Future of Spine Stabilization

MARKET, EVIDENCE, REALITY

HALLETT MATHEWS MD, MBA
MAY, 2017

Hallett Mathews, MD, MBA
My Journey….

- Licensed (VA) Board Certified (ABOS) Orthopedic Spine Surgeon
- 25 Years of Academic and Private Practice
- Numerous Board Positions in Numerous Societies and Journals
- Numerous Device Patents, Chapters, and Peer Reviewed Publications
- 10 years Post Practice in Medical Device Senior Leadership
- VP Clinical and Medical Affairs Medtronic 2007 – 2011
- MBA University of Tennessee, 2009, Honorary College of W & M 2002
- Executive Vice President and Chief Medical Officer, Paradigm Spine, LLC, New York, New York 2011 – present
- Alumni Advisory Board, University of Tennessee Haslam School of Business
- Foundation Board, Raymond A. Mason School of Business, College of W & M

1. Spine Industry Situation Overview
2. How Can We Solve The Situation?
3. Summary

Current Spine Industry Market Facts

1. ~$100 Billion Spent Annually On Treating Back Pain In The US Alone[1]
2. ~5,000 Ortho & Neuro Spine Surgeons In The US; + ~ 2,000 Internationally
3. ~150 Spine Companies In The US; + 150 Companies Internationally
4. Spine Market Increased From $100M To ~$7B From 1990 To 2011[2]
   - 20-Year CAGR ~24%[3]
5. ~8% Of Orthopedic Surgeons Are Hospital Employees[4]
6. ~15% Of All Surgeons Have Some Economic Relationships With Industry[5]
7. ~20% Of Spine Surgeons In US Are Performing Minimally Invasive Surgery[6]

(1) "Artificial Spinal Disc Designed to Treat Chronic Lower Back Pain", Randolph Jonsson, www.gizmag.com/artificial-disc-treat-back-pain/22929, June 13, 2012.
(2) "2011 Spinal Industry Update", Orthopedic News Network, October 4, 2011.
(3) Based on Vercoglioni Bros., LLC estimates.
(4) "Hospital Employment vs. Private Practice: What Makes Sense for Orthopedic Surgeons", www.becker.com, March 21, 2012.
(5) "Challenges To Medical Device Innovation", Levins, Hoag, LDI Health Economist Magazine, June 2012.
(6) "The State of Minimally Invasive Spine Surgery: Q&A With SMISS President Dr. William Taylor ", Miller, Laura, www.becker.com, February 21, 2012.

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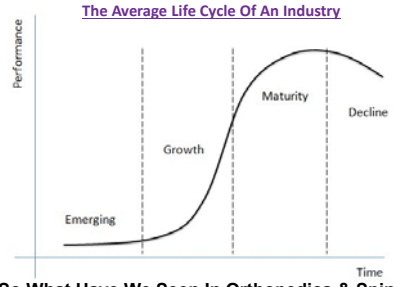
Industry Life Cycle Overview

The Average Life Cycle Of An Industry



So What Have We Seen In Orthopedics & Spine?

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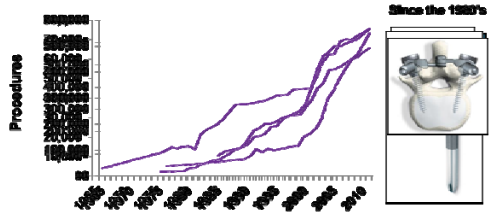
Historical Growth Of Key Products / Industries

Total US Spinal Fusion Procedures



So Where Are We Today?

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Current Orthopedics Market Overview

The Reality Of Today's Market…

2010-2012
U.S. Spine / Orthopedic Market Growth

Segment	2010A [1]	2011A[1]	2012E[2]
Hip	2%	2%	1%
Knee	3%	(1)%	3%
Spine	0%	(2)%	0%
Trauma	9%	5%	4%

Industry Growth At Historical Lows!

3-Year CAGR ~0%!!

"Find Me the Growth"
BMO Capital Markets Equity Research

All Segments Either Maturing Or Declining
Spine Segment = Least Growth

(1) Weighted Average of publicly-traded information for: DePuy, Zimmer, Stryker, Smith & Nephew, Biomet, Wright Medical, Exactech, Synthes, Medtronic, Orthofix, Globus Medical, NuVasive, Integra, RTI Biologics, Alphatec, Kensey Nash, China Kanghui, Trans1, Medicrea & Tornier.

(2) Weighted Average of publicly-traded information for: DePuy, Zimmer, Stryker, Biomet, Medtronic, Wright Medical, Globus Medical, Exactech, RTI Biologics, Orthofix, NuVasive, Alphatec, China Kanghui, Medicrea, & Trans1.

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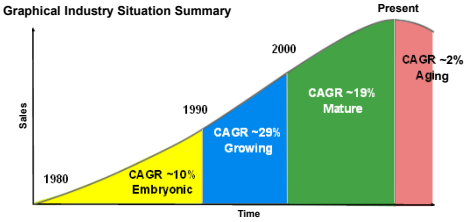
Graphical Industry Situation Summary



- **Over The Past 3 Years, Industry CAGR ~0%** [1]
- **Pricing Pressure Now Exists In Every Sub-Segment & Global Geography**
- **↓ Procedures, ↑ Commoditization, ↓Surgeon Loyalty = The Perfect Storm!**
- **~$10 Billion Spine Market Will Decline to ~$7 Billion Over Next 3-4 Years!**

The Train Is Off The Tracks… How Bad Will The Wreck Be?

(1) Viscogliosi Bros., LLC Estimates.

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Why Is There No Growth?

1. **Larger Companies: Becoming Increasingly Defensive & Reactive; Slow Growth!**
   - Shutting down R&D since 2010 & reallocating resources
   - Focused on distribution of existing products in US & OUS markets
2. **Smaller Companies: No Growth!; Investors Increasingly Moving Out Of Spine**
   - Many existing smaller spine companies are already bankrupt or on the brink!
   - PE / VC's now financing very few new "spine-based" start-ups
3. **Physicians: Currently Stuck In The "*Technology Trap*"**
   - Being forced to choose among 1,000's of "me-too" products
   - They are the keys to industry innovation, yet continue to move farther from industry
     - Haven't invented new spine technology frontiers since early 2000's
4. **Distribution: Current Model Is Highly Fragmented & Under Stress**

   A. Independent Distributors:
     - Focus is strictly on "surgeon relationships", not "best-in-class" technologies/outcomes
     - 100's of boutique distributors undercutting big box distributor pricing & market share

   B. Direct reps are losing compensation in current environment

   C. PODs currently at war with traditional distribution model

   D. Traditional sales forces have been historically expensive & unsustainable over long-term

Tension Is Everywhere Because The "Pie" Is Shrinking

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What Are The Ramifications Of No Growth?

Less Opportunity For Everyone!

- Less Opportunity For Industry - *Less jobs; less comp.; less top exec.'s!*
- Less Opportunity For Investors - *Seeking growth, yield & returns in other faster-growing industries!*
- Less Opportunity For Surgeons - *Less $$ comp.; less ability to impact standard of care!*
- Less Opportunity For Patients - *No new treatment algorithms!*

To Understand The Growth Issue

Must Understand *WHY* There Is A Lack Of Innovation!

The 2016 Spinal Solar System - 4 Key Growth Inhibitors

Lack Of Technology & Innovation: 4 Key Growth Inhibitors

- **Macro-Economic Environment: Everybody Feels The Pinch (Surgeons & Patients)**
  - 2007-2009 period was devastating to industry growth; stock & housing market collapses didn't help!
  - Healthcare reform, a crossroads, investors are leaving the market, yet our healthcare expenditures up!
- **Big Industry: Focused On Day-To-Day Fusion & Minimizing Risk**
  - Today there are ~300 spine companies "commoditizing the marketplace" 1000's of "me too" products
  - No R&D; declining margins; high inventory needs: **It's A Race To The Bottom!**
    - Focused on spine product sales, not on patient outcomes; NOT VALUE ADDED!
- **Hospitals Are Shifting The Local Market Power Dynamic**
  - Physicians increasingly becoming "hospital employees" & aligning with hospital economics
  - New products are being blocked out of the hospital through vendor consolidation, rep minimization, etc.
- **"Perceived" Regulatory & Reimbursement Hurdles Provide Excuses For Inertia**
  - Clinical trials not a industry core competency; uncertainty & unpredictability of FDA a deterrent to growth

It's Easy To Blame Someone Else…

But The Reality Is We Brought This On Ourselves…

So, Let's Dive Deeper

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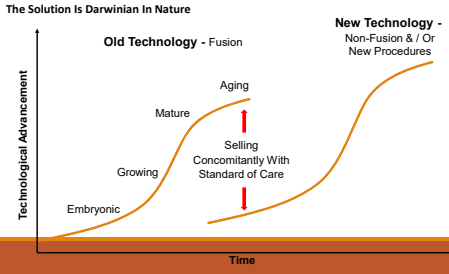
The Solution Is Darwinian In Nature



(Company or Industry) Re-Invention Is Messy & Ugly…
Darwin: Adapt & Evolve or Live The Extinction Event

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What is True Spine Stabilization Innovation??

Approaches
Invasivity
Indications
Materials
Biomechanics
Wear debris
Longevity
Industry has taken us down this pathway….
Regenerative Medicine – Stem cells, scaffolds, and biologics

Does Stabilization have to be Fusion?

Bob Mulholland, MD, FRCS Nottingham, England 2002 " Instability is best defined as ***painful loading of a segment***. As degeneration progresses, we increasingly load arthritic painful segments that create vertical and translational instability that we eventually can measure radiographically."

We Must Realize That Spine Needs Innovation

➢ Current Spine Technologies	➢ Invented
1. MIS Pedicle Screws	1. 1985 (F. Magerl)
2. Interspinous Fusion	2. 1960s (Wilson)
3. Stand-Alone Cages	3. 1987 (John Dove)
4. Facet Fusion	4. 1911 (Hibbs and Albee)
5. Plate Fixation System	5. 1970 (Roy-Camille)

"New Technology" Has Existed for 30-100 Years

STILL NOT THE "RIGHT" EVIDENCE!!!

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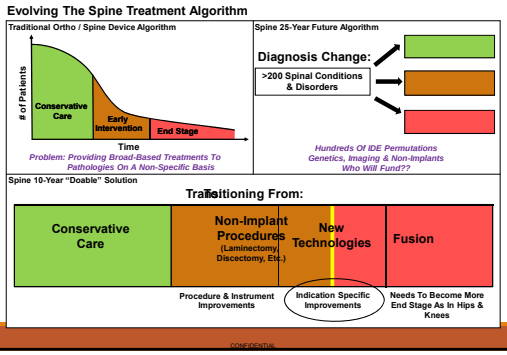
SPINE ARTHROPLASTY PMA ANALYSIS

	Product	Sponsor	IDE Year	PMA Year	# Yrs. to Approval
Lumbar					
2	activL®	Aesculap	2006	2015	9
1	ProDisc®-L	Synthes	2001	2006	5
3	CHARITÉ™	DePuy	1999	2004	5
Cervical					
1	PRESTIGE®LP (2-Level)	Medtronic	n/a	2016	-
2	PRESTIGE®LP	Medtronic	2004	2014	10
3	Mobi-C® (2-Level)	LDR Spine	2006	2013	7
4	Mobi-C®	LDR Spine	2006	2013	7
5	PCM	NuVasive	2004	2012	8
6	SECURE®-C	Globus	2005	2012	7
7	BRYAN®	Medtronic	2002	2009	7
8	ProDisc™-C	Synthes	2003	2007	4
9	PRESTIGE®C	Medtronic	2002	2007	5

Evolving The Spine Treatment Algorithm



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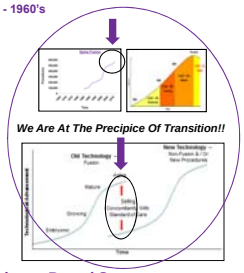
Treat 1st Generation Spine For What It Is

- **Total Hip Was A Failure….From The 1950's - 1960's**
  - **Today the market is ~$2.6 billion** (1)
  - **Bottom Line:** It takes time!!
- **A Truly Classic Example:**
  - **Total disc replacement - perception as market failure**
    - Charité® was a failure as a 1st generation:
      - Lack of reimbursement
      - Surgeon adoption – tough learning curve
    - ProDisc today is a success:
      - Lumbar & cervical ProDisc replacement is a $150mm - $200mm franchise
      - Sales force has product differentiation pulling through fusion
    - "Next-to-market" discs will drive growth!



We Are At The Precipice Of Transition!!

True Entrepreneurs & Evidence Based Surgeons Will Have Perseverance to Accelerate Market Transformation

(1) Orthopedic News Network

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Level 1 Evidence Is The True Judge

- **Current Spine Surgery Evidence Inadequate**

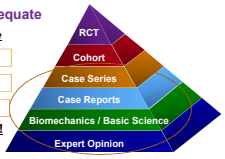
MEDCAC's 2006 Review of Spine Evidence

1,391 Articles Initially Reviewed

83 Articles Included in Tech Assessment

3 RCT Articles Considered by MEDCAC

1,388 total articles were deemed insufficient!
Still Not The "Right" Evidence!!



How Did The Market Evolve Like This?

- **Evidence Will Be Only Savior to Pricing & Sustained Market Growth**
  - Spine reimbursement coverage is at risk with every payor, thus inhibiting growth
  - Data, more rigor, more science & more independence needed to draw stronger conclusion
- **Companies That Present Evidence Will Create Value & Industry Growth**

A Market Without Level 1 Evidence Is No Longer Sustainable!

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The PMA Roulette!

In roulette, you have a 1 in 37, or 2.7% chance of winning….

In today's spine market, you have the same odds of receiving FDA PMA Approval of a new device

FDA Approval as a Medical Device

Yet, PMAs Are The Standard By Which All Is Measured!

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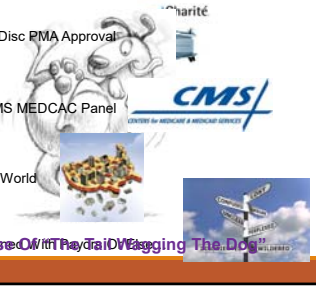
And We Haven't Even Talked About The Payors……!

Let's Think About Where We've Been & Where We're Going



2005: Charite Total Disc PMA Approval

2006: Landmark CMS MEDCAC Panel

2007: A Brave New World

2017: Better Be Aligned With Payor Drivers

Lastly Be Aware Of The Tail Wagging The Dog

Case In Point: The United Healthcare Pre-Authorization Form

SPINE SURGERY INFORMATION REQUEST FORM

WHY IS A PAYOR DOING THIS?

Lack Of "Right" Evidence Has A Price!

The True Evolution Of A Motion Preservation PMA Study

	2000	2010	2020
Primary Study Objective	Efficacy	Safety	Risk Benefit
Study Control(s)	1	1	2-3
# Of Patients	~200	~400	~800
Follow-Up Rate	75%	85-90%	Min. 90%
Monitoring Visits	100	400	~1,000
Health Economics Data	No	Yes	Yes
Independent CEC	No	Yes	Yes
Data Safety Monitoring Board	No	Yes	Yes
Estimated Costs	**~$15mm**	**~$50mm**	**~$100+mm**

Scientific Evolution Requires The Evolution Of Overall Study Execution!!

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FDA IDE Studies have:

- Taught us how to manage the scientific discipline required of multicenter Prospective Randomized Control Trials
- Given us solid science behind our choice of technology and of implants
- Given us scientifically valid long term outcome measures for clinical and radiographic success for both fusion and arthroplasty
- Allowed us to give better advice to our patients, and by extension, made us better doctors

Growth & Innovation In Spine:

Everyone Seems To Have An Opinion & A Voice…

Deliver The "Right" Evidence

The Payors Will Pay…

Growth Will Be Re-Initiated

A Lot Of Noise, But The Message Is Clear…

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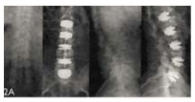


Next Generation Disc Simplify Medical Simplify Disc

The Future of Cervical Arthroplasty – A Metal-Free Solution – Not Sold In the USA, Currently Under FDA IDE Trial

Simplify is an MRI compatible, motion preserving, artificial cervical disc that can be used to treat single level Symptomatic Cervical Disc Disease (SCDD) from levels C3-C7 in selected patients. *Simplify Disc currently enrolling in FDA IDE Trial*

Simplify Design Rationale

Designed For Ease of Patient Imaging with MRI-Compatible Materials

Traditional cervical disc implants are made of metal alloys, which require CT scans to evaluate tissue adjacent to the artificial disc. Simplify™ Disc is composed of MRI-compatible materials, so CT scans of the cervical spine and their resulting radiation exposure are not required

Lower Disc Height Options

Simplify Disc has disc heights ranging from 4mm, 5mm & 6mm to more closely match patients' disc heights. This may produce clinical results which could potentially benefit patients with smaller anatomies.

Simplify Conforms to Patient Anatomy and articulates with a semi-constrained core

Maximum range of anatomic motion:
+/- 12° flexion/extension
+/- 12° lateral bending
Unconstrained in rotation
Heights: 4mm, 5mm, 6mm
Footprints: 15x12mm, 15x14mm, 18x16mm

Simplify Description

* Simplify is comprised of advanced medical polymer endplates and a mobile ceramic core
* Bony integration promoted with a porous Ti endplate coating
* Concave articulating endplate surfaces with retention rails
* Semi-constrained, fully articulating, self-centering biconvex mobile ceramic core.

Simplify is the ONLY cervical artificial disc composed primarily of MRI compatible materials featuring two PEEK endplates articulating on a ceramic core.

Next Generation Disc Simplify Disc Simplify Medical

Simplify MRI Imaging

An MRI Friendly Solution

Simplify is comprised of PEEK, an advanced polymer, and a medically proven ceramic. These durable materials are MRI friendly and designed to enable use of non-radiation-producing imaging that is less invasive than the widely used CT/ Myelogram. This reduces ionizing radiation exposure to patients.

Pre-operative cervical MRI with no Spinal implant.

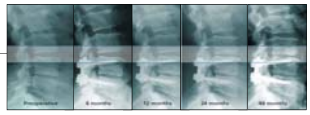
Conventional cervical disc with metallic interference in MRI.

Simplify MRI Image

Future of Spine Stabilization?

Lumbar arthroplasty? Index and adjacent level motion is maintained

Long Term Comparison of coflex® & Single level Fusion from the FDA IDE Study



- Maintenance of Foraminal height demonstrates coflex® supports the direct decompression
- Range of Motion preserved in both index and adjacent levels at 5 Years.
- Allows for faster pain relief (i.e., statistically significant ODI improvement) (at 6 weeks)
- 86% of coflex® patients experienced a clinically significant improvement in ODI scores at 5 years.
- 65% of Superion® patients had ODI success at 2 years

- Increased hypermobility in the adjacent segment as early as 24 months.
- Revision & reoperation rates of adjacent segments reported as early as 24 months
- 72% of fusion patients experienced a clinically significant improvement in ODI scores at 5 years.

RANDOMIZED TRIAL

SPINE Volume 40, Number 5, pp 275-282
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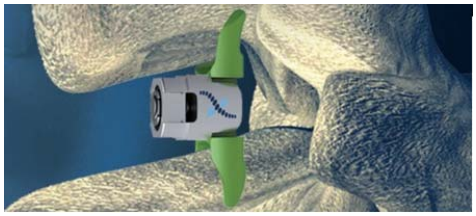
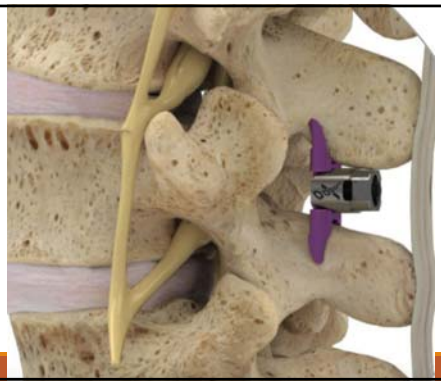
Superion Interspinous Process Spacer for Intermittent Neurogenic Claudication Secondary to Moderate
Lumbar Spinal Stenosis

Two-Year Results From a Randomized Controlled FDA-IDE Pivotal Trial

Vikas V. Patel, MD,* Peter G. Whang, MD,† Thomas R. Haley, DO,‡ W. Daniel Bradley, MD,§ Pierce D. Nunley, MD,¶ Raphael P. Davis, MD,/ Larry E. Miller, PhD,**†† Jon E. Block, PhD,†† and
Fred H. Geisler, MD, PhD‡‡



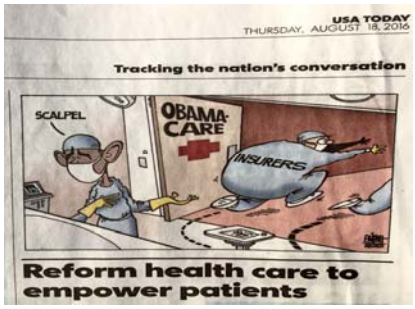


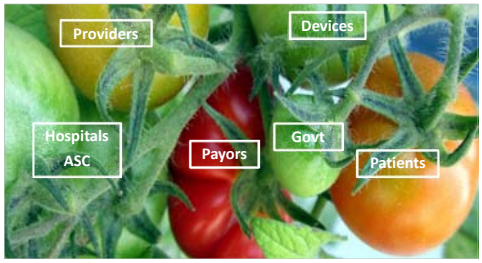
PREMIER®
Stem Cell Institute

Kenneth A Pettine M.D.
Tyler J Santomaso, BSc

Stem cell Research

Treatment of Multi-level Discogenic Low Back Pain with Bone Marrow Concentrate





- *Aligning Value Driven Stakeholders to Accomplish Real Healthcare Reform*

Patient Centered Healthcare

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Thank You