the key U.S. market, five years into the future – even after other major medtech companies establish themselves in the space?

SPRUCE POINT CAPITAL MANAGEMENT

Market Share Estimates Out Of Thin Air

Spruce Point believes that analysts have taken a relatively unsophisticated and naïve approach to estimating Penumbra's neurovascular aspiration catheter sales in future years: they appear simply to project 2-3% market share loss per year in each of its major markets due to rising competition, and derive annual aspiration catheter sales from the resulting output, assuming ~3% growth in acute ischemic strokes per year and an ongoing shift away from legacy treatments in favor of mechanical thrombectomy. While the latter two market sizing assumptions are perhaps not unreasonable, we find neither an analytical nor historical basis for the 2-3% annual share loss assumption: it is simply introduced as a simple way to project future sales while acknowledging increasing competition, and is probably built around Company guidance.





Spruce Point believes that consensus estimates for future aspiration catheter revenues are not analytically robust. Yet, as with most companies, the market interprets these estimates as a good indicator of future sales, and as perhaps the most educated, rigorous, and analytically complete assessment of future performance. Accordingly, we believe that Penumbra shares are currently valued according to estimates which likely feature a high degree of error.

SPRUCE POINT CAPITAL MANAGEMENT

Street Market Share Estimates Conflict With Competitor Statements

Market analysts believe that, as of fiscal year end 2018, Penumbra held 89% share of the U.S. aspiration catheter market. Yet, on its May 23 earnings call, Medtronic claimed to have 15% of this market already, ahead of schedule. Management expects to achieve 25% share by the end of its fiscal year and "eventually" 50%. With *just one* of Penumbra's four major competitors claiming 15% share, how could Penumbra's current share possibly be 89%? Medtronic's projection also flies in the face of analyst forecasts, which put Penumbra's U.S. aspiration share at 88% by the end of FY19, and which don't see Penumbra's share falling beneath 75% until after 2023.

Medtronic Q4 FY19 Conference Call (05/23/19)

"And then just wanted to ask one question on neuro. So, the neurovascular growth is very strong, could you talk about some of the components of that and whether you're seeing a stronger market there, are there any product launches that help you this quarter?"

- Matthew Taylor – UBS

"Yes, sure. So first of all, in neurovascular, we have -- at Medtronic, we've a broad portfolio playing in every segment, and that is our strategy. And we're on number one positions in both ischemic and overall hemorrhagic, and we've recently refreshed that entire portfolio. Nobody else can say this. So it's a very strong market. We're very well positioned across every segment.

Now, what's driving our growth in the near term is the -- first of all, entering the aspiration market, where we launched the 068 and now the 071 Riptide systems or catheters, and we've got -- we're getting really, really positive feedback on both. The 068 started out a little slow because we had to make some adjustments to it. We had a soft launch. Made some adjustments to the product, and now it's picking up. ***The 071 hit the ground running and we're getting great feedback. And we estimate that we're somewhere around 15% of this market already, well ahead of our plans in the aspiration segment, well ahead of our plans. We see ourselves getting to 25% by the end of the fiscal year and we think we'll eventually get to 50% of this aspiration market.*** *And on top of that, we just launched our next-gen stent retriever to maintain and extend our lead in that segment. So those are some of the things that are driving it. And I'd say the other big driver is just the global nature. We are just growing very fast in China. And so the fact that we're global is also helping, especially in China. So it's a global and broad and refreshed product portfolio."*

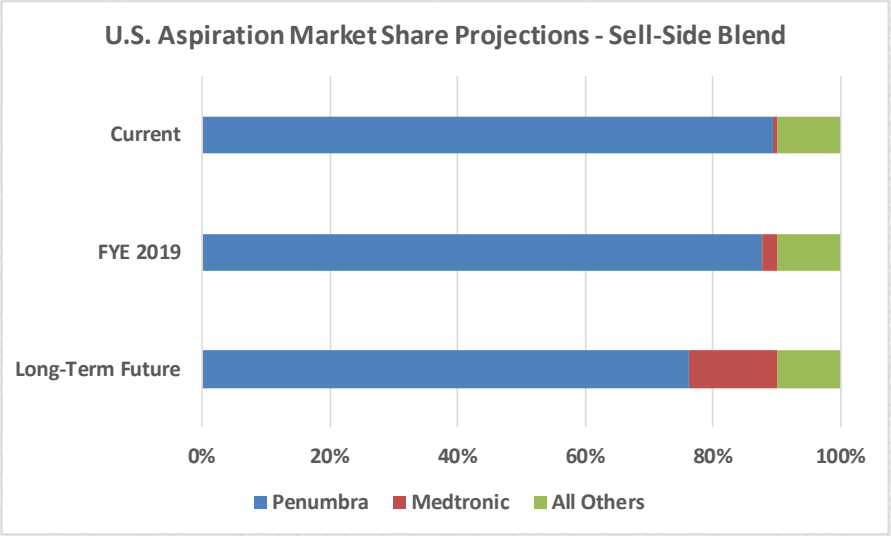
- Geoffrey Martha – Executive Vice President and President of Restorative Therapies Group, Medtronic

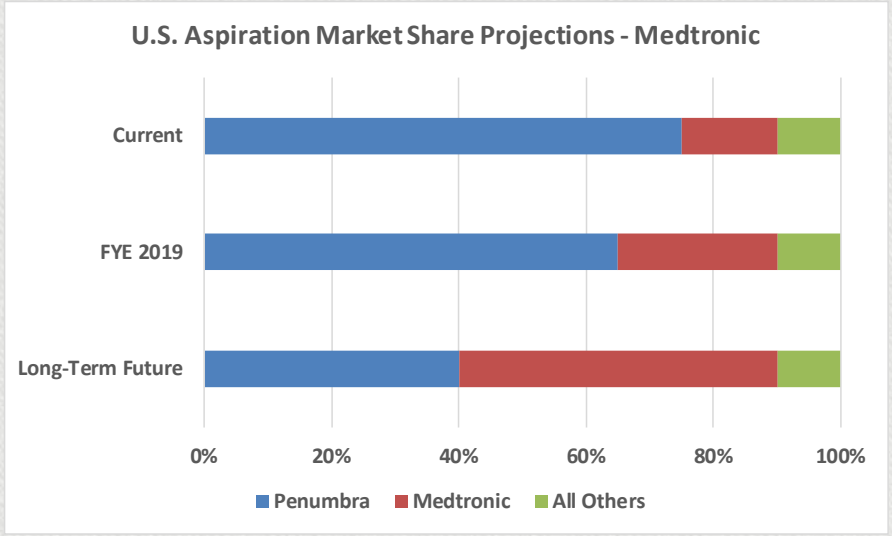
If Medtronic's claims regarding its current share and share trajectory are at all credible – and we have no reason to believe that they are not – then sell-side market share estimates for Penumbra, and sales growth estimates by extension, are off by a tremendous margin.

SPRUCE POINT CAPITAL MANAGEMENT

Street Market Share Estimates Conflict With Competitor Statements

If we assume that all neurovascular aspiration catheter players outside of Penumbra and Medtronic collectively control 10% of the market – generally in-line with market estimates and our own diligence – and conservatively assume that this share remains constant into the future, Medtronic's market share projections would imply that Penumbra currently controls just 75% share, falling to 65% by Medtronic's fiscal year end and to 40% into the future. Blended sell-side estimates, meanwhile, would imply that Medtronic currently has less than 1% share, growing to only 2% by its fiscal year end. This conflicts significantly with our own diligence and, we believe, is likely incorrect.



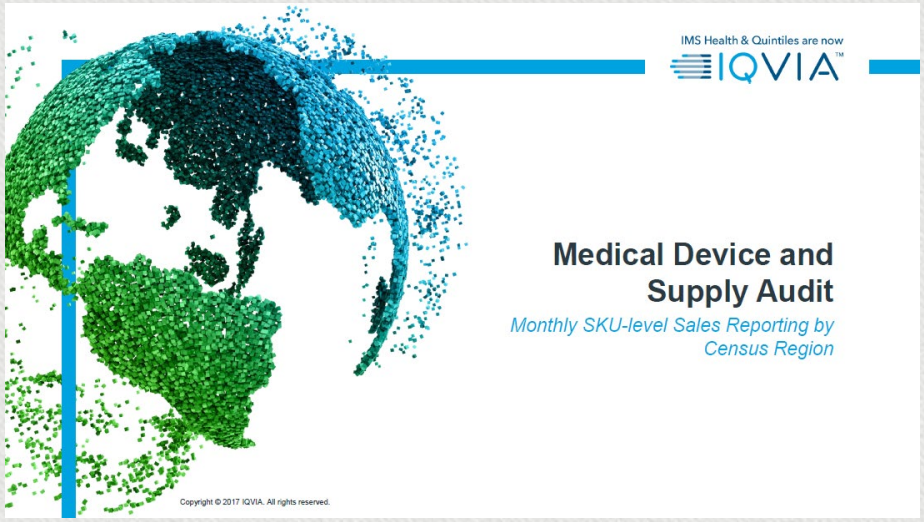


While these inconsistencies suggest that there may be discrepancies in the sell side's view of the base of the market, we are intrigued most by the fact that, regardless of how analysts identify and measure the market, they appear to significantly underestimate the *pace* of competitive market share gains: again, the sell side appears to assume that Penumbra will lose 2-3% market share per year, while Medtronic claims to have gained 15% in under a year and to be on pace to capture another 10% this year.

SPRUCE POINT CAPITAL MANAGEMENT

IQVIA: Evaluating Shifting Market Share With Hospital Transaction Data

In order to evaluate conflicting claims about aspiration catheter market share, Spruce Point obtained recent hospital transaction data from IQVIA. IQVIA – formerly IMS Health and Quintiles – is a publicly-traded healthcare data analytics and technology services company which serves the life sciences sector. It collects and analyzes data on pharmaceuticals, medical equipment, electronic medical records, and a wide range of other life sciences topics to provide medical professionals, researchers, salespeople, executives, and others with relevant insights on healthcare-related topics. Using IQVIA's Medical Device and Supply Audit (MDSA), we were able to evaluate sales trends for all neurovascular mechanical thrombectomy devices through May 2019. The MDSA records 100% of medical device purchases by 650 non-federal, short-term acute care hospitals in the U.S. and, from this, projects nation-wide sales (in both units and dollars) on a SKU-level basis for nearly 3,000 medical product manufacturers. This allowed us to study shifts in aspiration catheter market share on just a two-month lag.



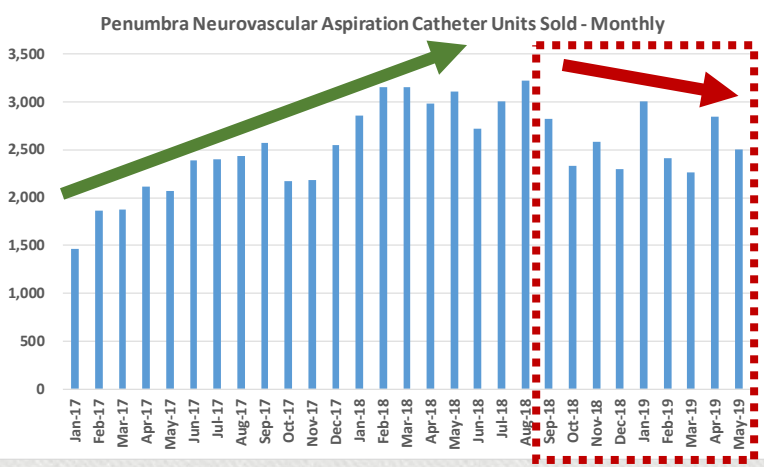
It is important to note that, to our knowledge, this data is known to very few market participants: it is designed for and provided primarily to the health care industry. Our understanding is that it is known to few, if any, sell-side brokerage firms. It is also priced to a corporate end market and, as such, is likely too expensive for all but the largest of buy-side firms. We believe that the market is generally blind to this data, and that prices of Penumbra shares must adjust to reflect this powerful, credible, and compelling information.

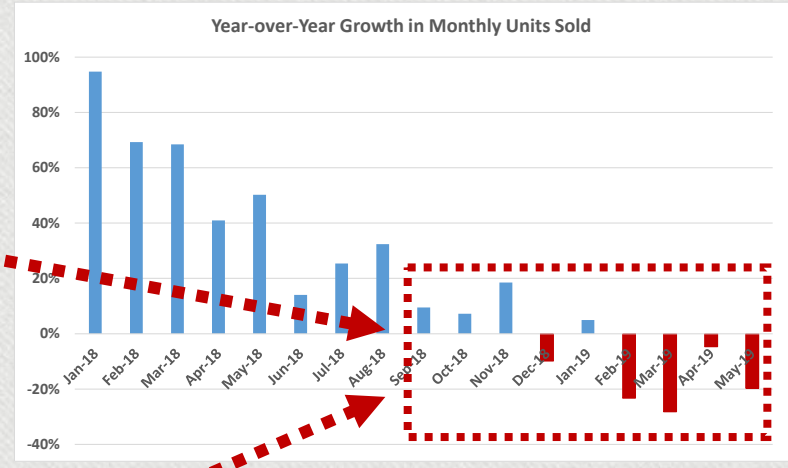
Source: Medical Device & Supply Audit, June 2013 – May 2018, IQVIA Inc. All Rights Reserved.

SPRUCE POINT CAPITAL MANAGEMENT

Market Data Corroborates Penumbra's Dramatic Market Share Loss

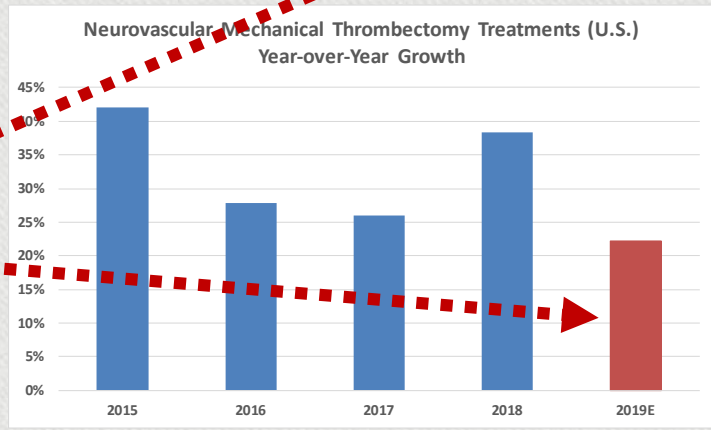
Spruce Point's analysis of recent market data confirms that Penumbra is, in fact, rapidly losing share in real time. IQVIA MDSA data show that, as of May – the last month for which data is currently available – monthly sales of Penumbra's neurovascular aspiration catheters have declined year-over-year for five of the last six months. Penumbra's growth trajectory appears to be losing steam so rapidly that its rate of growth has not only slowed, but has turned *negative* in a neurovascular mechanical thrombectomy market which is itself growing at 20-40% per year.





Source: Medical Device & Supply Audit, June 2013 – May 2018, IQVIA Inc. All Rights Reserved.

We find it striking that Penumbra's apparent unit sales growth in the neurovascular aspirator vertical has been *negative* even as the mechanical thrombectomy market grows at a brisk rate



Source: Blended Sell-Side Estimate

While prior declines indicated by IQVIA did not translate into *negative* sales growth, it does appear to reflect recent sales growth decelerations directionally, and could provide context for the recent pickup in DSOs. Do stretched receivables suggest that the indicated decline in AC transactions could translate to observable trends in Penumbra's financial statements on a lag? Did international sales cover up U.S. declines?

SPRUCE POINT CAPITAL MANAGEMENT

Apparent Sales Decline Coincides With Wave Of Competitive Entry

We note that the sales decline indicated by the transaction data coincides with the H2 2018 FDA approval of multiple neurovascular aspiration catheters by competitors. Importantly, the accompanying onset of new competition is also visible in the transaction data. IQVIA began to capture sales of Medtronic's React 68 neurovascular aspiration catheter in Sep 2018, the first quarter during which Penumbra sales began to show hints of slowing down in the data set. This strengthens our belief that the observed slowdown in Penumbra sales in the transaction data is in fact a realistic representation of real-time market dynamics, and makes us more confident that the onset of new competition will continue to eat away at Penumbra sales.

Penumbra Unit Sales Declines Coincide With Emergence Of New Competitors

	MM/YY	1/18	2/18	3/18	4/18	5/18	6/18	7/18	8/18	9/18	10/18	11/18	12/18	1/19	2/19	3/19	4/19	5/19	Since 9/18
PENUMBRA	Total Neuro AC Units Sold	2,859	3,151	3,155	2,980	3,111	2,721	3,005	3,228	2,817	2,334	2,586	2,299	3,001	2,416	2,265	2,840	2,498	24,678
	Total Neuro AC Units Sold, % Growth (YoY)	95%	69%	68%	41%	50%	14%	25%	32%	10%	7%	19%	--10%	5%	-23%	-28%	-5%	-20%	-
MEDTRONIC	React 68 Units Sold	-	-	-	-	-	-	-	-	21	230	199	238	250	347	261	182	151	2,329
	React 71 Units Sold	-	-	-	-	-	-	-	-	-	-	?	?	?	?	?	?	?	?
RELATIVE INCREMENTAL SHARE	PENUMBRA	100%	100%	100%	100%	100%	100%	100%	100%	99%	91%	93%	91%	92%	87%	90%	94%	94%	91%
	MEDTRONIC	-	-	-	-	-	-	-	-	1%	9%	7%	9%	8%	13%	10%	6%	6%	9%

Source: Medical Device & Supply Audit, June 2013 – May 2018, IQVIA Inc. All Rights Reserved.

Importantly, note that Medtronic's React 71 – its newest and, per doctors with whom we've spoken, most popular neurovascular aspiration catheter – is not yet captured in the IQVIA data. Therefore, the above data represents Medtronic's *minimum* relative incremental market share vs. Penumbra. From our conversation with doctors, we are confident that the recent decline in React 68 sales reflects cannibalization by the React 71.

IQVIA has informed us that sales data for the React 71 will be available as of mid-August, in just several weeks. We anticipate that the data could show sales of over 1,600 React 71 catheters since Sep 2018, which would put Medtronic's cumulative relative incremental share at 15%, where management claimed it to be.

SPRUCE POINT CAPITAL MANAGEMENT

IQVIA Data Appears Increasingly Credible, Both Directionally And In Absolute Terms

Our analysis of IQVIA's sales data suggests that it is becoming an increasingly accurate and reliable indicator of Penumbra revenue. While Penumbra's reported U.S. sales differed from U.S. sales of Penumbra SKUs captured by IQVIA by 33% in 2014 – perhaps because Penumbra's narrower customer base introduced bias into the data – IQVIA's Penumbra sales data came within 2% of Penumbra's reported U.S. sales in 2018. IQVIA has also successfully captured inflections in Penumbra's U.S. sales trajectory through the past two years, reflecting both the step-down in growth in 2017 and the slight increase in growth in 2018.

IQVIA Becoming An Increasingly Reliable Indicator Of Penumbra U.S. Sales

($M)	2014	2015	2016	2017	2018
Penumbra Reported U.S. Sales	$83.0	$127.3	$176.1	$219.2	$290.7
IQVIA Total Sales of Penumbra SKUs	110.7	149.9	209.8	245.0	297.6
% Delta	**33.4%**	**17.8%**	**19.2%**	**11.8%**	**2.4%**
Penumbra Reported U.S. Sales Growth (YoY)	-	53.5%	38.3%	24.5%	32.6%
IQVIA Total Sales of Penumbra SKUs, Growth (YoY)	-	35.4%	39.9%	16.7%	21.5%

Source: Medical Device & Supply Audit, June 2013 – May 2018, IQVIA Inc. All Rights Reserved.

IQVIA's increasing reliability as an indicator of Penumbra sales makes us confident that the consistent sales decline indicated through recent months is a signal of a genuine downward inflection in Penumbra's U.S. growth, if not a contraction.

Tracking Data Corroborated By Doctors

In the course of our research, we spoke with numerous neurosurgeons at institutions of a wide range of sizes, including practices which conduct anywhere from 60 to 200 mechanical thrombectomies per year. The trend among them was almost universal: whereas most used Penumbra almost exclusively until only recently, they now purchase only 0-30% of their neurovascular aspiration catheters from Penumbra. This shift among neurosurgeons from ~100% to 0-30% reliance on Penumbra has occurred over the course of just six to nine months.

Neurosurgeons Rapidly Switching From Penumbra To Competitors

		Mechanical Thrombectomies per Year		Aspiration Catheter Usage Share: 2018		Aspiration Catheter Usage Share: 2019			
	Region	Individually	Practice-Wide	Penumbra	Other	Penumbra	Medtronic	Terumo	Other
Doctor 1	Midwest	80-100	200	**100%**	-	**15%**	15%	70%	-
Doctor 2	Southeast	75	75	**90%**	10%	**30%**	70%	-	-
Doctor 3	Northeast	30	150-180	**~40%**	60%	**-**	100%	-	-
Doctor 4	West Coast	25-35	120	**90%**	10%	**30%**	70%	-	-
Doctor 5	Southwest	?	?	**100%**	-	**50%**	50%	-	-

*"**I am 70% Sofia [Terumo], probably 15% Medtronic React 71, and 15% Penumbra. It used to be that we were 100% Penumbra when they were the only thing out there**. In 2017, I got a partner who had in his training, had used Sofia for this purpose even though it did not have an indication for thrombectomy… And then Medtronic came out, and then Vecta [Stryker] came out. **Sofia was way better than Penumbra's and so we pretty much switched**. It took me a month or two to agree to that, but we switched… **Their Jet7 catheter sucks and they know it.**"*

- Neurosurgeon
Individually: 80-100 mechanical thrombectomies per year
Practice: ~200 mechanical thrombectomies per year

*"Penumbra used to always beat itself. Once something new came out, Penumbra would come out with something better. **But now Medtronic has the React 71, and that is kicking ass. In our shop, we have shifted 40-50% of our business from the Penumbra Jet to Medtronic** – and now it is backordered. Medtronic never expected it to be this successful. And **Cerenovus [Johnson & Johnson] is coming out with some interesting stuff too in the next six months. I think they are going to be even bigger than the React 71.**"*

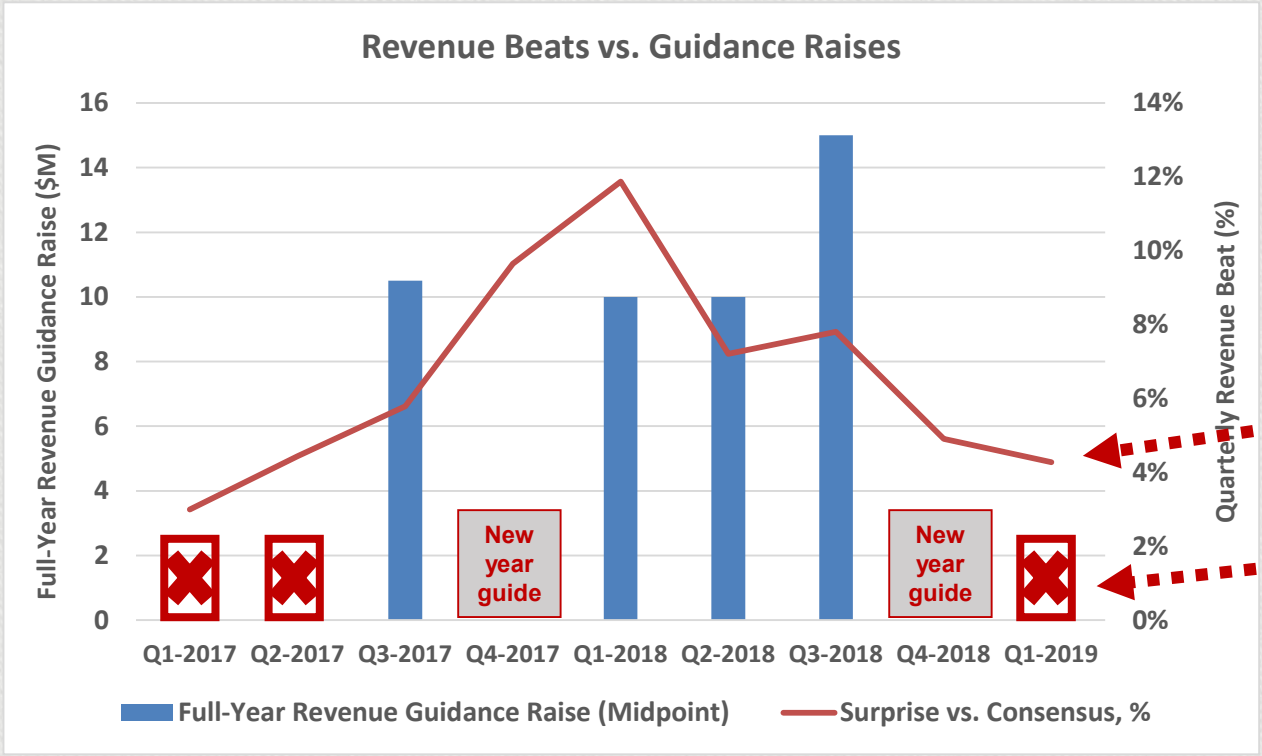
- Neurosurgeon

Between the transaction data and our conversations with doctors and other industry experts, the evidence overwhelmingly suggests that Penumbra is losing tremendous market share at an extremely rapid pace.

SPRUCE POINT CAPITAL MANAGEMENT

Management Gearing Up For A Miss?

As one would expect, management has historically been most likely to raise revenue guidance when achieving relatively larger quarterly revenue beats. While Penumbra has beaten analyst estimates every quarter since Q3 FY15, its last two beats were relatively slim – and, in Q1, management declined to raise full-year revenue guidance for the first time in almost two years. We are concerned by the fact that Penumbra is achieving slimmer revenue beats and declining to raise guidance just as IQVIA data indicates that its neurovascular aspiration catheter sales are slowing in the U.S. Could management be preparing the market for a near-term revenue miss?



Slimmest quarterly revenue beat since Q1 FY17

No full-year revenue guidance raise

First failure to raise guidance since Q2 FY17

With Penumbra now facing significant on-label competition from large medical device manufacturers for the first time in its history, the competitive environment in which Penumbra has historically produced constant beats has radically changed through the last ~6 months. Investors and analysts may be expecting more of the same while transaction data reveals – in real time – that the world in which Penumbra could consistently grow neurovascular sales at double-digit rates simply no longer exists.

Product Commoditization Skews Market Share Outlook And Obscures Market Growth Potential

SPRUCE POINT CAPITAL MANAGEMENT

Don't Let The "Med Tech" Label Fool You: Aspiration Catheters Are Disposable Commodities

While Penumbra was until recently the only company to offer an aspiration catheter approved by the FDA for thrombus aspiration in cases of acute ischemic stroke, doctors report that many of their peers use guide catheters "off-label" for the same purpose. Guide catheters are accessories used during mechanical thrombectomies "as a conduit for retrievers." Though they are not cleared by the FDA for neurovascular aspiration thrombectomy, they are physically capable of serving the same purpose when paired with an aspiration catheter vacuum pump. For reasons such as cost or product preference, doctors may choose to use a guide catheter "off-label" rather than an FDA-approved aspiration catheter when performing aspiration thrombectomies to treat ischemic stroke. This practice was so widespread that, in March 2017, the FDA issued a letter warning against this practice after receiving complaints – reportedly from Penumbra itself, per industry experts.

Catheter Kerfuffle: How Concerning Is Off-Label Use in Stroke Interventions?

The FDA sent a reminder to doctors clarifying that not all catheters are cleared for aspiration. But experts say comfort and safety should be considered.

Amid growing interest in interventional stroke treatments, some questions have recently emerged regarding the use of various catheters for aspiration thrombectomy that aren't approved for that purpose. But is it really a big deal clinically, or is it simply an issue generated by a battle over market share in this booming area?

Only one company makes catheters that are cleared by the US Food and Drug Administration (FDA) for thrombus aspiration in acute stroke–Penumbra–but other manufacturers make similar devices that have been cleared as guide catheters (also called intermediate or distal access catheters) for the purpose of delivering additional devices into the vasculature of the brain.

Neurointerventionalists, who have become accustomed to using devices in an off-label fashion due to the lack of dedicated devices in their field, tend to use what they feel comfortable with. That means some of these other catheters get used for aspiration.

"It's a balance between patient safety and outcomes versus allowing people to practice the way they feel is in the best interest of the patient," Ashutosh Jadhav, MD, PhD (University of Pittsburgh, PA), told TCTMD. "We, as a community, need to be pretty protective of operator autonomy, assuming it's within the constraints of patient outcomes and safety."

In its "dear doctor" letter, the FDA noted that it has received a "small number of adverse event reports" stemming from use of a guide catheter for removing a clot, including one case involving vessel perforation that ultimately led to death from a large subarachnoid hemorrhage.

But some neurointerventionalists interviewed by TCTMD said that this is not really a clinical issue, as there is not much difference in performance between the catheters–regardless of labeled indication–when it comes to using them for aspiration either alone or in conjunction with stent retrievers. Instead, the issue is seen more as an attempt for Penumbra to protect its market share in an increasingly competitive stroke market.

Physicians interviewed by TCTMD indicated that there might not be much of a difference in terms of performance between Penumbra's catheters and guide catheters from the other companies.

"Penumbra makes great catheters, and they're effective for intracranial work for doing thrombectomy as a standalone device or as an adjuvant device," Donald Heck, MD (Novant Health, Winston-Salem, NC), said.

But he pointed out that the catheters manufactured by the other companies are constructed similarly, can be delivered intracranially, and have been shown to maintain their integrity under aspiration. "So in that sense they would at least in theory perform similarly to a device that has been shown to be safe for that purpose," Heck said, adding that he tends to use other companies' catheters for aspiration adjunctively with a stent retriever.

"Obviously there's proprietary differences in how the catheters are constructed," Heck said, adding that "they're very similar from a performance perspective."

Jadhav acknowledged those potential complications, but said that he's not aware of any data showing that aspiration-related events are more frequent with catheters used in an off-label fashion. "At least with the [catheters] that are commonly being used right now, there's been no data that they're unsafe in that scenario," he said. "There are theoretical complications with any of these catheters whether they're indicated for aspiration or not."

And Jensen said, "I am unaware either in the literature or through what I hear from my colleagues that there is one system that is consistently causing higher complication rates than other systems."

With little difference in performance, physician preference and cost seem to be main drivers of the choice of one catheter over another.

"In this space, people end up using what they're comfortable with," Jadhav commented, noting that there is a roughly equal split between Penumbra and other catheters used for aspiration in his practice.

Jensen agreed that physician comfort was the main determinant of catheter choice, saying that she has a go-to system that she uses for nearly all cases, which allows her to perform the procedures as quickly as possible. "It's good to know what's available to you, but if you don't get comfortable with one system, I think then you really never get comfortable," she said.

But cost may influence the decision, as well. Turk confirmed that the Penumbra catheters are currently more expensive than catheters from other companies.

Source

If the aspiration catheter is so low-tech that its role can be satisfied by cheaper existing products, why should Penumbra expect to maintain a premium price as neurovascular aspiration thrombectomies become more commonplace?

Why should Penumbra expect to maintain its historical market dominance as established med tech companies rapidly enter the "on-label" space without having to develop any new technology?

Why would you invest in a (nearly) one-product company whose "regulated" headline product is exists in a vertical which the FDA has failed to effectively police – and which has now seen a flood of FDA-approved competitors in any case?

SPRUCE POINT CAPITAL MANAGEMENT

Off-Label Catheter Usage Suggests Doctor Readiness To Adopt Competitors

Some Penumbra bulls see the "off-label" phenomenon as a positive for the stock: whereas the Company's "headline" market share of the neurovascular aspiration catheter space is thought to be ~90%, its "effective" market share could really be ~70% due to the use of off-label catheters not captured in market data, thus inflating the apparent downside to existing share levels. Spruce Point, however, believes that rampant "off-label" catheter use is clear evidence that Penumbra's neurovascular aspiration catheter is a commodity product at high risk to substitutes and competitive threats: these devices are so basic that catheters designed for other purposes could be used in their place, and we have evidence of doctors preferring even these non-dedicated catheters over Penumbra's aspiration thrombectomy-specific catheters.

"[Medtronic's] intermediate catheter – it is the aspiration catheter."

- Neurosurgeon
Individually: 75 mechanical thrombectomies per year
Practice: 75 mechanical thrombectomies per year

"I am a 70% Sofia, probably 15% Medtronic React 71 and 15% Penumbra. It used to be that we were 100% Penumbra when they were the only thing out there. In 2017, I got a partner who had, in his training, used Sofia for this purpose even though it did not have an indication for thrombectomy. [Sofia's] original indication was as a distal access catheter which means that there is something in the head [of the catheter] that allows you to deliver something else into the head…. If you don't have an indication, you can't send your salesforce out to sell the Sofia as an aspiration catheter for mechanical thrombectomy. We switched to Sofia before there was an indication for mechanical thrombectomy. You can use anything off label, but the salesperson can't sell an off-label indication – that is against FDA regulation. If you ask them about an off-label use, they can say, 'That is off label and I can't speak to that, but I have had some clients who use it off label and I can get them in touch with you.'"

- Neurosurgeon
Individually: 80-100 mechanical thrombectomies per year
Practice: ~200 mechanical thrombectomies per year

"The FDA label matters more to less-sophisticated doctors, like radiologists. People like me do whatever I think is best."

- Neurosurgeon

"They are a commodity product. We basically just decided in our [RFP] process – if you step back and think about what they're offering, they're just plastic tubes, right? How hard is it to make plastic tubes?"

- Neurosurgeon
Individually: 30 mechanical thrombectomies per year
Practice: ~150-180 mechanical thrombectomies per year

"Penumbra went around to and made a very big deal about physicians using Medtronic, Terumo and Stryker aspiration catheters that previously did not have the stroke label indication. They freaked out a lot of doctors. This annoyed the doctors a lot because [the Penumbra salesman] should not be telling the doctors how they should be treating their patients. This also swayed some doctors to use Penumbra."

- Neurovascular Products Sales Director

If Penumbra's market share has until now been protected by only the FDA's relatively weak 510(k) approval process, which can be satisfied in just 30-90 days, investors should not be confident that it can maintain its share or price levels now that competitors have finally entered the market "on-label."

If some doctors have such a strong preference for non-Penumbra catheters – whether due to price or product quality – that they were willing to skirt FDA regulations to use non-approved catheters in neurovascular aspiration thrombectomy, we would expect the recent FDA approvals of a swath of competitors to serve as a catalyst for significant migration among doctors who might have wanted to switch, but who felt pressured to adhere to FDA regulations.

SPRUCE POINT CAPITAL MANAGEMENT

510(k) Pathway Reduces Barriers To Entry

Aspiration catheters designed for acute ischemic stroke treatment are cleared for clinical use by the FDA under the "510(k) pathway." All medical devices must be cleared by the FDA through either a Premarket Approval (PMA) or Premarket Notification (PMN) before they can be used in the U.S. Class III devices – those which sustain life or are otherwise deemed high-risk – must be cleared through the more demanding PMA route, which requires that the device's safety and efficacy be demonstrated through clinical trials. Class I and II devices – which present "low to moderate risk" or "moderate to high risk," respectively – need only be cleared through a PMN under section 510(k) of the U.S. Federal Food, Drug, and Cosmetic Act, which requires only evidence of "substantial equivalency" with existing devices and can be processed in just 30-90 days. As competitors already appear to have had all the necessary technology in their intermediate catheters to go to market with aspiration catheters of their own, it is no surprise that they were able to enter the space so quickly, highlighting the low barriers to entry in this vertical going forward.

Medtronic React 68 FDA Approval

Indications for Use:
The Riptide™ Aspiration System is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (within the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset. Patients who are ineligible for intravenous tissue plasminogen activator (IV t-PA) or who fail IV t-PA therapy are candidates for treatment.

Device Comparison:

	Penumbra System® ACE 68 Reperfusion Catheter	React™ 68 Catheter
Indication for Use (IFU) Statement	The Penumbra System® is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (within the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset.	The Riptide™ Aspiration System is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (within the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset. Patients who are ineligible for intravenous tissue plasminogen activator (IV t-PA) or who fail IV t-PA therapy are candidates for treatment.

Stryker AXS Catalyst Distal Access Catheter FDA Approval

Table 1: Product Feature Comparison of Subject Device to Predicate Device

Detail	Submission Subject Device AXS Catalyst Distal Access Catheter	Primary Predicate Device Penumbra Reperfusion Catheter
Regulation Name	Percutaneous Catheter	Same as Subject Device
Regulatory Class	II	Same as Subject Device
Product Code	NRY	NRY
Intended Use/ Indications for Use	The AXS Catalyst Distal Access Catheter as part of the AXS Universal Aspiration System is indicated for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (in the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset. Patients who are ineligible for intravenous tissue plasminogen activator (IV t-PA) or who failed IV t-PA are candidates for treatment.	The Penumbra System is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (in the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset.

FDA clearance through the 510(k) pathway requires only evidence of "substantial equivalency" with a "predicate device" already on the market. That these aspiration catheters were cleared through direct comparison with Penumbra reinforces the commoditization of the industry and the ease with which competitors can enter the neurovascular aspiration catheter market.

SPRUCE POINT CAPITAL MANAGEMENT

Discounted Bundling By Deep-Pocketed Mega-Cap Competitors Threatens Industry Pricing

According to doctors with whom we spoke throughout our diligence, product bundling has grown increasingly common in the mechanical thrombectomy space as large medical device companies continue to cross over into the aspiration catheter market from the stent retriever vertical. On top of whatever discounts they offer vs. Penumbra on a per product basis at face value, large medical device companies are beginning to offer discounted mechanical thrombectomy packages which include a broad set of relevant tools, including both stent retrievers and aspiration catheters. Doctors with whom we spoke reported discounts on bundled items of between 10-20%. Discounted bundling by deep-pocketed medical device companies poses a powerful risk to industry pricing: assuming that its near-term stent retriever market share projections are correct, Medtronic, whose stent retriever has dominant share, and which is widely regarded as the industry's gold standard, can effectively give away its aspiration catheters for free and still grow profit dollars into FY19, without even assuming any market share gains in the stent retriever space.

*"[Medtronic] is saying – the intermediate aspiration catheter, the React – the microcatheter, the Phenom 27 – and then the stent retriever, and the wire, the Asahi wire…let's bundle all of this. **The list price of all of this when you put it all together is $14,000 or $15,000. 'So we're going to give you a bundling discount, and let's now bring it down to $12,000.** So if you use all of this together, and we're going to give you a discount to $12,000.' Well, if the doctors are using it already and like their products, then that's attractive to the hospital – it becomes very palatable to use this combination of bundling and so forth. So I think that it's a sales tactic – it's a tactic of 'you win, we win.'"*

- Neurosurgeon
75 mechanical thrombectomies per year

*"**From a cost perspective, it is cheaper for us to use Medtronic. To go back to Penumbra, I would have to see a significant improvement in performance.** I really don't think the pump is the distinguishing feature. Each company will now give you their pump for free. A few years ago when there was no competition, you had to buy the pump from Penumbra."*

- Neurosurgeon
Individually: 25-35 mechanical thrombectomies per year
Practice: 120 mechanical thrombectomies per year

*"**The primary competitive advantage that Medtronic has over Penumbra is its company size and its ability to bundle its products across service lines and offer volume discounts to hospitals.** From a pricing standpoint, Medtronic can be more aggressive than Penumbra or Terumo. Penumbra shouldn't rest on its laurels. It should make them nervous if Medtronic has painted a bulls-eye on them. Medtronic is a behemoth of a company that can flex its economic muscles -- it can bundle product and give rebates. Medtronic has great ways to encourage hospitals to use their products. Our hospital has a contract with Medtronic. **[Us doctors] are always being pushed by hospital administration to use more Medtronic because of the greater rebates being offered. As more companies develop aspiration technology there will be more price competition.**"*

- Surgeon

*"**Penumbra's stent retriever is definitely inferior. And its strategy of bundling a low-cost stent retriever with its aspiration catheters is not working.** Others are already at price parity, so it doesn't really matter anyways."*

- Neurosurgeon

Penumbra, meanwhile, would not be able to analogously take stent retriever share by lowering its stent retriever prices due to widespread disdain for its stent retrievers.

SPRUCE POINT CAPITAL MANAGEMENT

Discounted Bundling By Deep-Pocketed Mega-Cap Competitors Threatens Industry Pricing

We estimate that, even if it were to give its stent retrievers away for free as part of its mechanical thrombectomy bundles, Medtronic would be able to grow its mechanical thrombectomy profit dollars through 2019, even when assuming no stent retriever share gains.

$M		2018	2019E			
Stent Retriever Market Share	Medtronic	60%	60%	60%	60%	60%
	Penumbra	5%	5%	5%	5%	5%
Stent Retriever Procedures	Medtronic	16,178	18,664	18,664	18,664	18,664
	Penumbra	1,348	1,555	1,555	1,555	1,555
Aspiration Market Share	Medtronic	10%	25%	25%	25%	25%
	Penumbra	90%	75%	75%	75%	75%
Aspiration Procedures	Medtronic	2,741	8,585	8,585	8,585	8,585
	Penumbra	24,669	25,754	25,754	25,754	25,754
Accessories[1]	Medtronic	18,919	27,249	27,249	27,249	27,249
Average Selling Price (Medtronic)	Stent Retriever	$8,000	$8,000	$8,000	$8,000	$8,000
	Aspiration	$4,000	$3,000	$2,000	$1,000	$0
	Accessories	$3,000	$3,000	$3,000	$3,000	$3,000
	TOTAL	$15,000	$14,000	$13,000	$12,000	$11,000
COGS (Medtronic)[1]	Stent Retriever	$1,600	$1,600	$1,600	$1,600	$1,600
	Aspiration	$800	$800	$800	$800	$800
	Accessories	$600	$600	$600	$600	$600
	TOTAL	$3,000	$3,000	$3,000	$3,000	$3,000
Revenue	Total	$197.1	$256.8	$248.2	$239.6	$231.1
	Growth %	-	30%	26%	22%	17%
Gross Profit	Total	$157.7	$203.7	$195.1	$186.6	$178.0
	Growth %	-	29%	24%	18%	13%
	Margin %	80%	79%	79%	78%	77%

With the market-leading stent retriever and well-received aspiration catheters, Medtronic could likely take aspiration share extremely rapidly (as it has been) by temporarily giving away its aspiration catheters for free, or selling it at a steep discount. It would not sacrifice near-term gross profit growth by doing so, and could position itself for longer-term segment growth by establishing itself as the dominant player in neurovascular mechanical thrombectomy.

With limited ability to bundle on its own, Penumbra could face significant price compression in its core aspiration vertical without an opportunity to compensate by growing share in its relatively underpenetrated stent retriever vertical.

1. Assumes slightly above company-wide gross margin, per conversations with industry experts. Accessory quantities equal to sum of aspiration and stent retriever units.

SPRUCE POINT CAPITAL MANAGEMENT

Low-Quality Stent Retriever Puts Penumbra At A Disadvantage Amidst Industry Trends

Even as aspiration catheters grow increasingly popular in the treatment of acute ischemic stroke, industry trends continue to favor vendors which can provide high-quality stent retrievers. As stent retrievers are more R&D-intensive and not as commoditized as aspiration catheters, neurosurgeons will be more likely to source their bundles from experienced manufacturers of stent retrievers than from established aspiration catheter providers like Penumbra (all else equal). The growing popularity of the "solumbra" technique (combined thromboaspiration / stent retriever thrombectomy) will only reinforce this trend: even as thromboaspiration becomes more popular, its growth will not necessarily come at the expense of the use of stent retrievers, which, again, as the more IP-intensive device, will be more likely to drive the purchase decision. Penumbra does, in fact, offer a stent retriever, but the doctors with whom we spoke were unanimous in their disdain for it, and there is no evidence that the Company is capable of developing a stent retriever on par with those of deep-pocketed mega-cap medical device companies.

*"**Penumbra has offered a similar kind of [bundling] arrangement [as Medtronic], but I told them that I am not interested because I have used their stent retriever and I don't think it is as good as the Solitaire [Medtronic]. And the discount that they are going to offer – truthfully, they could even offer it for me for free and this would not convince me to use it.** The arrangement with Penumbra that they were offering was that if they tried first with aspiration and its not successful, then if we use their stent retriever then we could use that for free as a bailout strategy. I don't want to use their stent retriever because it is just going to take me extra time and I won't get the vessel open and then I will have to switch to the Solitaire anyway. **I am not interested in using Penumbra's stent retriever even if its severely discounted in price for me.**"*

- Neurosurgeon
Individually: 25-35 mechanical thrombectomies per year
Practice: ~120 mechanical thrombectomies per year

*"**It is widely recognized that doctors hate Penumbra's stent retriever**…. Penumbra is trying to get into stent retrievers and has fallen flat on their face. **Penumbra has not gotten any traction with their stent retriever. The development of a stent retriever is not easy at all.** Medtronic and Stryker are on their 2nd or 3rd generation of their stent retrievers and have really optimized the performance of their technology. Aspiration on the other hand is not rocket science. These are the same tubes that are used for other procedures in the brain. The regulatory process for aspiration catheters are all 510K which is simple and don't need clinical data. **The stent retriever is a much more complex system.**"*

- Neurovascular Products Sales Director

*"Medtronic has the Solitaire – it's a great stent retriever. And you compare that to **the Penumbra stent retriever, which is this 3D separator – in my opinion, it wasn't as good. They actually had a trial with the 3D separator and it didn't perform too well.** So what ended up happening at that point in time was that Penumbra said, 'Ok, well, we need to come up with some other way of gaining the market. **Let's just tag on into this only aspiration thing – we have the great catheter, let's just jump on that.**' But one thing with Penumbra is that they still need a better stent retriever than what they have…. **I think the person who has the better stent retriever [will be the winner in solumbra].** The reason for that is because we need a stent retriever that decreases the amount of distal embolization."*

- Neurosurgeon
Individually: 75 mechanical thrombectomies per year
Practice: 75 mechanical thrombectomies per year

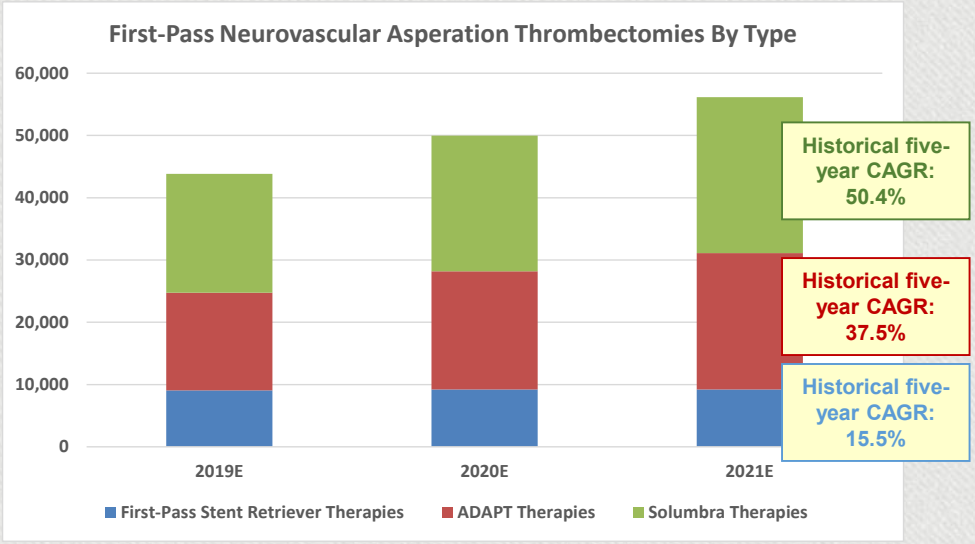
If the trend towards bundling continues to dominate the space, and if bundle purchasing decisions are driven by a combination of price considerations and the quality of the stent retriever, we should expect 1) large medical device companies with significant scale for bundling and 2) companies with the best stent retrievers to win out.

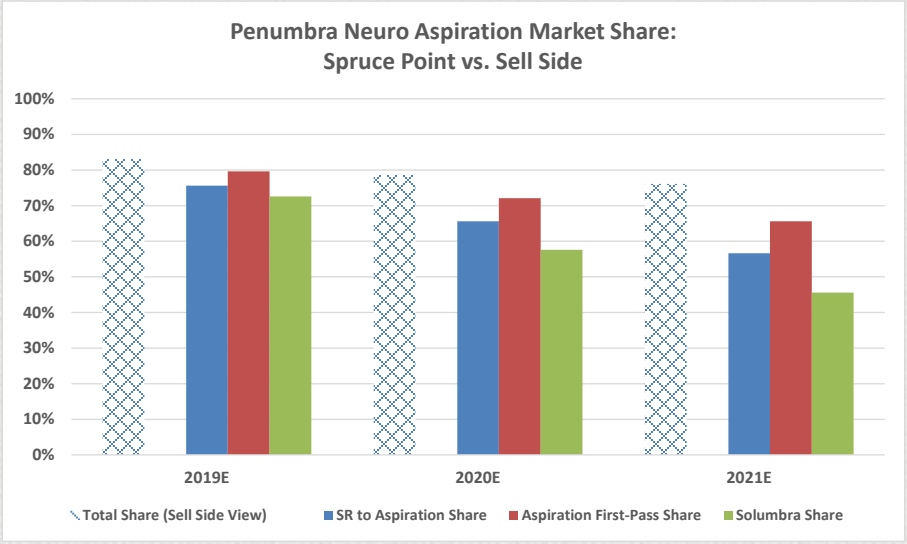
Penumbra is a laggard in BOTH 1) scale and 2) stent retriever quality. The simultaneous growth of bundling and the solumbra technique – even as solumbra expands the market for aspiration catheters – will put Penumbra at a significant competitive disadvantage to larger peers.

SPRUCE POINT CAPITAL MANAGEMENT

Failure To Model Market More Granularly Leads To Misestimation

In failing to account for the changing dynamics within neurovascular thrombectomy, analysts once again overestimate Penumbra's neurovascular sales due to oversimplification of the market. Analysts appear to calculate Penumbra's U.S. neurovascular sales by projecting the total number of mechanical thrombectomies to be performed – through both stent retriever and aspiration – and applying a forecasted market share to each subsegment of the market. However, most industry experts agree that the combined "solumbra" method will account for a significant share of the growth of the neurovascular thrombectomy market. From our conversations with doctors, we expect Penumbra to lose share at a particularly rapid rate in this subsegment: bundling among larger competitors, along with the importance of the quality of the stent retriever, will encourage migration to Medtronic and other competitors. Due to the weakness of its stent retriever and its inability to bundle effectively, Penumbra is positioned to perform relatively weakly in the largest and historically fastest-growing segment of the neurovascular thrombectomy market.





Source: Blended Sell-Side Estimate

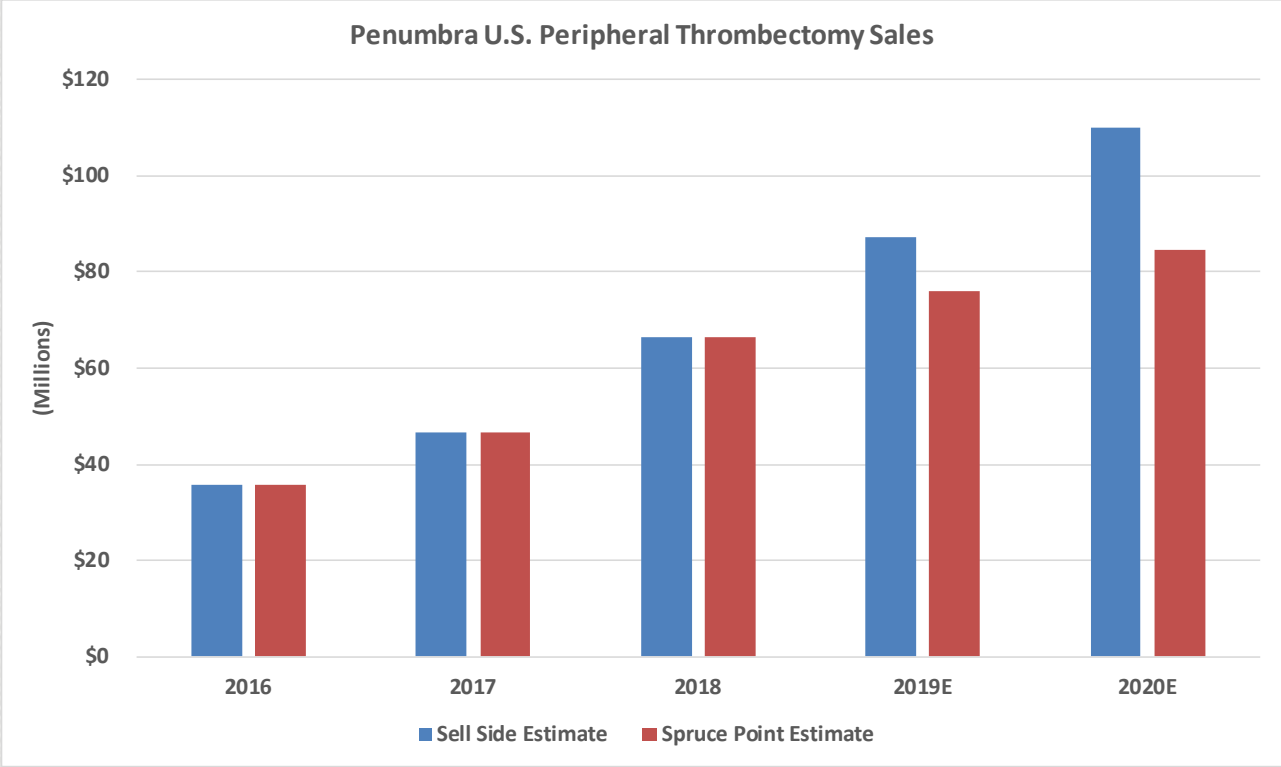
Not only are analysts overestimating Penumbra's future blended market share across neurovascular aspiration thrombectomy types, but they are failing to account for the sub-segment dynamics within aspiration.

Spruce Point believes that Penumbra's major point of weakness will be in the solumbra subsegment, in which bundles will become increasingly common, and in which the quality of the stent retriever is of utmost importance.

SPRUCE POINT
CAPITAL MANAGEMENT

Penumbra U.S. Ischemic Stroke Sales: Spruce Point Versus The Street

Spruce Point sees Penumbra's U.S. ischemic stroke sales flattening through the next several years as large competitors in the medical device space take share and pressure Penumbra prices.



Promotional Management Team Gearing Up For A Slowdown?

SPRUCE POINT CAPITAL MANAGEMENT

A Promotional Management Team With A History Of Empty Projections

Management has a history of promotional behavior, particularly in the face of past failures. Industry experts report, for example, that management promoted its neuro embolization business heavily in the mid-2010s following the launch of its smart coils. However, the smart coil has thus far been a disappointment, and the neuro embolization business has been largely flat through the past several years. Interestingly, management has also apparently been making visits to doctors to promote its new lines of catheters and USB-enabled pump (the purpose of which nobody can quite figure out).

Management Buddying Up To Doctors To Promote The Business

*"**Their Jet7 catheter sucks and they know it**… [Penumbra's] CEO was just on a goodwill tour trying to make sure -- his last words for us as we all shook hands goodbye was '**Don't give up on us.'***

*They rolled out this new pump for everybody. We were told that it has higher aspiration force than the one they had before… They replaced the old one with the new one for free. **This new pump has a USB port on the back of it.** And Adam's words were 'I think you know me well enough that I didn't design this pump with a USB port to charge your phone.' **So there is something to new technology that will be related to power that [Adam] thinks is going to revolutionize aspiration. And I don't know what that is that they are trying to.**"*

- Neurosurgeon
Individually: 30 mechanical thrombectomies per year
Practice: ~150-180 mechanical thrombectomies per year

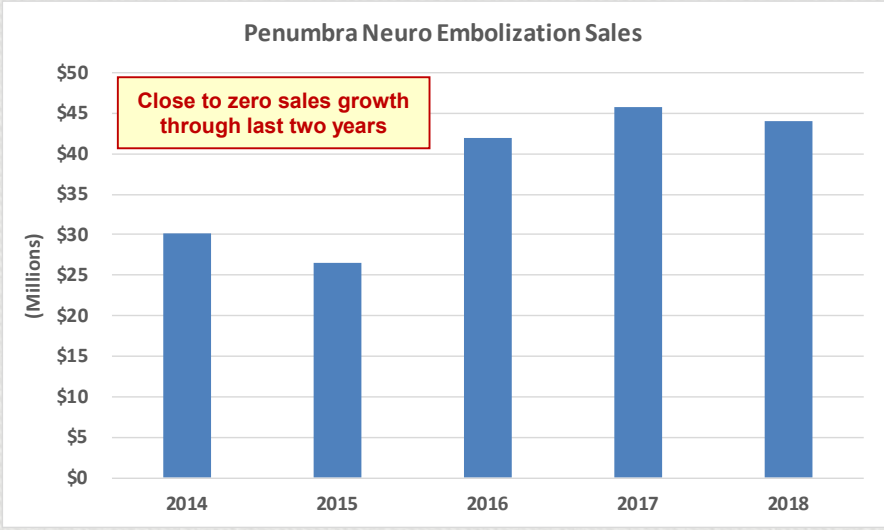
*"**Homeboy wouldn't be going on goodwill tours if they were rocking it.**"*

- Neurosurgeon
Individually: 90 mechanical thrombectomies per year
Practice: 200 mechanical thrombectomies per year

Management Pumping Up Weak Business Lines

*"**[Penumbra] launched their smart coils with a lot of fanfare, but it has not come through in the way they said it would.** It did not surpass the technology of Target, Stryker's Coil, which is #1 in the in the US and World Market."*

- Neurovascular Products Sales Director



SPRUCE POINT CAPITAL MANAGEMENT

Unusually High Payments To Non-Employee Doctors

The Physician Payments Sunshine Act (Section 6002 of the Affordable Care Act of 2010) requires medical product manufacturers to disclose to the Centers for Medicare and Medicaid Services (CMS) any payments or other transfers of value made to physicians or teaching hospitals. Spruce Point analyzed over 28,000 transactions made by Penumbra to doctors from 2013-18. We found that Penumbra paid seven doctors $2.9M of consulting fees in the form of stock between Feb 9, 2016 and Dec 31, 2018, none of which has been disclosed in public filings. Stock payments to non-director and non-employee doctors of this magnitude are very rare in the CMS Open Payments Database. We also found that $4.4M of Penumbra stock was repurchased from 11 doctors in the year preceding the Company's IPO. We find this concerning for a relatively young medical device company which has been funding studies for years in an attempt to gain clinical support for its core products.

Public Companies Paying > $1M Of Stock In Consulting Fees

Company	Payments To Doctors (Directors)		Payments To Doctors (Non-Directors)			Percent Of Total	
	Number Of Doctors	Total Payments	Number of Doctors	Total Payments	Average Payment Per Doctor	Director	Non-Director
ABIOMED	2	$6,324,774	2	$143,190	$71,595	98%	2%
Quidel Corporation	2	$3,095,461	-	-	-	100%	0%
Penumbra, Inc.	**-**	**-**	**7**	**$2,971,414**	**$424,488**	**0%**	**100%**
DexCom, Inc.	2	$1,990,040	-	-	-	100%	0%
Gilead Sciences Inc	1	$1,145,007	-	-	-	100%	0%

Source: CMS Open Payments Database

SPRUCE POINT CAPITAL MANAGEMENT

Unusually High Payments To Non-Employee Doctors

The Open Payments database also reveals that Penumbra has issued an unusually large quantity of travel and lodging reimbursements to doctors, with the most popular destination being Las Vegas (just ahead of Penumbra's own headquarters in Alameda). After cross-checking the dates and locations of these reimbursements with the dates and locations of relevant medical conferences and industry conferences, it appears that most of these trips were not related to conferences. Our conversations with industry participants confirm that Penumbra has a reputation for pampering doctors.

Destinations For Penumbra Travel & Lodging Reimbursements

City	Total Travel & Lodging Reimbursements	Unique Doctors
Las Vegas, NV	$281,678.68	242
Alameda, CA	$274,516.78	231
Miami, FL	$180,985.59	139
San Francisco, CA	$121,028.58	118
Laguna Beach, CA	$81,758.56	84
Orlando, FL	$53,655.75	68
Memphis, TN	$83,219.08	67
Chicago, IL	$65,363.48	66
New York, NY	$41,437.08	45
Minneapolis, MN	$38,774.51	34

*"**Penumbra will cross the line that many won't to get their products in the hands of surgeons.**"*

- Neurovascular Products Sales Director 1

*"**Penumbra is aggressive….** At symposiums, they will cover all costs of a nice hotel stay, food, travel, etc."*

- Neurovascular Products Sales Director 2

Source: CMS Open Payments Database

SPRUCE POINT CAPITAL MANAGEMENT

Penumbra Not Holding Itself To Peer Ethical Standards

The Advanced Medical Technology Association, more commonly known as AdvaMed, is a medical device trade association which "promotes competitive policies that foster the highest ethical standards." The organization's "Code of Ethics on Interactions with Health Care Professionals" sets guidelines for member companies on a broad set of industry activities, from consulting arrangements with doctors and research financing to reimbursement for travel and lodging. The vast majority of major U.S. medtech companies (including all companies listed as competitors on Penumbra's 10-K) are members of AdvaMed: per AdvaMed's website, organization members manufacture close to 90% of medtech products purchased in the U.S. Interestingly, Penumbra is not one of them.

Interactions with Health Care Professionals

The scope of beneficial interactions between Health Care Professionals and Companies is broad and includes interactions intended to:

- *Promote the Advancement of Medical Technologies.* Developing and improving cutting edge Medical Technologies are collaborative processes between Companies and Health Care Professionals. Innovation and creativity are essential to the development and evolution of Medical Technologies, which often occur outside a Company's laboratory.
- *Enhance the Safe and Effective Use of Medical Technologies.* The safe and effective use of sophisticated electronic, *in vitro* diagnostic, surgical, or other Medical Technologies often requires Companies to provide Health Care Professionals appropriate instruction, education, training, service and technical support. Regulators often require this type of training as a condition of product approval.
- *Encourage Research and Education.* Companies' support of *bona fide* medical research, education, and enhancement of professional skills improves patient safety and increases access to Medical Technologies.
- *Foster Charitable Donations and Giving.* Companies make monetary and Medical Technology donations for charitable purposes, such as supporting indigent care, as well as patient and public education. This increases access to—as well as the quality of—care and treatment in patient populations that may not otherwise be reached.

The Purpose of the Code of Ethics

AdvaMed recognizes that Health Care Professionals' first duty is to act in the best interests of patients. Companies can serve the interests of patients through beneficial collaborations with Health Care Professionals. To ensure that these collaborative relationships meet high ethical standards, they must be conducted with appropriate transparency and in compliance with applicable laws, regulations and government guidance. AdvaMed recognizes the obligation to facilitate ethical interactions between Companies and Health Care Professionals in order to ensure that medical decisions are based on the best interests of the patient. The ethical principles that govern these interactions are the subject of this Code of Ethics.[1] To that end, AdvaMed restates and amends its Code of Ethics and Frequently Asked Questions (collectively "Code of Ethics" or "Code"), effective July 1, 2009.

Company	10-K Listed Peer	AdvaMed Member
Boston Scientific Corporation	✓	✓
Johnson & Johnson	✓	✓
Medtronic	✓	✓
Stryker	✓	✓
Terumo	✓	✓
Penumbra	-	✗

*"**Penumbra is not held to the same standard as [us] and [competitor]**…. We have to be much more cautious [about our spending]. We have limits that we have to stay under."*

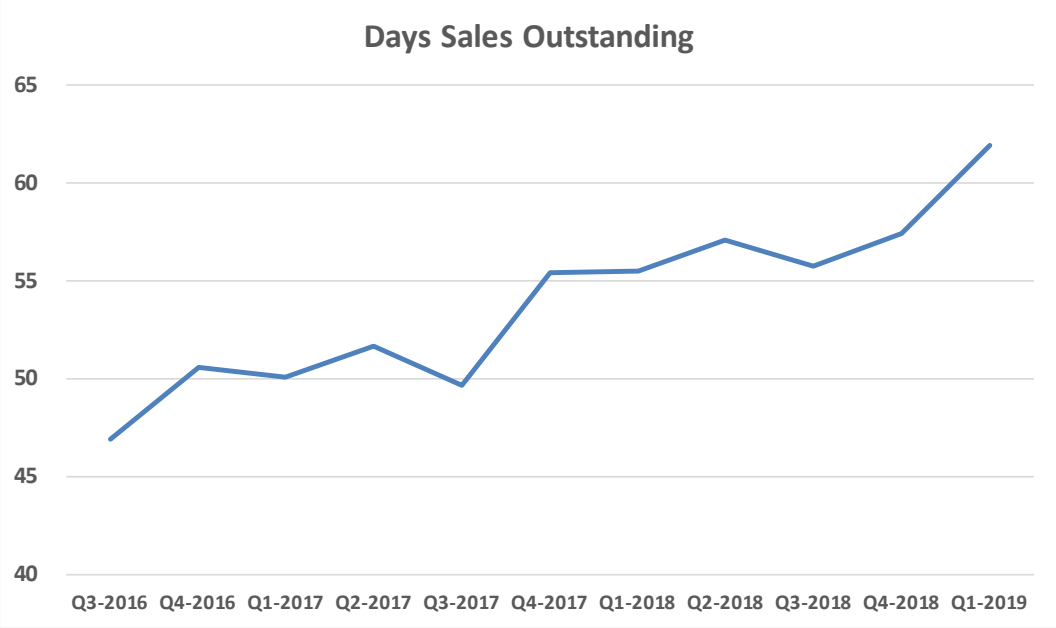
- Neurovascular Products Sales Director

Source: AdvaMed

SPRUCE POINT CAPITAL MANAGEMENT

Stretched Financials Suggest Declining Earnings Quality

Just as rising competition has put pressure on Penumbra sales, management appears to be acting aggressively to maintain growth. In particular, DSOs have grown steadily and consistently since Penumbra first went public, and are now at an all-time high by a wide margin. This growth has accelerated through the last two quarters, during which time, we believe, competition became even fiercer with the release of new aspiration catheters from Medtronic and Stryker. These trends suggest that Penumbra sales and earnings may be artificially inflated by aggressive accounting or business practices.



Could stretched financials give the impression of stronger underlying earnings and sales growth as Penumbra faces increasingly strong fundamental headwinds?

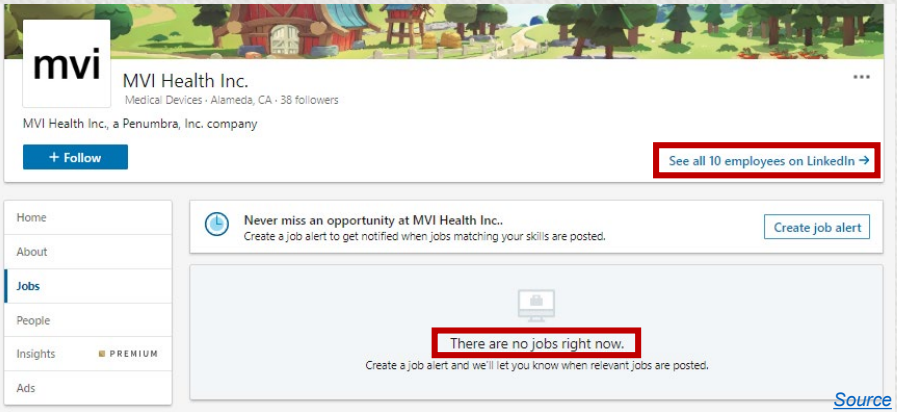
SPRUCE POINT CAPITAL MANAGEMENT

Non-Core M&A Unrelated To Company Competencies

In Jan 2018, Penumbra announced the launch of MVI Health, a 50/50 joint venture formed with virtual reality technology developer Sixense Enterprises. Management later acquired another 40% of MVI from Sixense for $20M on Aug 31, giving it a 90% controlling interest in the entity. Though management is vague regarding its plans for this business, industry experts believe that Penumbra intends to develop virtual reality technology designed to assist stroke patients in the recovery process. Why should Penumbra – a young medical device company with effectively one vertical – commit resources to the development of highly-speculative virtual reality technology when it has no experience developing software or products outside of its thrombectomy tools? We fear that management is simply looking to move into a sexy and easily-hyped business line to continue to promote the Company, and we have little confidence that MVI will amount to anything but a waste of cash.

Per LinkedIn, MVI Health has ten employees and is not hiring.

Is this really enough to develop a novel form of stroke therapy and all of the associated technologies behind it?



Source

Clinical studies suggest that any potential therapeutic benefits of virtual reality for stroke patients are limited

Virtual reality for stroke rehabilitation

Review question

We wanted to compare the effects of virtual reality versus an alternative treatment or no treatment on recovery after stroke using arm function and other outcomes such as walking speed and independence in managing daily activities after stroke.

Background

Many people after having a stroke have difficulty moving, thinking, and sensing. This often results in problems with everyday activities such as writing, walking, and driving. Virtual reality and interactive video gaming are types of therapy being provided to people after having a stroke. The therapy involves using computer-based programs designed to simulate real life objects and events. Virtual reality and interactive video gaming may have some advantages over traditional therapy approaches as they can give people an opportunity to practise everyday activities that are not or cannot be practised within the hospital environment. Furthermore, there are several features of virtual reality programs that might mean that patients spend more time in therapy: for example, the activity might be more motivating.

Authors' conclusions:

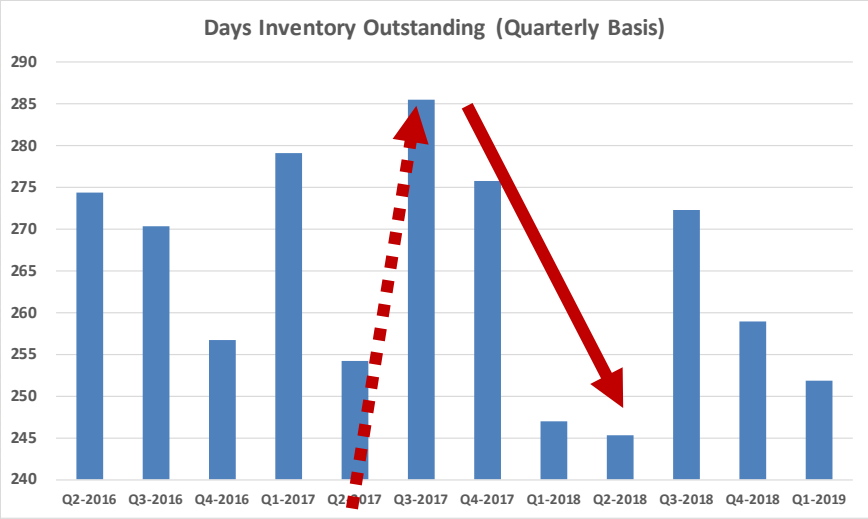
We found evidence that the use of virtual reality and interactive video gaming was not more beneficial than conventional therapy approaches in improving upper limb function. Virtual reality may be beneficial in improving upper limb function and activities of daily living function when used as an adjunct to usual care (to increase overall therapy time). There was insufficient evidence to reach conclusions about the effect of virtual reality and interactive video gaming on gait speed, balance, participation, or quality of life. This review found that time since onset of stroke, severity of impairment, and the type of device (commercial or customised) were not strong influencers of outcome. There was a trend suggesting that higher dose (more than 15 hours of total intervention) was preferable as were customised virtual reality programs; however, these findings were not statistically significant.

Source

SPRUCE POINT CAPITAL MANAGEMENT

Acquisition Of Distributor Coincides With Concerning Financial Patterns

In Q3 FY17, Penumbra acquired Crossmed S.p.A., its Italian distributor, for a total purchase price of $18.7M (3.0x FY17 sales of $6.2M). In Spruce Point's experience, distributor acquisitions are a common tactic used by companies looking for a quick sales boost. Might Penumbra have acquired its Italian distributor to aggressively move Penumbra product? Interestingly, we note that, after Penumbra DSI spiked in Q3 FY17 – as we would expect – this metric immediately corrected to historical levels in the subsequent two quarters. Meanwhile, Penumbra's "Other International" sales (which include Europe) increased by an abnormal amount in the subsequent quarter. Could the effects of the acquisition have papered over slower or negative QoQ rest-of-world growth? Might future acquisitions of foreign distributors have the same effect?



DSIs peak in Q3 FY17, the quarter during which Penumbra acquired Crossmed, before rapidly correcting through subsequent quarters

Other International revenue rises by ~5x the average quarter-over-quarter increase in the quarter following the Crossmed acquisition

SPRUCE POINT CAPITAL MANAGEMENT

Distributor Acquisitions Are Hallmark Warning Signs Of Financial Trouble

We note that distributor acquisitions are a common signal of managerial aggressiveness in the face of financial strain, and a sign that management may be looking to paper over underlying weaknesses. Spruce Point has a highly successful track record of identifying struggling companies by monitoring notable distributor acquisitions and unearthing broader fundamental weaknesses at the acquiring business.

Distributor Acquisitions: A Classic Red Flag

Date	Company	Distributor	Note	Spruce Point Successful Call
11/21/16	iRobot / IRBT	Sales on Demand	IRBT's largest Japanese distributor accounting for 12.9% of sales in 2016	★
10/26/15	Valeant / VRX	Philidor	Valeant disclosed an option to buy its distributor for $100m. This would be the trigger for the downfall of Valeant	
May 2011	Caesarstone / CSTE	U.S. Quartz	CSTE acquired U.S. Quartz pre-IPO. Now its CEO is competing against CSTE with Vadara Quartz	★
7/15/15	Sabre Corp / SABR	Abacus	Related party acquisition included Abacus distribution agreement with other Asian airlines	★
11/25/14	3D Systems / DDD	Robotec	Announced deal to acquire Robotec to access Latin America and create 3D Systems Latin America.	

SPRUCE POINT CAPITAL MANAGEMENT

Management Resorting To Bully Tactics To Protect Market Share?

In 2017, as the practice of using intermediate catheters for aspiration thrombectomy was becoming increasingly widespread, the FDA received a complaint about, and subsequently issued a warning against, the use of off-label catheters as aspirators in the treatment of acute ischemic stroke. Several doctors and industry experts with whom we spoke saw this as an aggressive attempt by Penumbra to preserve market share. They acknowledge that, for the time being, it likely succeeded in scaring many purchase officers into buying only on-label aspiration catheters for neurovascular thrombus removal. However, they also note that most doctors saw through this tactic, and that it rubbed many the wrong way: neurologists apparently do not like being told how to treat their patients. Penumbra has since communicated warnings to doctors that their aspiration catheters are cleared by the FDA for use only with Penumbra accessories and vacuum pumps, even though, according to doctors, these items are entirely interchangeable. Is management resorting to policing its doctors to protect its commodity products from competition?

*"Part of the commodity here is that…**it's hard to have IP around a plastic tube.** Especially if you argue that you can put any suction on it. Just to give you a bit of context, **there have been some companies engaging in a somewhat nefarious game of trying to sell supply chain departments that their aspiration catheters can only be used with their aspiration pump or their aspiration tubing, because that's the way that it is approved by the FDA.** I mean – that's great, right? But obviously that is also a very hollow argument because **I could hook these things up to a wall suction and they would work just the same way. And everyone knows that.** So, it is things like – **some things they've been trying to do by essentially putting fear of human destruction into the hands of people who are not clinical, and they don't know how to respond to that.**"*

- Neurosurgeon
Individually: 30 mechanical thrombectomies per year
Practice: ~150-180 mechanical thrombectomies per year

*"**Penumbra went around to, and made a very big deal about, physicians using Medtronic, Terumo and Stryker aspiration catheters that previously did not have the stroke label indication.** They freaked out a lot of doctors. This annoyed the doctors a lot because [the Penumbra salesman] should not be telling the doctors how they should be treating their patients. **This also swayed some doctors to use Penumbra.**"*

- Neurovascular Products Sales Director

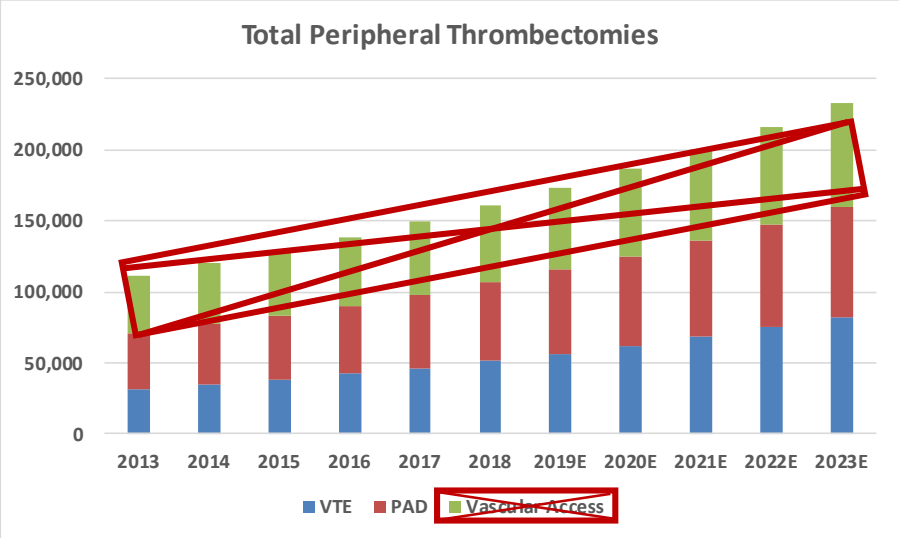
*"The FDA label matters more to less-sophisticated doctors, like radiologists. **People like me do whatever I think is best.**"*

- Neurosurgeon

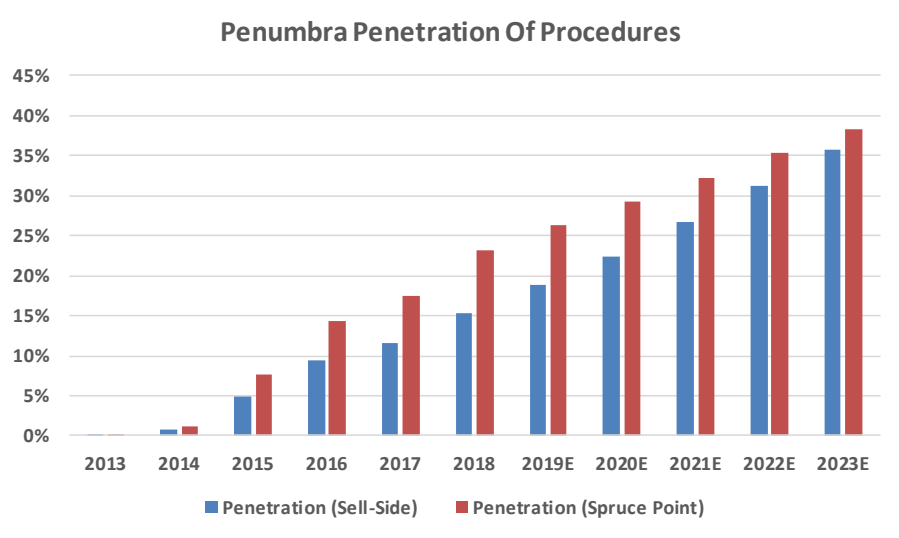
SPRUCE POINT CAPITAL MANAGEMENT

Diverting Attention Away From Bad News? Management Promoting A New Growth Engine Just As The Old One Is Set To Peter Out

Management has recently begun to promote its peripheral thrombectomy business, which sells catheters and accessories for use in treating clots outside of the brain and heart. We find it interesting that management has chosen to promote this business just as it begins to experience serious competitive pressure in its core neurovascular business. We also believe that sell-side growth expectations are excessive for this segment: many analysts include "vascular access" patients as part of Penumbra's vascular TAM, but doctors have told us that the TAM for Penumbra's vascular Indigo System is likely restricted to peripheral artery disease (PTE) and venous thromboembolism (VTE) patients, among whom there were ~110K thrombectomies in 2018. A fraction of these patients are also on Medicare and not candidates for a more expensive thrombectomy procedure. Spruce Point estimates that, in FY18, Penumbra achieved ~25% penetration among this universe of thrombectomy patients. While procedures are expected to continue to grow at a high single-digit rate, we do not expect Penumbra to be able to take significantly more share than it already has in what is a highly competitive market – already more competitive than the neuro vertical.



Source: Blended Sell-Side Estimate



Source: Blended Sell-Side Estimate

By ruling vascular access patients out of Penumbra's target market, we believe that the U.S. TAM for Penumbra's peripheral thrombectomy business is 33% lower than the Street believes

As of FYE 2018, we believe that Penumbra is 10% more penetrated in the U.S. than the sell side believes

With Penumbra more penetrated than the sell side believes in the peripheral thrombectomy market – a market which is already more crowded and competitive than the neuro market – we believe the Company's runway for growth is far more limited than is generally perceived.

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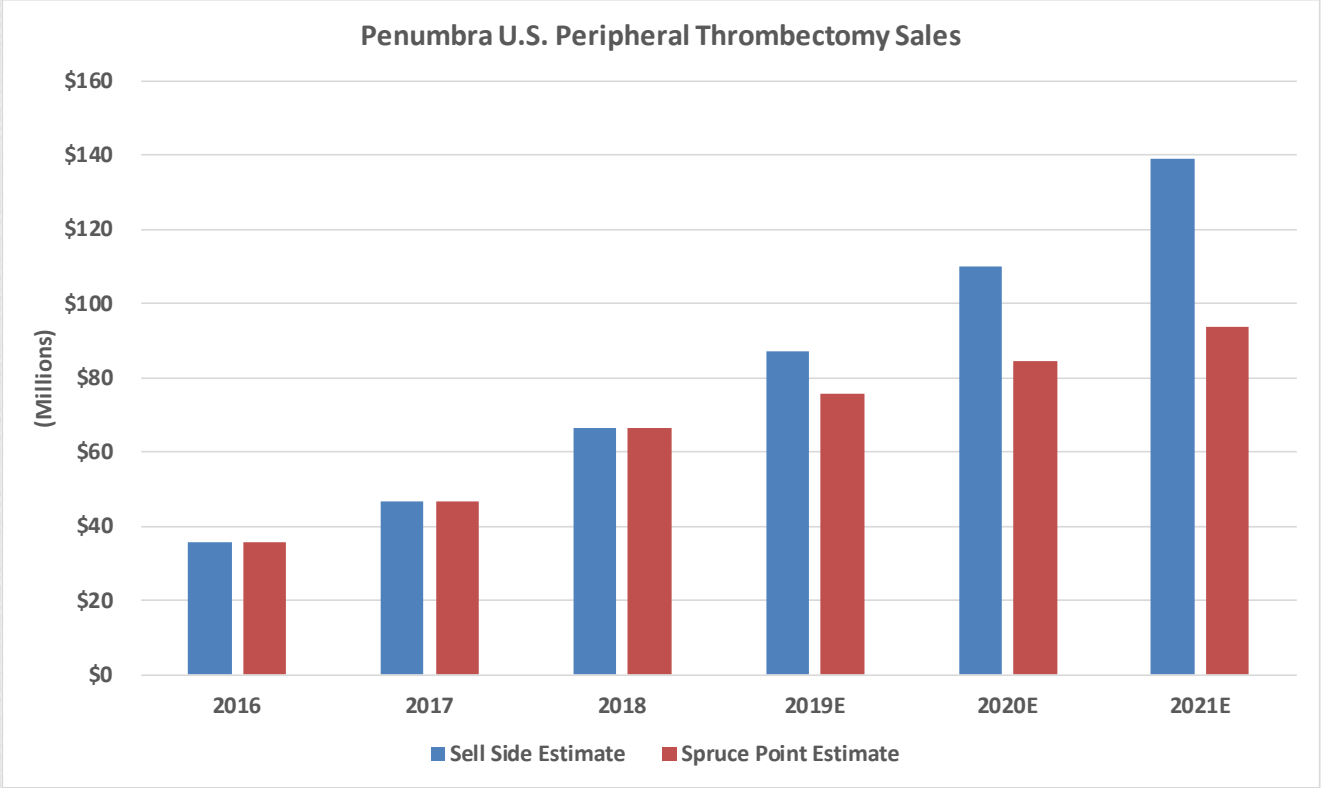
Penumbra U.S. Peripheral Thrombectomy Sales: Spruce Point Versus The Street

Spruce Point believes that, after a recent period of strong growth as surgeons have shifted away from tPA, Penumbra's U.S. peripheral thrombectomy sales growth will flatten as the existing market becomes more saturated.



Estimates And Valuation

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Summarizing The Sales Decline: Sales Growth Set To Be Cut Almost In Half

Spruce Point believes that, with Penumbra U.S. Stroke revenue growth set to slow in the face of heavy competition, and with consensus peripheral thrombectomy sales expectations far too aggressive, company-wide sales growth is set to be cut almost in half from Street estimates, from FY19 through FY21.

($M)	Blended Sell-Side Estimate			Spruce Point		
	FY19E	FY20E	FY21E	FY19E	FY20E	FY21E
U.S. Stroke – Aspiration Procedure Share	88.8%	84.4%	81.1%	75.8%	64.4%	55.0%
(A) U.S. Stroke – Aspiration Revenue	$125.1	$144.7	$163.4	**$110.5**	**$107.2**	**$103.5**
U.S. Stroke – Stent Retriever Procedure Share	11.7%	14.9%	18.0%	10.7%	12.6%	13.7%
(B) U.S. Stroke – Stent Retriever Revenue	$13.5	$20.9	$28.9	$12.8	$16.3	$19.5
(C) Total U.S. Stroke Sales ((A) + (B))	**$138.6**	**$165.6**	**$192.3**	**$123.3**	**$123.5**	**$123.0**
U.S. Peripheral Thromb. Penetration (of PAD and VTE)	28.4%	33.3%	39.3%	26.2%	29.2%	32.2%
(D) U.S. Peripheral Thromb. Revenue	**$87.1**	**$109.9**	**$139.2**	**$75.8**	**$84.5**	**$93.9**
(E) Remaining Penumbra Revenue	$305.7	$359.2	$407.4	$305.7	$359.2	$407.4
Total Penumbra Revenue ((C) + (D) + (E))	**$531.3**	**$634.7**	**$738.8**	**$504.8**	**$567.2**	**$624.3**
Revenue Growth, YoY	***19.4%***	***19.4%***	***16.4%***	***13.4%***	***12.4%***	***10.1%***

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Valuation Exceeds Appropriate Peer Group

Medtech companies which produce devices cleared under PMAs (as opposed to the 510(k) pathway) are generally deemed to be protected from competition by stronger barriers to entry and, naturally, tend to trade at relatively higher multiples. So why does Penumbra trade in line with producers of devices cleared under the PMA pathway?

				EV / Sales		Expected Sales Growth	
Company	Ticker	FDA Pathway	R&D as a % of Sales	FY19	FY20	FY19	FY20
Glaukos Corp	GKOS	PMA	27.4%	11.9x	10.0x	27.3%	18.9%
ABIOMED, Inc.	ABMD	PMA	12.2%	15.5x	13.1x	1.5%	18.7%
Tandem Diabetes Care Inc	TNDM	PMA	15.9%	11.6x	9.3x	69.9%	24.8%
Insulet Corporation	PODD	510(k)	15.7%	11.4x	9.6x	21.4%	18.7%
DexCom, Inc.	DXCM	PMA	19.4%	10.9x	9.2x	24.5%	18.2%
Penumbra Inc	PEN	510(k)	8.1%	11.3x	9.5x	20.6%	19.9%
Edwards Lifesciences Corp	EW	PMA	16.7%	10.6x	9.5x	11.1%	10.9%
iRhythm Technologies Inc	IRTC	510(k)	14.1%	9.7x	7.4x	42.8%	31.5%
ResMed Inc.	RMD	510(k)	6.9%	7.6x	6.9x	-0.1%	10.7%
Cardiovascular System, Inc.	CSII	510(k)	12.3%	6.1x	5.4x	13.3%	12.8%
Wright Medical Group, Inc.	WMGI	510(k)	7.1%	5.1x	4.7x	15.0%	11.1%
Nevro Corp	NVRO	PMA	12.5%	5.4x	4.9x	-5.3%	10.6%
Globus Medical Inc	GMED	510(k)	7.8%	5.1x	4.7x	7.8%	9.0%
NuVasive, Inc.	NUVA	510(k)	5.6%	3.2x	3.0x	4.8%	5.1%
PMA Average			17.3%	11.0x	9.3x	21.5%	17.0%
510(k) Average (Ex-PEN)			9.9%	6.8x	5.9x	15.0%	14.1%

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PEN Improperly Trading In Line With Higher-Quality Peers

PEN trades in line with more advanced and R&D-intensive medical device companies despite its weak IP, relatively low gross margins (even by the standard of 510(k) companies) and increasingly competitive landscape. We believe that investors must reevaluate Penumbra's current valuation in light of its growing fundamental headwinds and low business quality.

($ in millions, except per share figures)

		Price	52-wk		Sales		Sales Growth (%)		Gross Margin		R&D	EV / Sales		FDA
Name	Ticker	7/30/2019	High	EV	2019E	2020E	2019E	2020E	2019E	2020E	% Sales	2019E	2020E	Pathway
FDA Pathway: PMA														
Edwards Lifesciences Corp	EW	$216.87	99%	$44,836	$4,235	$4,698	11.1%	10.9%	76.6%	76.6%	16.7%	10.6x	9.5x	PMA
DexCom Inc	DXCM	$156.39	99%	$13,946	$1,284	$1,518	24.5%	18.2%	64.7%	65.8%	19.4%	10.9x	9.2x	PMA
ABIOMED Inc	ABMD	$279.23	61%	$12,131	$781	$927	1.5%	18.7%	83.2%	83.0%	12.2%	15.5x	13.1x	PMA
Tandem Diabetes Care Inc	TNDM	$64.37	86%	$3,627	$312	$390	69.9%	24.8%	52.5%	55.5%	15.9%	11.6x	9.3x	PMA
Glaukos Corp	GKOS	$78.88	95%	$2,740	$231	$274	27.3%	18.9%	86.4%	86.5%	27.4%	11.9x	10.0x	PMA
Nevro Corp	NVRO	$67.37	98%	$1,997	$367	$406	-5.3%	10.6%	68.0%	70.3%	12.5%	5.4x	4.9x	PMA
					Max		69.9%	24.8%	86.4%	86.5%	27.4%	15.5x	13.1x	
					Average		21.5%	17.0%	71.9%	73.0%	17.3%	11.0x	9.3x	
					Min		-5.3%	10.6%	52.5%	55.5%	12.2%	5.4x	4.9x	
FDA Pathway: 510K														
ResMed Inc	RMD	$130.22	98%	$19,796	$2,605	$2,882	-0.1%	10.7%	58.9%	59.5%	6.9%	7.6x	6.9x	510K
Insulet Corp	PODD	$125.83	99%	$7,802	$684	$812	21.4%	18.7%	65.8%	67.6%	15.7%	11.4x	9.6x	PMA
Wright Medical Group NV	WMGI	$28.84	88%	$4,637	$961	$1,068	15.0%	11.1%	79.4%	79.5%	7.1%	4.8x	4.3x	510K
Globus Medical Inc	GMED	$45.68	79%	$3,902	$769	$838	7.8%	9.0%	77.0%	76.9%	7.8%	5.1x	4.7x	510K
NuVasive Inc	NUVA	$60.02	83%	$3,702	$1,155	$1,214	4.8%	5.1%	72.9%	73.4%	5.6%	3.2x	3.0x	510K
iRhythm Technologies Inc	IRTC	$83.30	85%	$2,042	$210	$277	42.8%	31.5%	75.6%	76.6%	14.1%	9.7x	7.4x	510K
Cardiovascular Systems Inc	CSII	$46.01	93%	$1,508	$246	$278	13.3%	12.8%	80.6%	80.0%	12.3%	6.1x	5.4x	510K
					Max		42.8%	31.5%	80.6%	80.0%	15.7%	11.4x	9.6x	
					Average		15.0%	14.1%	72.9%	73.4%	9.9%	6.8x	5.9x	
					Min		-0.1%	5.1%	58.9%	59.5%	5.6%	3.2x	3.0x	
Penumbra Inc	PEN	$179.49	97%	$6,090	$537	$643	20.6%	19.9%	65.7%	66.6%	8.1%	11.3x	9.5x	510K
Penumbra Inc -- Spruce Adj					$505	$567	13.5%	12.3%						

Source: Bloomberg, Spruce Point Research

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Insiders Selling Aggressively As The Stock Climbs

Insiders owned 24.8% of PEN shares prior to the Company's IPO in Sep 2015. Today, just four years later, they own only 9.6% of shares. Insiders appear to sell at almost every significant uptick in PEN shares. We find this particularly concerning in light of new fundamental challenges to the business.

Insider Ownership	
Pre-IPO	24.8%
2016	22.0%
2017	13.5%
2018	10.7%
2019	9.6%

SPRUCE POINT CAPITAL MANAGEMENT

Widespread Bullishness Despite No Upside Represented By Sellside Price Targets

Despite almost unanimous bullishness among analysts, the average sell-side price target is currently 16% *below* current price levels. Penumbra shares currently trade above even the highest price target of $180. We note that Penumbra is a relatively small player in the medical device universe, and that most of the med-tech analysts responsible for covering the Company cover relatively large universes of stocks. It is not surprising to us that analyst recommendations appear out of sync with their price targets, nor that analysts appear to be missing the ongoing inflection in Penumbra's market share. Regardless, we believe that market expectations must be updated for the competitive headwinds revealed in this report.

Broker	Rating	Price Target	Companies Covered
Wells Fargo Securities	Buy	180	26
BofA Merrill Lynch	Buy	180	27
RBC Capital Markets	Buy	174	21
J.P. Morgan	Buy	170	25
Canaccord Genuity	Buy	160	20
William Blair & Co	Buy	-	17
BMO Capital Markets	Neutral	152	23
Average		**$169**	**23**
% Price Target Upside[1]		**-5.8%**	**-**

Source: Bloomberg

SPRUCE POINT CAPITAL MANAGEMENT

Spruce Point Sees 40-55% Downside ($85-$110) In PEN Shares

Spruce Point believes that rising competition in Penumbra's U.S. ischemic stroke business is driving pricing pressure and market share losses which will soon translate into significantly reduced segment sales growth. We also believe that forecasted growth rates in its U.S. peripheral thrombectomy business are not sustainable given a more realistic view of market penetration. As company-wide sales growth falls by nearly half, we expect that PEN's revenue multiple will adjust downwards as investors adjust their growth expectations to be more in line with our own, more realistic estimates. Spruce Point sees 40-55% downside in PEN shares as sales growth adjusts downwards and investors adjust their own projections.

		Bull Case		Bear Case	
($M)	Current / Sell-Side	Bull Case	% Change	Bear Case	% Change
2020 Sales Estimate	$643.1	$573.2	-10.9%	$567.2	-13.3%
EV / Sales Multiple	10.0x	6.5x	-35.6%	5.0x	-50.5%
Enterprise Value	**$6,421.6**	**$3,725.8**	**-43.4%**	**$2,836.0**	**-57.0%**
Net Debt (Cash)	($139.5)	($145.1)	-	($145.1)	-
Market Cap	$6,561.1	$3,805.3	-43.4%	$2,931.1	-55.7%
Diluted Shares Outstanding	36.6	36.6	-	36.6	-
Share Price	**$179.49**	**$110.81**	**-38.4%**	**$84.35**	**-53.1%**
Downside	-	**-38.2%**		**-53.0%**	