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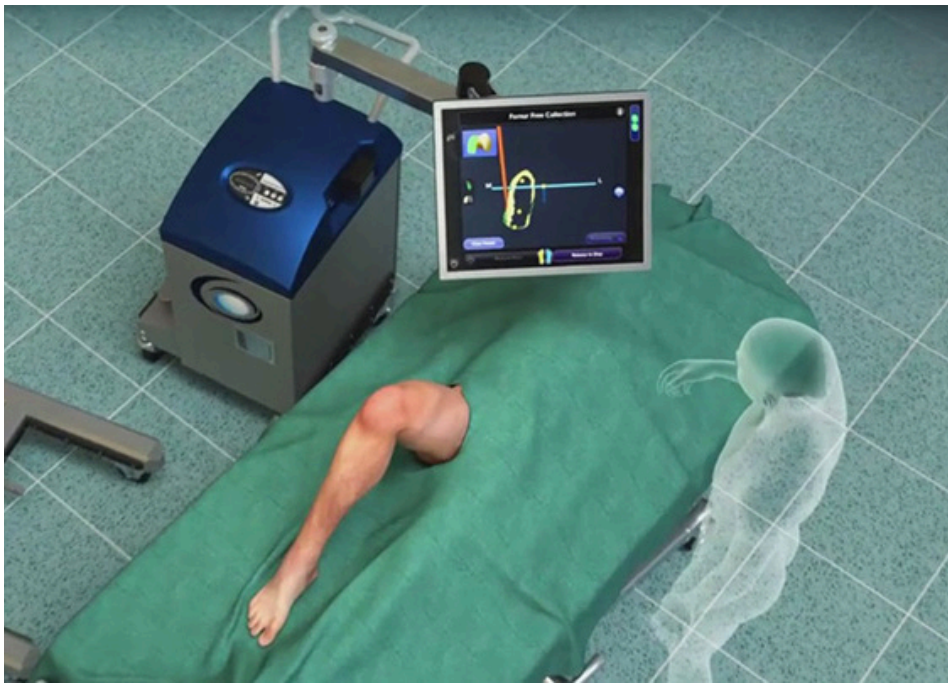
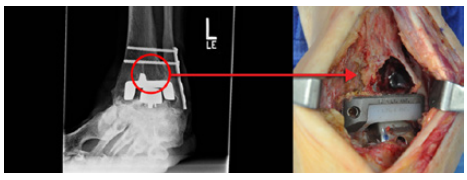
Orthopedics This Week

WEEK IN REVIEW





BREAKING NEWS

For all news that is ortho, read on.

Orthopedic Power Rankings

Robin Young's Entirely Subjective Ordering of Public Orthopedic Companies

THIS WEEK: Third quarter earnings for every sector EXCEPT orthopedics are the worst in four years. For Q3 2015 the blended earnings change for ALL sectors is (2.2%). Thirty-nine sectors had negative earnings guidance while only 17 had positive. Only nine sectors reported higher earnings growth rates and one sector led them all—Health care. Health care led ALL sectors with the biggest earnings upside surprises. And leading the way are ZBH, SYK, MDT, JNJ, GMED, OFIX, IART, EXAC, SNN and NUVA.

RANK	LAST WEEK	COMPANY	TTM OP MARGIN	30-DAY PRICE CHANGE	COMMENT
1	1	Zimmer Biomet	31.22%	11.33%	Zimmer shocked Wall Street with much stronger than expected earnings with $22 million in Q3.
2	2	Stryker	22.94	1.62	Stryker also beat Wall Street's earnings estimates for Q3. Sales, however, SYK came in below expectations—which was also consistent across the major ortho companies.
3	5	Medtronic	27.92	10.43	MDT's fiscal year is different from other health care companies, but the rising tide lifted this boat as well.
4	3	Johnson & Johnson	28.44	8.23	JNJ added $23 billion in market value in the last 30 days—which reflects a flight to health care from other sectors whose earnings are disappointing.
5	10	Globus Medical	30.19	8.18	GMED reports this week and the consensus of analysts is that investors will see a slight earnings increase on an 8% rise in sales.
6	7	Orthofix	2.35	0.89	OFIX also reports this week and the consensus of analysts is that OFIX will report slightly down earnings on sales that will be down 4% from last year.
7	8	Integra LifeSciences	13.74	0.03	IART joins GMED and OFIX releasing earnings this week. Analysts are expecting IART to report rising profit margins for Q3.
8	4	Exactech	10.26	(2.29)	EXAC reported flat sales and a slight pull back (4%) in earnings for Q3. Highlight: Extremity sales up 7%. Lowlight: Knee sales down 16%.
9	6	Smith & Nephew	20.19	(2.51)	SNN makes a big bet on large joint robotics with the $275mm purchase of Blue Belt Technologies.
10	NR	NuVasive	13.25	(2.20)	Huge earnings surprise for the 3rd quarter—289% jump in earnings to $0.35/share. Sales up 5.6%.

Robin Young's Orthopedic Universe

TOP PERFORMERS LAST 30 DAYS

	COMPANY	SYMBOL	PRICE	MKT CAP	30-DAY CHG
1	Zimmer Biomet	ZBH	104.57	$21,266	11.33%
2	Medtronic	MDT	73.92	$104,494	10.43%
3	CryoLife	CRY	10.54	$300	8.32%
4	Johnson & Johnson	JNJ	101.03	$279,544	8.23%
5	Globus Medical	GMED	22.35	$2,125	8.18%
6	Alphatec Holdings	ATEC	0.35	$35	6.06%
7	MicroPort Scientific	853	0.42	$596	5.54%
8	Stryker	SYK	95.62	$35,907	1.62%
9	Orthofix	OFIX	34.05	$642	0.89%
10	Integra LifeSciences	IART	59.57	$2,172	0.03%

WORST PERFORMERS LAST 30 DAYS

	COMPANY	SYMBOL	PRICE	MKT CAP	30-DAY CHG
1	LDR Holding Corp.	LDRH	25.30	$733	-26.73%
2	RTI Biologics Inc	RTIX	4.21	$243	-25.97%
3	MiMedx Group	MDXG	7.28	$793	-24.56%
4	ConMed	CNMD	40.56	$1,124	-15.04%
5	TiGenix	TIG.BR	0.97	$163	-10.61%
6	SeaSpine Hldgs Corp.	SPNE	15.08	$168	-6.91%
7	Wright Med Grp N.V	WMGI	19.33	$2,010	-5.20%
8	Aurora Spine	ASG	0.19	$5	-5.13%
9	Xtant Medical Hldgs	XTNT	3.15	$37	-3.37%
10	Smith & Nephew	SNN	34.12	$15,268	-2.51%

LOWEST PRICE / EARNINGS RATIO (TTM)

	COMPANY	SYMBOL	PRICE	MKT CAP	P/E
1	Exactech	EXAC	17.03	$239	15.34
2	Globus Medical	GMED	22.35	$2,125	17.20
3	Johnson & Johnson	JNJ	101.03	$279,544	17.66
4	Zimmer Biomet	ZBH	104.57	$21,266	19.91
5	Stryker	SYK	95.62	$35,907	20.75

HIGHEST PRICE / EARNINGS RATIO (TTM)

	COMPANY	SYMBOL	PRICE	MKT CAP	P/E
1	CryoLife	CRY	10.54	$300	69.16
2	NuVasive	NUVA	47.16	$2,315	54.14
3	MiMedx Group	MDXG	7.28	$793	40.44
4	Smith & Nephew	SNN	34.12	$15,268	30.47
5	Integra LifeSciences	IART	59.57	$2,172	24.95

LOWEST P/E TO GROWTH RATIO (EARNINGS ESTIMATES)

	COMPANY	SYMBOL	PRICE	MKT CAP	PEG
1	RTI Biologics Inc	RTIX	4.21	$243	1.42
2	Globus Medical	GMED	22.35	$2,125	1.51
3	ConMed	CNMD	40.56	$1,124	1.63
4	Exactech	EXAC	17.03	$239	1.72
5	Zimmer Biomet	ZBH	104.57	$21,266	1.88

HIGHEST P/E TO GROWTH RATIO (EARNINGS ESTIMATES)

	COMPANY	SYMBOL	PRICE	MKT CAP	PEG
1	Medtronic	MDT	73.92	$104,494	3.60
2	Johnson & Johnson	JNJ	101.03	$279,544	3.56
3	NuVasive	NUVA	47.16	$2,315	3.54
4	MiMedx Group	MDXG	7.28	$793	2.70
5	Integra LifeSciences	IART	59.57	$2,172	2.42

LOWEST PRICE TO SALES RATIO (TTM)

	COMPANY	SYMBOL	PRICE	MKT CAP	PSR
1	Alphatec Holdings	ATEC	0.35	$35	0.17
2	RTI Biologics Inc	RTIX	4.21	$243	0.92
3	Exactech	EXAC	17.03	$239	0.96
4	Xtant Medical Hldgs	XTNT	3.15	$37	1.05
5	SeaSpine Hldgs Corp.	SPNE	15.08	$168	1.21

HIGHEST PRICE TO SALES RATIO (TTM)

	COMPANY	SYMBOL	PRICE	MKT CAP	PSR
1	TiGenix	TIG.BR	0.97	$163	25.94
2	MiMedx Group	MDXG	7.28	$793	6.71
3	Wright Med Grp N.V	WMGI	19.33	$2,010	5.83
4	Medtronic	MDT	73.92	$104,494	5.16
5	LDR Holding Corp.	LDRH	25.30	$733	4.91

PSR: Aggregate current market capitalization divided by aggregate sales and the calculation excluded the companies for which sales figures are not available.

Smith & Nephew Bets $275 Million on Robotics

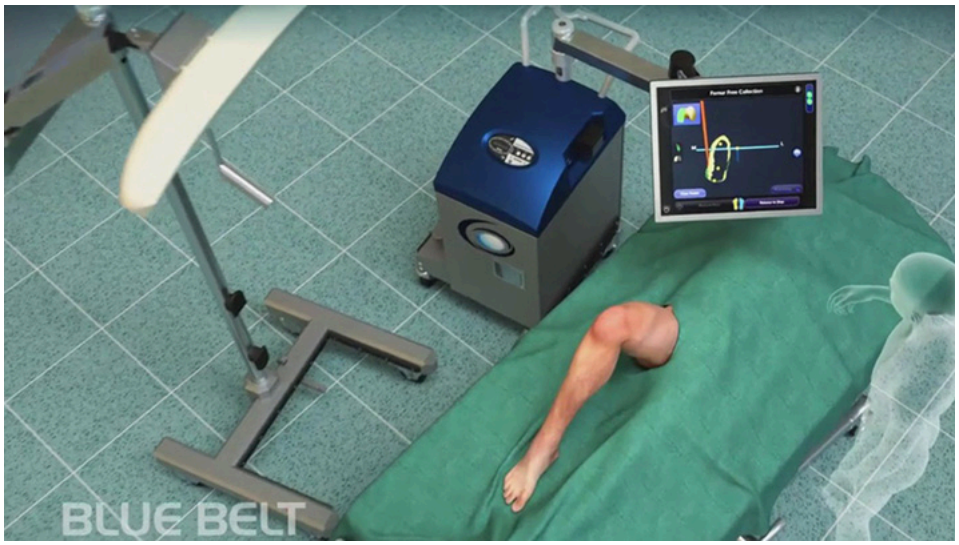
BY ROBIN YOUNG

On October 29, Smith & Nephew, the venerable 159-year-old supplier of orthopedic implants and instruments, agreed to plunk down $275 million to buy one of the fastest growing young robotics companies in medicine—12-year-old Blue Belt Holdings, Inc.

In the last 12 months Blue Belt has sold 40 of its Navio systems and close to 2,000 partial knee replacement surgeries have been performed using the Navio.

Two years ago (November 2013) Stryker Corporation bought MAKO Surgical, the largest and most successful supplier of robotic devices for orthopedic surgery, for $1.65 billion.

Smith & Nephew paid slightly more to acquire Blue Belt (14x sales) than Stryker did to buy MAKO (13x) but Stryker's commitment (6% of its market capitalization) was larger.



Courtesy of Blue Belt Holdings, Inc.

$ in Millions	Blue Belt Holdings	MAKO Surgical
Annual Revenues at Time of Purchase	**$19**	**$125**
Purchase Price	$275	$1,650
Purchase Price / Annual Revenues	14x	13x
% of Buyer's Market Value Paid	2%	6%

Source: Public documents and RRY Publications

Robotics – Transforming Orthopedics

The Harvard Business Review called surgical robots one of "10 Innovations That Will Transform Medicine." In 2012, Global Analysts, Inc. predicted that worldwide demand for service robots (which includes medical) would eventually reach $38.42 billion. Now two major orthopedic companies—Stryker and Smith & Nephew—have put a collective $2 billion bet on robots.

Douglas Padgett, M.D., chief of Adult Reconstruction for Hospital for Special Surgery in New York, uses robotic assist devices and says; "Surgical navigation is not enough [of a benefit]. These robotic assist systems improve both the precision and the accuracy of each case which reduces, for example, problems associated with poor socket placement. With the system any surgeon can improve the accuracy of their bone preparation as well as the precision of their implant delivery."

Robotics, as a tool to standardize precision in surgery, are a very big deal.

50% of all Hip Procedures Imprecise

In a study of 2,061 total hip revisions, researchers found that 50% of the acetabular cups were outside the optimal range in terms of both version and abduction. The study, which won the John Charnley Award, and published in the journal *Clinical Orthopedics and Related Research* (Orthop Relat Res. 2011 Feb;469(2):319-29), looked at postoperative AP pelvis and cross-table lateral radiographs on patient who received a total hip arthroplasty or hip resurfacing from 2004-2008.

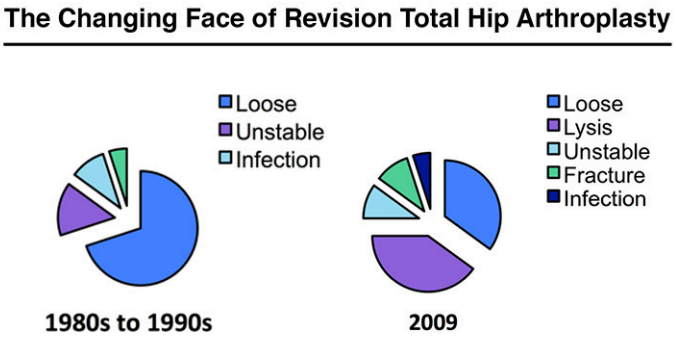
From 1,823 hips, 1,144 (63%) of the acetabular cups were within the abduc-

tion range (defined as movement of a limb toward the midline or axis of the body) and 1,441 (79%) were within the version range (defined as the tipping angle of the joint) but ONLY 917 (50%) were within the range for both.

Why so poor? The authors (Callanan MC, Jarrett B, Bragdon CR, Zurakowski D, Rubash HE, Freiberg AA, Malchau H.) said that surgical approach, surgeon volume and obesity independently predicted mal-positioned cups.

Surgical-assist tools like Blue Belt's Navio or MAKO's Rio address two of the three factors which, according to the study, affect malpositioned cups.

Approximately 280,000 total hip replacement procedures are performed in the U.S. annually. That number implies that between 2004 and 2008 (the study period) roughly 700,000 patients received mal-positioned artificial hips and are at risk for instability, lysis and revision surgery.



Source: Dr. Douglas E. Padgett, Hospital for Special Surgery, NY, NY

The Consequences of Mal-Positioning

Mal-positioned knee or hip components are by far the most common cause of poor outcomes and revision surgeries. In the case of hips, two bad things happen when the cup or stem is mal-positioned: the ball starts to rattle around inside cup and may come out entirely (instability) or the two components start rubbing together unnaturally and tiny particles of either component break off and cause inflammation (lysis).

In the last 10 years instability and lysis have become the dominant causes of hip failure.

And the cost of correcting or living with mal-positioned knees or hips is, conservatively, billions of dollars. By contrast, the cost of pursuing perfection using surgical robots may well be just hundreds of millions of dollars.

Robotics: Medicare's Friend

In July 2015 Medicare introduced a revolutionary five-year bundled payment model, called the "Comprehensive Care for Joint Replacement (CCJR) Program" which will pay 750 hospitals in 75 geographic areas a lump sum for each hip and knee replacement episode starting from hospital admission to 90 days after discharge. At the end of a year, those hospitals will have a chance to earn more money or have some of their payments clawed back by Medicare, depending on patient outcomes.

In September 2015 the 500,000 member Colorado Public Employees Retirement Association offered its members the opportunity to receive their hip or knee replacements for a fixed cost, all in.

Robotics, it seems, may become one of the tools that will help hospitals to participate in the coming flat fee, bundled care large joint future.

Robotic assisted surgery addresses the 82% of the cost of knee or hip reconstructive surgery that is non-implant related. These are the surgeon, anesthesia, nurses, rehab and poor outcomes or revision costs.

Small gains—like fewer errors, more consistent outcomes, less blood loss, more efficient surgeries—can have a huge effect on overall costs.

Not surprisingly, surgical robots have had the greatest acceptance in the most technically challenging procedures like neurosurgery (first used in the 1980s), oral and maxillofacial surgery (extremely tight tolerances), laparoscopic abdominal or gynecological surgery, cardiac surgery and uni-knee replacement procedures.

How Do Surgical Assist Devices (Robots) Work?

Surgical robots use computer technology to accomplish two things—improve pre-surgery planning and, in collaboration with the surgeon, perform a more accurate and precise surgery which, in turn, improves long term outcomes.

The whole process starts with an accurate model of the patient's anatomy. A typical system creates a 3D dimensional data set which is an exact geometrical map of normal and pathological tissues and structures at the operative site. Typically, CT is preferred. MRI data sets can have volumetric deformations.

Then these systems analyze and process the image data. One trick programmers have built into these systems is to color contrast different anatomical levels so that hard structures like bone are easy to distinguish from soft tissues like cartilage or arteries and veins.

Using the virtual 3D anatomical model, surgeons refine their diagnosis and simulate the upcoming surgery. When all surgical planning is done, the robot then uses that data to program preplanned actions during actual surgery.

During surgery, the robot (or surgical assist device) uses these programmed images and surgeon-generated datasets to direct the actual surgery.

There are three basic types of surgical robots:

1. **Supervisory controlled** – robot executes a series of pre-programmed actions and actually performs the surgery.
2. **Telesurgical** – also known as remote surgery, the surgeon manipulates the robotic arms during the procedure.
3. **Shared-control** – the surgeon performs the surgery and the robot uses the pre-programmed information to provide steady-hand manipulations of the instrument.

Both Blue Belt and MAKO's systems are shared-control systems. The surgeon directs the cuts and burrs, but the robot makes sure that every move is precise according to the patient's own anatomy.

Economic Rationale

The #1 hurdle to adoption for any robotic assist system is cost. MAKO's systems run about $1 million with an annual fee of about $100,000. Blue Belt's systems cost about $400,000 with an annual fee of about $40,000.

So, what is the economic rationale for these systems? There are three basic arguments:

1. The cost of precision must be less than the cost of imprecision.
2. The robot must deliver consistently excellent outcomes.
3. The robot must be a platform technology that can be employed for multiple indications. After it is fired up at 6am, it must be able to be used continuously until the last patient is wheeled into recovery. In a medium size orthopedic practice this probably means a platform for knee, hip, shoulder, elbow, hand or any other surgery so that the cost will be amortized over the maximum number of surgeries. In a high volume large joint practice, it means knees and hips.

Wall Street's Take

Two billion dollars is a lot to pay for these two young firms—12-year-old Blue Belt or 9-year-old MAKO.

But surgical robotics companies operate in a different Wall Street universe than implant suppliers.

Intuitive Surgical, Inc., the pioneer for surgical robotic assist systems and supplier of the da Vinci Surgical System robot is now 20 years old and Wall Street's investors have afforded the company a $18.64 billion market value.

Investors think Intuitive's sales are worth about $8 for every $1 generated. By contrast, investors think that Smith & Nephew's sales are worth $3 for every $1 generated and Stryker's sales are worth about $4 for every $1 generated.

Wall Street puts a much higher value on surgical robotics than on implant suppliers.

How Will Blue Belt and Smith & Nephew Do?

In its SEC filings, Smith & Nephew said "We expect annual revenue growth at Blue Belt Technologies to be in excess of 50% over the medium-term from a 2015 base of approximately $19 million. Investment in the combined R&D programmes and supportive clinical evidence will dilute Group trading profit margin by around 60bps in 2016, with the business becoming profitable in 2018. Return on capital employed is expected to exceed our weighted average cost of capital in year four."

In addition, Smith & Nephew plans to roll out the Navio robotics system for its JOURNEY UNI partial knee and the recently acquired ZUK uni knee.

In 2017, SNN hopes to be able to launch a total knee Navio system to support the JOURNEY II as well as SNN revision knee systems and the JOURNEY II XR bi-cruciate retaining knee arthroplasty system.

Last week Stryker reported its results for the first six months of 2015 and MAKO, which it had purchased about two years ago, announced that it had placed 13 robots in the second quarter, up from 9 in the first quarter.

If Stryker's experience is any clue, Smith and Nephew should do well with Blue Belt.

Robotic assisted surgery is well on its way to becoming part of the orthopedic standard of care. ♦

How's That Binge Buying of Surgeon Practices Going?

BY WALTER EISNER

Hospitals have been bingeing on snatching up physician practices and ambulatory surgical centers. Insurers are consolidating and some are acquiring healthcare systems. All of them want to capture "patients" and control costs through streamlined purchasing strategies and standardizing care.

Uncle Sam is dumping fee-for-service and replacing payments to hospitals through a pay-for-performance system which is supposed to reward providers who can figure out how to reduce the costs of treating patients while maintaining quality metrics.

"Get bigger. Capture the Bundle," said Dick Rothman, M.D., the founder of the Rothman Institute, to his orthopedic colleagues at an annual meeting of the American Academy of Orthopaedic Surgeons.

In the middle sits the surgeon who is the only player in the healthcare system sworn to act in the best interest of the patient.

Hospital Employed Physicians

Some orthopedic surgeons are okay becoming employees of hospitals and accepting the rules of standardized care developed by their peers. Some are leading efforts through organizations like National Orthopaedic & Spine Alliance (NOSA) where physicians control the clinical standards and assume financial risk. Some don't like it and believe focusing on cost savings will compromise their clinical options and potentially harm their patients.

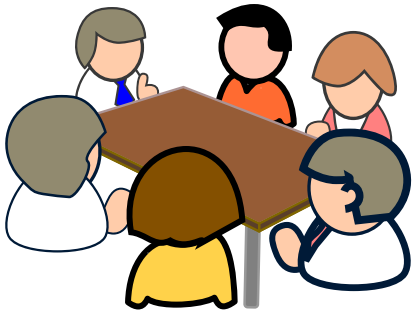


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Photo creation by RRY Publications, LLC

Orthopedic Surgeon's Whistleblower Suit

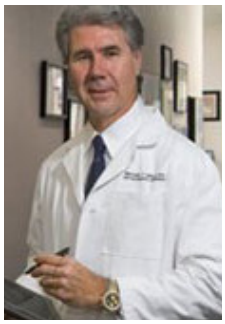
Ray Horwood, M.D., the orthopedic surgeon who recently left the Cleveland Clinic's Fairview Hospital over the clinic's decision to limit the number of orthopedic device vendors at their facility and standardize surgical procedures, is one of those surgeons.

But he's not the only one.

Another orthopedic surgeon, Michael Reilly, M.D., of Fort Lauderdale, Florida, thinks it's a bad idea for physicians, patients or society when hospitals buy up physician practices. He felt so strongly about it that he filed a whistleblower lawsuits against North Broward Hospital District in 2010 accusing the publicly owned hospital of violating the False Claim Act by engaging in improper financial relationships with physicians. The whistleblower complaint was unsealed last month.

On Tuesday, September 15, 2015, the hospital system agreed to pay the U.S. $69.5 million to settle the allegations. Reilly will receive over $12 million from the settlement.

Reilly's lawsuit claimed that the hospital hired community doctors, paid them millions of dollars and tracked the revenue generated from the admissions, procedures and tests generated by those doctors. He says the hospital's CEO told him, "We are making money off these guys.



Michael T. Reilly, M.D.; browardorthopedic.com

Reilly claims the hospital's system carefully tracked the return on their investment of the

doctors, recording the value of referrals and pressuring them to increase volume if they lagged.

Stark and False Claims Challenges

The government said the hospital provided compensation to nine employed physicians that exceeded the fair market value of their services and, therefore, violated that Stark Statute and the False Claims Act.

According to Reilly's lawsuit, over a decade ago, Broward started hiring some orthopedists and cardiologists for more than $1 million per year. He says the hospital paid Erol Yoldas, M.D., the team doctor for the Florida Marlins, nearly $1.6 million in 2009. The hospital also agreed to pay senior executives large bonuses if they increased revenue and the bottom line.

Reilly's lawyer told him that the deal the hospital offered him was illegal, so he rejected it.

Physicians on staff feel compelled to generate ordering procedures and use a particular brand of orthopedic device. By staying independent, Reilly said if he had concerns about the hospital's radiology department, which he claims some doctors did, he could refer people to a different facility.

But that freedom can go away if you are an employee and raises the odds that a patient will end up at a higher-cost, lower-quality facility, according to a recent study from Stanford University researchers cited by Reilly.

"My wish would be that the hospital-physician employee contract would go away," said Reilly in an interview. "You could pick just about any hospital, and I will tell you there is a component where that contract is driven by referrals."

Reilly told *Kaiser Health News* in an October 7, 2015 article that he worries that these types of arrangements between hospitals and physicians will keep occurring. "We have got to get hospitals out of the business of hiring doctors," he said in an interview. "It's potentially detrimental to the patient, and it's terrible for health care."

"Doc Binge Buying Rolls On"

But the trend is continuing as a June headline in *Modern Healthcare* stated, "*Doc Binge Buying Rolls On.*" According to the American Medical Association, a third of doctors now work directly for hospitals or for practices with at least partial hospital ownership.

According to the story, hospital purchases of physician practices in the 1990s led to losses and an unwinding of many deals. But this time around the hospitals appear to have found a way to absorb the cost of employing physicians. One reason given for this is the influx of paying patients from reforms in the Affordable Care Act. Efficiencies associated with hospital consolidation and an improving economy have also contributed to this "binge" buying of practices.

Modern Healthcare's Annual Systems Survey, which this year included responses from about 80 health systems across the country, found that despite the increased costs that come with having physicians on staff, physician employment increased 3.8% between 2013 and 2014.

Hospital system officials say they are becoming more selective about which specialists they hire and looking more closely at compensation models and how the new physicians are integrated into their system.

While the hiring of high-priced surgeons gets attention, the real prize is primary-care physicians. They are the backbone of referrals to hospitals. For example, Spectrum Health in Grand Rapids, Michigan, had a 40-member primary-care group just six years ago. Now the number of employed physicians has swelled to 668, including a 10% bump since 2013, according to the Modern Healthcare report.

Bob Collins, managing partner at The Medicus Firm, a physician recruitment agency said, "There's an arms race for primary-care providers. By far, that's where there's the greatest angst and need."

"But surgeons are also in demand, particularly in the subspecialties of cardiothoracic and neurosurgery. "It's all about fulfilling a broader service line in the community," said Mark Folk, a healthcare attorney at Waller Lansden Dortch & Davis.

The Prize

And the investments in physician employees appear to be paying off.

The average revenue increase from buying physician practices as reported by *Modern Healthcare* was 10.2%. The average operating margin in 2014 rose to 3.3% among systems in the survey's financial database, an increase from 2.5% the previous year. That's because large systems are able to spread out their fixed costs such as health information technology. In other words, Big Data to drive clinical practice standardization.

What About Pay-for-Performance?

In theory, moving away from fee-for-service (volume) payment models to

pay-for-performance (quality) was supposed to create a more value-based care delivery model.

But that's not what's necessarily happening in some systems where labor costs account for more than half of revenue and systems are trying to manage expenses. Compensation still largely follows productivity-based formulas, despite moves toward value-based care delivery models, said Travis Singleton, senior vice president at Merritt Hawkins.

The physician recruitment firm actually has seen a move away from value-based payment incentives. Only 24% of its assignments feature bonuses linked to quality or value metrics, down from 39% the previous year. "As much as we want to believe our system is moving to outcomes, by and large, our system is based on volume," Singleton said.

Provider as Payer

Beyond buying up physician practices to capture more patients, some health systems are taking another route. They're deciding to become insurers themselves.

Those systems are watching the consolidation in the insurance industry and see a threat. Consolidation could drive up premiums and limit choices for patients. Frank Williams, the CEO of Evolent Health Inc., told *Modern Healthcare* that providers are starting to realize they need to control their own destiny.

"It certainly is going to give providers reason to be nervous about sitting across the table from a payer that is going to use that size and scale in their negotiations," said Steven Glass, the chief financial officer of the Cleveland Clinic. Cleveland Clinic hasn't made a decision yet about starting its own insurance plan, but is keeping the option on the table, Glass said.

Health systems getting into the insurance game is not a new concept, large systems like Kaiser Permanente in California and Geisinger in Pennsylvania have been doing it for decades. But the Affordable Care Act has made it easier for local hospitals to offer plans under the private health insurance exchanges. It's also easier for them to buy up rehabilitation and skilled nursing facilities to give them a broader network of services.

For-profit hospital operator, Tenet Healthcare Corp. operates six health plans with about 100,000 members. Tenet entered the business two years ago when it acquired Vanguard Health Systems.

A new health plan should aim for an enrollment of at least 100,000 to spread the risk, said Ray Herschman, president of xG Health Solutions, a Geisinger spinoff launched two years ago to help other hospitals develop insurance plans.

In a December survey of 45 large healthcare systems by Advisory Board Company, one-third said they already offered an insurance plan. Among the remaining respondents, three-quarters said they had either made the decision to start an insurance plan in the next three years or were considering it.

So the buying binge of physicians continues because hospitals need a large enough network of doctors to attract consumers to their facilities and health plans. In the meantime, surgeons have to continue to act in the best interest of their patients. As demonstrated by Drs. Horwood and Reilly, what's best for the patient is still open for debate. ♦

16 Reasons Surgeons Are Conservatives

BY WALTER EISNER

Neurosurgeon Ben Carson, one of the leading candidates for President, is also one of the most conservative candidates. But among his surgeon colleagues, Dr. Carson is pretty main stream.

Why are surgeons seemingly more conservative than their general medicine colleagues? Is there something about a "liberal" or "conservative" mind that causes medical students to self-select towards particular areas of medicine?

The web site *ProCon.org* found 16 peer-reviewed studies which seem to show that liberals and conservatives have different brain structures, different physiological responses to stimuli, and activate different neural mechanisms when confronted with similar situations.

Other studies measuring campaign contributions from physicians point to demographics. There are more females than males choosing, for example, general medicine and women contribute more to liberal politicians. Second, physicians in the for-profit healthcare world are more conservative than employee surgeons in not-for-profit healthcare systems.

So, here are the 16 differences between conservative and liberals that emerged from these studies as described by *ProCon.org*.

1. Conservatives spend more time looking at unpleasant images while liberals spend more time looking at pleasant images.

One study found evidence that individual-level variation in people's physiological and attentional responses to aversive (unpleasant) and appetitive (pleasing) stimuli are correlated with broad political orientations. Specifically, it found that greater orientation to aversive stimuli tends to be associated with conservatives and greater orientation to appetitive stimuli with liberal inclinations.

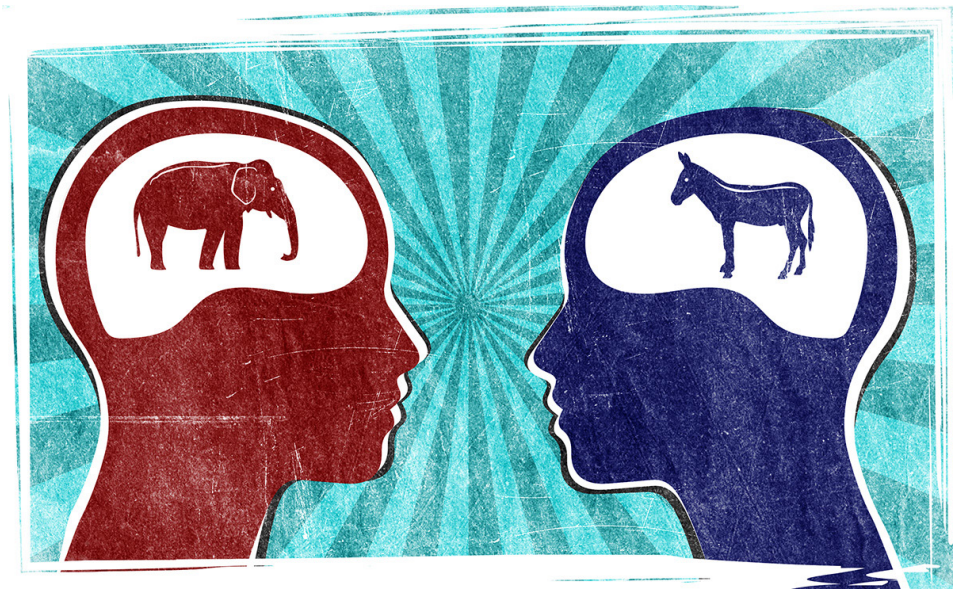


Photo creation by RRY Publications, LLC

2. Reliance on quick, efficient, and "low effort" thought processes yielded conservative ideologies, while effortful and deliberate reasoning yielded liberal ideologies.

When effortful, deliberate responding is disrupted or disengaged, thought processes become quick and efficient; these conditions promote conservative ideology… "Low-effort thought might promote political conservatism because its concepts are easier to process, and processing fluency increases attitude endorsement."

3. People who react strongly to disgusting images are more likely to self-identify as conservative.

"People who believe they would be bothered by a range of hypothetical disgusting situations display an increased likelihood of displaying right-of-center rather than left-of-center political orientations… Individuals with marked involuntary physiological responses to disgusting images [measured by change in mean skin conductance]…

Courtesy of Wikimedia Commons and Michael Vadon

are more likely to self-identify as conservative and, especially, to oppose gay marriage than are individuals with more muted physiological responses to the same images."

4. Liberals have more tolerance to uncertainty (bigger anterior cingulate cortex), and conservatives have more sensitivity to fear (bigger right amygdala).

Using structural MRI (magnetic resonance imaging), researchers found that greater liberalism was associated with increased gray matter volume in the anterior cingulate cortex (ACC), whereas greater conservatism was associated with increased volume of the right amygdala...

The amygdala is where we process fear. The bigger the amygdala the more sensitivity to fear, which suggests that individuals with larger amygdala are more inclined to integrate conservative views into their belief systems. The anterior cingulate cortex is where we monitor uncertainty and conflicts.

Thus it is conceivable that individuals with a larger ACC have a higher capacity to tolerate uncertainty and conflicts, allowing them to accept more liberal views.

5. Conservatives have stronger motivations than liberals to preserve purity and cleanliness.

"Reminders of physical purity influence specific moral judgments regarding behaviors in the sexual domain as well as broad political attitudes. Environmental reminders of physical cleanliness shifted participants' attitudes toward the conservative end of the political spectrum and altered their specific attitudes toward various moral acts.

2016 Republican Clown Car Parade / Courtesy of DonkeyHotey

Conservatives show a stronger tendency to feel disgust and find specific violations of sexual purity more offensive... When taken together, these two sets of results point to the possibility that political orientation may be, in some measure, shaped by the strength of an individual's motivation to avoid physical contamination and that resulting vigilance for threats to purity may serve to reinforce a politically conservative stance toward the world."

6. Liberals are more likely than conservatives to shift their attention in the direction of another person's gaze.

Conservatives tend to be more supportive of individualism and less likely to be influenced by others. Researchers found "standard gaze cuing effects across all subjects, but systematic differences in these effects by political temperament. Liberals exhibit a very large gaze cuing effect while conservatives show no such effect at various SOAs [stimulus onset asynchrony]…"

7. Republicans are more likely than Democrats to interpret faces as threatening and expressing dominant emotions, while Democrats show greater emotional distress and lower life satisfaction.

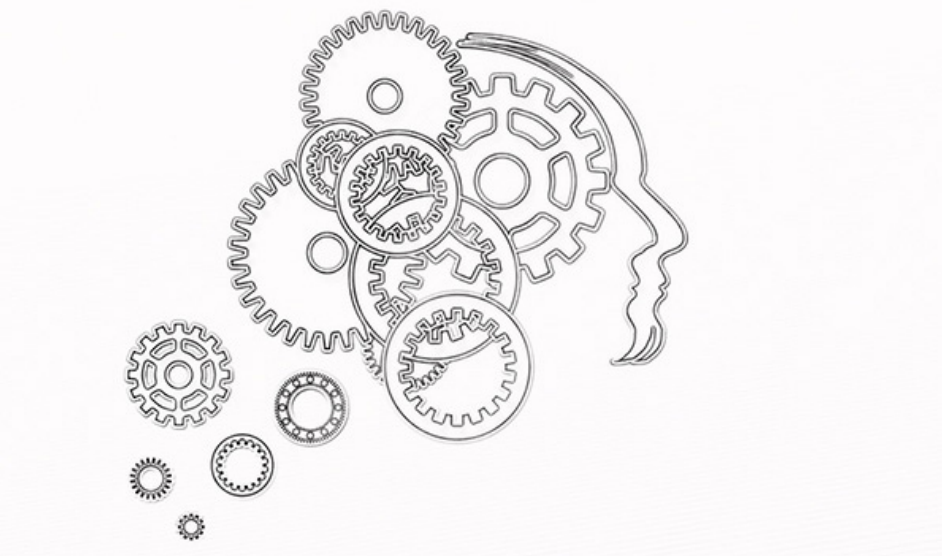
Republican sympathizers were more likely to interpret the faces as signaling a threatening expression as compared to Democrat sympathizers. Republican sympathizers were more likely to perceive the faces as expressing dominant emotions than were Democrat sympathizers.

Democrat sympathizers showed greater psychological distress, more frequent histories of adverse life events such as interpersonal victimization experiences, fewer and less satisfying relationships, and lower perceptions of the trustworthiness of peers and intimate affiliates.

8. Conservatives have greater sensitivity to negative stimuli.

Conservatives are sensitive to avoidance motivation, which produces 'inhibition' responses manifested in greater rigidity. Self-regulation appears to provide a useful perspective for understanding how one's political views may affect categorization processes and, more broadly, the association between political conservatism and rigidity.

9. Conservatives have more activity in their dorsolateral prefrontal cortices, the part of the brain that activates for complex social evaluations.



pixabay.com

This could be explained by claiming that conservative statements require more complex social judgments marked by greater cognitive dissonance between self-interest and sense of fairness.

The representation of complex political beliefs relies on three fundamental dimensions, each reflected in distinctive patterns of neural activation:

- The degree of individualism of political beliefs was linearly associated with activation in the medial PFC [prefrontal cortex] and TPJ [temporoparietal junction]
- The degree of conservatism with activation in the DLPFC
- The degree of radicalism with activation in the ventral striatum and PC/P [posterior cingulate/precuneus]

Findings support the interpretation that the political belief system depends on a set of social cognitive processes including those that enable a person to judge themselves and other people, make decisions in ambivalent social situations, and comprehend motivational and emotional states."

10. Conservatism is focused on preventing negative outcomes, while liberalism is focused on advancing positive outcomes.

Liberals seek to provide for group members' welfare while conservatives want to protect the group from harm. These reflect the fundamental psychological distinction between approach and avoidance motivation. Conservatism is avoidance based; it is focused on preventing negative outcomes (e.g., societal losses) and seeks to regulate society via inhibition (restraints) in the interests of social order. Liberalism is approach based; it is focused on advancing positive outcomes (e.g., societal gains) and seeks to regulate society via activation (interventions) in the interests of social justice.

11. Genetics influence political attitudes during early adulthood and beyond.

Genetic influences on political attitudes are absent prior to young adulthood. During childhood and adolescence, individual differences in political attitudes are accounted for by a variety of environmental influences. However, in the early 20s, for those who left their parental home, there is evidence of a sizeable genetic influence on political attitudes which remains stable throughout adult life.

12. Conservatives learn better from negative stimuli than from positive stimuli and are more risk avoidant than liberals.

The relations among political ideology, exploratory behavior, and the formation of attitudes toward novel stimuli were explored in one study. Participants played a computer game that required learning whether these stimuli produced positive or negative outcomes. Learning was dependent on participants' decisions to sample novel stimuli… Political ideology correlated with exploration during the game, with conservatives sampling fewer targets than liberals. Moreover, more conservative individuals exhibited a stronger learning asymmetry, such that they learned negative stimuli better than positive. Conservatives pursued a more avoidant strategy to the game.

13. Individual political attitudes correlate with physiological traits, such as sensitivity to sudden noises and threatening visual images.

Individuals with measurably lower physical sensitivities to sudden noises and threatening visual images were more likely to support foreign aid, liberal immigration policies, pacifism, and gun control. Individuals with higher physiological reactions to those same stimuli were more likely to favor defense spending, capital punishment, patriotism, and the Iraq War. Thus, the degree to which individuals are physiologically responsive to threat appears

ologically responsive to threat appears to indicate the degree to which they advocate policies that protect the existing social structure from both external (outgroup) and internal (norm-violator) threats…

14. Liberals are more open-minded and creative whereas conservatives are more orderly and better organized.

Personality differences between liberals and conservatives are not only on self-report trait measures but also on unobtrusive, nonverbal measures of interaction style and behavioral residue.

15. When faced with a conflict, liberals are more likely than conservatives to alter their habitual response when cues indicate it is necessary.

Greater liberalism is associated with stronger conflict-related anterior cingulate activity, suggesting greater neurocognitive sensitivity to cues for altering a habitual response pattern.

Political orientation reflects individual differences in the functioning of a general mechanism related to cognitive control and self-regulation. Stronger conservatism was associated with less neurocognitive sensitivity to response conflicts. At the behavioral level, conservatives were also more likely to make errors of commission. Although a liberal orientation was associated with better performance on a response-inhibition task, conservatives would presumably perform better on tasks in which a more fixed response style is optimal.

16. Conservatives sleep more soundly and have more mundane dreams, while liberals sleep more restlessly and have a more bizarre, active dream life.

Conservative men sleep longer and better. They recall the fewest dreams, but have the most lucid awareness. Liberal women have the worst quality sleep, recall the greatest number and variety of dreams, and have the most dream references to homosexuality.

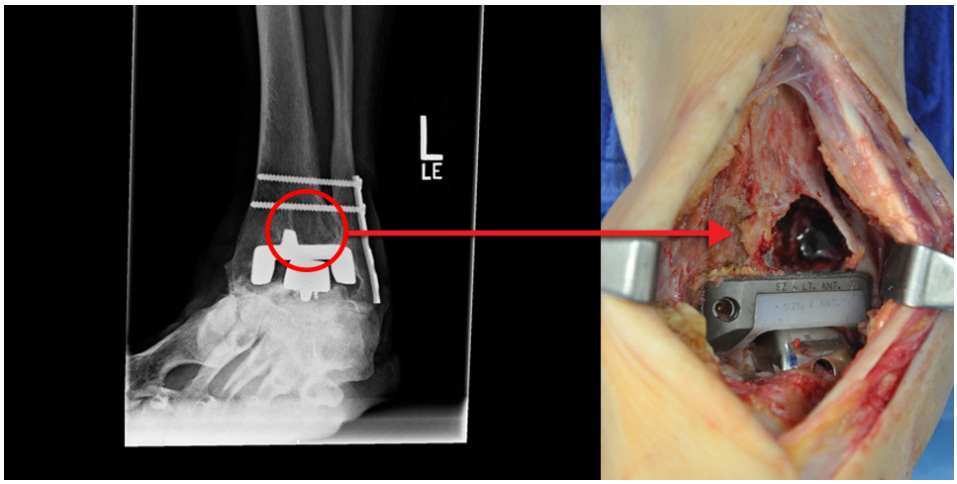
The Studies

Thanks to the folks at ProCon.org. We paraphrased and edit some of the responses and any mistakes are ours. ♦

Osteolysis in Total Ankle Arthroplasty: Why So Many Early Failures? // Stunning New Implant Data From Registry Consortium // Patients With Psychiatric Dx MUCH More Likely to Have Complications

BY ELIZABETH HOFHEINZ, M.P.H., M.ED.

Comprehensive Study Looks at Early Osteolysis in TAA Why are foot and ankle specialists seeing early osteolysis of their total ankle arthroplasties (TAA)? Steven Haddad, M.D., immediate past president of the American Orthopaedic Foot and Ankle Society (AOFAS), wants to figure it out. Dr. Haddad, an orthopedic surgeon with Illinois Bone and Joint Institute, LLC, told *OTW*, "Many of my foot and ankle colleagues are seeing patients who have undergone TAA show up with osteolysis as early as three years following surgery; some estimates run as high as 15% within that timeframe. This is in stark contrast to hip and knee surgery, where osteolysis typically occurs much later."



Osteolysis / Total Ankle Arthroplasty / Courtesy of Steven L. Haddad, M.D.

"Our team competed for a grant from the Orthopaedic Research and Education Foundation (OREF), and we were awarded $100,000 to study this issue. Our goal is to assess polyethylene particle wear after TAA as a potential cause of osteolysis that leads to early failure. Although we assume that polyethylene disease is the culprit, recent Finnish studies have biopsied specimens from prostheses generating substantial osteolysis, and found no polyethylene wear particles in those samples. These authors feel that osteolysis in TAA occurs from a different source: necrosis of bone around the implant stimulating the RANKL (receptor activator of nuclear factor kappa-B ligand) pathway. It is our goal to provide a comprehensive assessment to either confirm or deny this conjecture. We wish to know whether the pathway to osteolysis occurs due to polyethylene wear, or some other currently undefined mechanism."

"Our team proposed an aggressive, multifactorial study where we perform both a macro and micro evaluation. We will be testing three different ankle prostheses through five million cycles (each brand of prosthesis will undergo three testing cycles). We will be comparing the volumetric and linear wear rates of each polyethylene component in each prosthesis. In addition, we will be evaluating tissue samples obtained from over one hundred patients with osteolysis following TAA (from a variety of implants). We anticipate that combining this data will give substantial insight as to the biomechanics involved in generating osteolysis."

"Our goal is to use this combined data as a springboard to understand the role of total ankle implant design in potentially generating earlier osteolysis than seen by our hip and knee colleagues. We hope to combine newer technology where fluoroscopy and gait analysis are used to understand how different ankle implants articulate in vivo. We can then extrapolate this data to perform secondary wear testing on these same three total ankle prostheses, comparing this to the data we obtain through standard methodology in our index analysis. This type of 'anatomic motion' wear testing is currently being explored for total knee components, giving us the most complete understanding of osteolysis generation."

"This research is critical because TAA is exploding in popularity amongst surgeons. It is an escalating procedure

in managing end stage ankle arthritis, while fusion rates remain flat. Our goal is to persevere in studying this last variable element in predictability of prosthesis longevity. With this knowledge, we hope to equal our hip and knee colleagues in improving upon long-term successful total ankle arthroplasty outcomes for our patients."

International Orthopedic Registry Consortium Employs Advanced Algorithms to Reveal Hidden Implant Data. Clue: Mobile Non-PS Bearings May Not Be Great Option The International Consortium of Orthopedic Registries (ICOR) has exploded on the scene in recent years as a serious, thorough research endeavor. And they are getting some pretty interesting results. Art Sedrakyan, M.D., Ph.D., Sc.D. is the principal investigator of this FDA funded project. He told *OTW*, "With ICOR, we are seeing what 21st century surveillance might start to look like, namely, literature reviews, primary data collection, and working with clinician leaders worldwide for multi-national investigations. We developed an algorithm that allows us to combine summary data. That is summary level information obtained from each country/registry in a harmonized fashion…data is stratified by age, distribution of cement use, head sizes, etc. You can combine this harmonized information in a similar way from each participating registry."

Asked about recent ICOR results, Dr. Sedrakyan noted, "The most interesting findings are those involving the hip bearings, mobile knee and posterior stabilized knee implants. For example, we compared fixed with mobile knees and found that the mobile bearings had worse outcomes than fixed bearings. Because we were looking at specific causes of revisions we can't tell why, but there was, in fact, a substantially higher risk of revision associated with mobile bearings…and, this is a long-term follow-up study."

"I think orthopedic surgeons need to take note and think about possible reasons for this. Within ICOR we are taking a patient-centered approach and looking at all cause revision. Despite these studies not yet receiving much attention, in my opinion these are groundbreaking findings not reported before. Some estimates indicate that 30% of the bearings implanted annually might be mobile bearings. We need to understand why these failures occur and communicate this to the FDA. If patients ask for a mobile device seeking more functionality they have to be aware of the risk. Moreover, based on our systematic reviews they might not necessarily be getting that additional functionality. Many surgeons believe

that these bearings are completely similar in terms of long-terms outcomes. Our hope is that this work will reach the average practicing orthopedic surgeons so that their patients can benefit from internationally accumulated knowledge."

"On another note, we just had the annual meeting of Medical Device Epidemiology Network at FDA and discussed implementation of UDI (Unique Device Implementation) program for future surveillance of devices such as hip and knee implants. This will be extremely useful in tracking devices throughout their lifetimes. Unfortunately, major payers such as Medicare are not interested in implementing UDI even for implants within claims data due to logistics and expenses. In addition, there are two additional problems that we are facing. First, even if UDI is implemented we need a way to easily extract this from claims data and link it to clinical data in order to study and classify it. Second, we need to better understand long-term outcomes. How do you follow up with people? The only way to know is if we link to other claims (insurance, payor, or Medicare claims) and see if long-term outcomes such as revision occurs. But claims data sources are not well integrated, and the longitudinal data is limited."

"We have just received a new grant to create a network of U.S. registries that will allow us to explore linking to claims. It is a demonstration project that will hopefully soon become a coordinated registry network based on orthopedic registry data, claims from data owners and other stakeholders."

Psychiatric Dx Greatly Increases Complications, Discharge to Inpatient Facility Depression, anxiety, dementia and schizophrenia…one or more of these issues are faced by some orthopedic patients at one time or another—and these psychiatric comorbidities can very well affect your surgical outcomes. Wael Barsoum, M.D., president of Cleveland Clinic, Florida, always suspected that orthopedic surgeons were undertreating patients with psychiatric disorders. Dr. Barsoum, who has overseen a 17-year analysis of 8.3 million patients, tells *OTW*, "There are few studies in orthopedics that examine these issues and the roles they may play in a patient's recovery, but the reality is that orthopedic surgeons encounter troubled patients on a daily basis. With risk sharing and bundled payments becoming the status quo in the current healthcare climate, understanding how these comorbidities play a role in the overall treatment picture is essential."

"We can predict which patients should receive treatment, if he or she is not already, for psychiatric problems before undergoing surgery. Many of these patients are likely treatable preoperatively; if we can get them the appropriate treatment, their chances for better physical outcomes are enhanced. If the cost to treat these patients is substantially high due to increased adverse events and poorer outcomes, some hospitals and doctors will refuse to treat them. If the hospital is getting a fixed amount of money due to a bundled payment system, they are likely to tell patients, 'Go to a tertiary care center.'"

"Our findings show that if a patient has schizophrenia—even if treated preoperatively—their risk of an adverse event is 56% higher than a patient who does not have this condition. For someone who is depressed the risk of complications is 20% higher than someone who is not depressed. Interestingly, schizophrenia and depression predict the need for blood transfusions. While we don't have any definitive answers as to why this is, patients with these conditions often report fatigue, which mimics anemia."

"Discharge to an inpatient facility is a substantially higher cost that a routine discharge home. With that in mind, consider the increased costs involved with patients with dementia, who were 4.5 times more likely to require discharge to an inpatient facility than patients without that diagnosis. Patients with schizophrenia had a 2.4 times higher chance of requiring this kind of discharge, while for those diagnosed with depression the risk was 1.1 times higher than those without depression. This information is critical in determining how we can best partner with our psychiatric colleagues to optimize care for these patients. Organ transplant patients and bariatric surgery patients routinely undergo a psychiatric exam prior to surgery. I am not suggesting that every orthopaedic patient needs a psychiatric evaluation. However, if an orthopedic surgeon finds yellow/red flags in the psychiatric history of a patient, he or she should have a psychiatric exam administered to that patient preoperatively."

"As we are now in a period of healthcare reform and risk sharing, it is more imperative than ever that we are willing to undertake appropriate risk stratification. If you have a patient who is 92 with a history of renal failure, for example, then you know that the cost will be greater than doing hip replacement on a healthy 62 year old with arthritis. The issues we face are no different in terms of mental health. A better understanding of the increased risk is needed to first, ensure that the patient is preoperatively optimized, and second, create appropriate bundled care strategies." ♦

COMPANY

First Combined Zimmer Biomet Quarter Rocks

Investors and the orthopedics industry have been holding their collective breaths waiting to see how the Zimmer Biomet Holdings, Inc. merger is going to work out.

Courtesy of Zimmer Biomet

Revenue Rises

On October 29, 2015, company President and CEO Dave Dvorak put fears to rest. He announced that in the first quarter as a combined company, revenue, on a pro forma, constant currency basis, rose 0.7%. Investors practically swooned, driving the company's share prices up by over $10 per share. Wells Fargo analyst Larry Biegelsen said the revenue was in line with consensus.

Due to the merger, net sales of Zimmer Biomet increased 59.3% over the past year on a reported basis. "In an operating period marked by significant progress in the execution of our sales channel integration, we generated sequential top-line improvement and strong earnings growth. As we exit this year and progress through 2016, we are well positioned to continue improving revenue growth and delivering on our synergy commitments," Dvorak told analyst.

This wasn't Dvorak's first big merger, having successfully guided Zimmer through its $3.2 billion merger with Centerpulse AG (formerly Sulzer Medica) in 2003.

Hips and Knees Up

On a pro-forma, constant currency basis, knee sales did best, climbing 1.7%. Hips rose 0.3% and spine & CMF were up 0.3%. S.E.T., a new reporting category formed after the merger with Biomet, including surgical, sports medicine, foot and ankle, extremities and trauma, rose 1%.

The rise in knee sales was attributed to the company's Persona Knee, with management also citing its Vanguard Complete Knee System, as well as its Vanguard 360 Revision Knee System and bicruciate options, such as the Vanguard XP Total Knee System. In hips, Dvorak said he is "encouraged" by a quarter-over-quarter improvement and cited solid growth of the company's G7 and Continuum Acetabular Systems, as well as its Taperloc Complete Hip System and Avenir Hip system adding to the portfolio effort.

Third Quarter Ortho Winners & Losers

Now that all the large orthopedics companies have reported, BMO Capital Market analyst Joanne Wuensch estimates that worldwide knee market increased 2.1% ex-fx, against a tough 8% comp last year, and that Zimmer's share decreased to 38.9% from 40.1% year-over-year. She said DePuy Synthes also showed a decline to 23.8% from 24.1% year-over-year, while Smith and Nephew gained share to 12.6% from 11.7% year-over-year as did Stryker Corp. to 20.4% from 19.9%.

In hips, Wuensch estimates that the global hip market increased 1.0% ex-fx (versus 2.5% in the 3Q14). As

Zimmer Biomet 3Q15	Sales $ in million	% Change*
Total Sales	**$1,762.0**	**0.7%**
Knees	$632.0	1.7%
Hips	$434.0	0.3%
Surgical, Sports Medicine, Foot and Ankle, Extremities and Trauma	$371.0	1.0%
Dental	$103.0	down 0.9%
Spine & CMF	$148.0	0.3%
Other	$74.0	down 0.9%

Source: Zimmer Biomet Holdings, Inc.
** Pro forma constant currency*

in knees, Wuensch says Zimmer's hip share decreased to 33.9% from 34.7% year-over-years, and Smith & Nephew's slid to 10.7% from 11.2%.

Share gainers were Stryker Corp. (to 24.0% from 23.3%) and DePuy Synthes (to 26.9% from 26.6%).

Fears of the merger can now be put to rest, said Wuensch. "Expense synergies appear to be ahead of schedule, with management increasing its expense synergies by $20 million to $155 million in the first 12 months. On the expense side, early leverage can be seen, with gross margins improving to 76.2% from 75.5% year-over-year."

Management revised 2015 guidance, moderating revenue growth to 1.0-1.5% ex-fx from the previous guidance of 1.5-2.0%. — *WE*

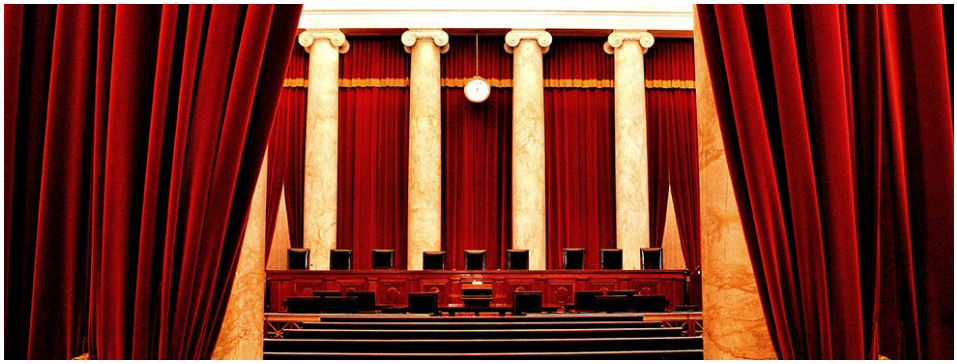
LEGAL

Stryker and Zimmer Biomet Heading to Supreme Court

Stryker Corporation and Zimmer Biomet Holdings, Inc. are heading to the U.S. Supreme Court over a patent damage award that may have far reaching consequences on the size of patent awards based on "willful infringement."

Stryker Sued Zimmer

Back in 2010 Stryker sued Zimmer over a portable lavage device that Zimmer manufactured to replace its bulky machine. Pulsed lavage is a technique that removes damaged tissue and cleans bones during joint-replacement sur-



Inside the U.S. Supreme Court/Wikipedia.org

gery. Stryker accused Zimmer of hiring someone to basically reverse engineer their device.

Stryker Wins Triple Damages

Stryker won the case and the trial judge tripled the $70 million jury award, "given the one-sidedness of the case and the flagrancy and scope of Zimmer's infringement." After additional costs were added, the final judgment in the case was $228 million.

Zimmer Wins Appeal of Award Size

Zimmer appealed the award. A federal circuit upheld the infringement verdict but threw out the increased damage award, saying that Zimmer had presented "reasonable defenses" to Stryker's claims.

Supreme Court Steps In

At least four justices on the Supreme Court agreed to hear the case. The Court will look at the appeals court ruling that has made it more difficult to get enhanced damages even if a jury finds that the infringer knew of the patent and used the invention anyway. Companies can say they had a reasonable belief the patent was invalid or not infringed to escape the penalty for "willful infringement."

The effect is "immunizing infringers from enhanced damages so long as they present at least one plausible defense," said the Stryker petition to the Court. Stryker argues the standard set by the U.S. Court of Appeals for the Federal Circuit, which handles patent cases, is too rigid.

According to an October 19, 2005 *Bloomberg* story by Susan Decker and Greg Stohr, the near-elimination of higher damage awards is part of a string of cases that have reduced the amount that patent owners can collect at trial. "The difficulty for the courts has been in finding a balance between deterring abusive lawsuits by patent owners out for a quick buck and ensuring competitors' disputes are resolved fairly."

> Brad Wright, a patent lawyer with Banner & Wifcoff in Washington, D.C., told *Bloomberg*, the justices likely took the case because they "view this as another example of the Federal Circuit imposing rigid bright-line rules as a predicate for reaching a legal conclusion."

In granting Stryker's appeal the Supreme Court said it would answer the following two questions:

1. Has the Federal Circuit improperly abrogated the plain meaning of 35 U.S.C. § 284 by forbidding any award of enhanced damages unless there is a finding of willfulness under a rigid, two-part test, when this Court recently rejected an analogous framework imposed on 35 U.S.C. § 285, the statute providing for attorneys' fee awards in exceptional cases?

2. Does a district court have discretion under 35 U.S.C. § 284 to award enhanced damages where an infringer intentionally copied a direct competitor's patented invention, knew the invention was covered by multiple patents, and made no attempt to avoid infringing the patents on that invention?

No dates for oral arguments were noted in the Court's decision to hear the case. — *WE*

MicroPort Modular Neck Recalled

The FDA has announced a Class I Recall for the modular neck component of a hip joint replacement system made by Shanghai, China-based MicroPort Orthopedics.

PROFEMUR Modular Neck/MicroPort Scientific Corporation and RRY Publications

The recalled product is the PROFEMUR Long Cobalt Chrome 8 Degree Varus/Valgus Modular Neck, Part 1254. The affected lots of the modular neck were manufactured and distributed from mid-June 2015 to the end of July 2015. Over 10,800 devices are part of the recall.

MicroPort sent a letter to distributors and hospital staff on August 7, 2015 notifying them of the voluntary recall. The company advised healthcare professionals to review the notice, locate all affected product, discontinue distribu-

tion and use of the devices and return the recalled product to its Arlington, Texas-based distribution center.

Unexpected Rates of Fracture

The reason for the recall, according to an October 2, 2015 FDA web posting, is that company received reports of an unexpected rate of fractures after surgery related to this specific modular neck. If the modular neck fractures, the patient may experience sudden pain, instability and difficulty walking and performing common task. An acute fracture will require revision surgery to remove and replace the neck and stem components. Acute fracture and emergency revision surgery is a serious adverse health consequence and could lead to neurovascular damage, hematoma, hemorrhage, and even death.

Patients with the devices should continue to follow-up with their doctors as prescribed by their surgeon, and should seek treatment immediately if they experience any sudden onset of severe hip pain, difficulty walking, trauma to the hip or leg, or tingling or loss of feeling in their leg.

Hip implants continue to cause problems for some device makers. In February, Johnson & Johnson's DePuy Synthes added $420 million to its $2.5 billion legal pot to resolve claims over recalled hip implants.

Then in June, Smith & Nephew plc pulled some hip implant sizes and related components from the market after data from the U.K.'s cost-effectiveness watchdog found that smaller sizes of the system had higher revision rates than expected.

Providers with questions are encouraged to e-mail cathy.park@ortho.microport.com. — *WE*

BIOLOGICS

Orthofix's Trinity Evolution Reports High Fusion Rates

Patients treated with Trinity Evolution, Orthofix International N.V.'s cellular bone allograft (CBA), demonstrated foot and ankle fusion rates of over 86% at 12 months after follow-up.

In the largest such study of the allograft to date, and published in *Foot & Ankle International*, the investigators also reported that the successful fusion significantly correlated with improvements in pain, function, and quality of life (QOL), even in patients with comorbidities such as obesity, diabetes and smoking.

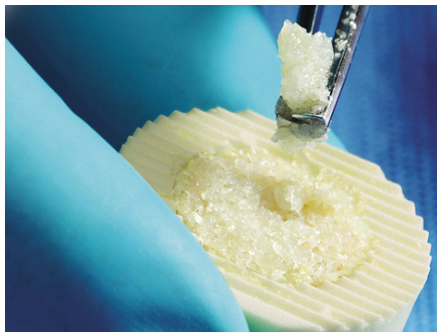
James Nunley, M.D., professor of orthopedic surgery and director of foot and ankle surgery at Duke University Medical Center in Durham, North Carolina, and senior author of the journal article, said the study observed fusion rates using Trinity Evolution that were "higher than or comparable to fusion rates in other published studies of autologous corticocancellous bone graft (autograft), a traditional gold standard used in foot and ankle procedures."

The prospective, multicenter, open-label clinical study evaluated 92 patients who underwent 153 foot and ankle fusion procedures. Compared with previous studies, this trial used prospective enrollment and included patients who were at high risk for bone fusion failure due to age, diabetes or obesity. The primary endpoint was successful fusion based on high resolution computed tomography scans and radiographs assessed by an independent lab.

80%+ Fusion Rate

Based on radiographic effectiveness, the company said the study demonstrated a per joint fusion rate of 81.1% (124/153) at six months, which increased to 86.8% (112/139) at 12 months. Additionally, comorbid factors known to be associated with fusion failure (pseudoarthrosis), such as diabetes, age and obesity, did not have a negative effect in this study. There were no serious adverse events attributable to the allograft as determined by an independent consultant.

Orthofix's Chief Scientific Officer James Ryaby, Ph.D. said the company designed this study to include diabetic, obese and older patients often seen by foot and ankle specialists who might not respond well to traditional allograft and autograft materials. "These results support Trinity Evolution as an important alternative to autograft and other bone growth materials in this difficult-to-treat patient population."



Trinity Evolution/Orthofix International N.V.

Trinity Evolution

Trinity Evolution, processed by the Musculoskeletal Transplant Foundation (MTF), is a cryopreserved CBA from allograft donor bone that facilitates effective bone formation by providing an osteoconductive scaffold, osteoinductive growth factors and osteogenic cells. According to the company, Trinity Evolution eliminates the need for harvesting autograft from patients, which reduces operating time and expense as well as discomfort and potential complications.

The product is the predecessor of Trinity Elite, a moldable bone graft material and the progeny of Osteocel, launched by Osiris Therapeutics, Inc. in 2005 as the first commercial product in the U.S. that contained adult allogeneic mesenchymal stem cells (MSCs) for use as a transplant. In November 2005, Blackstone Medical made a deal with Osiris to distribute, non-exclusively, Osteocel for use in promoting bone growth under its tradename Trinity Matrix. Blackstone was acquired by Orthofix in September 2006. Osiris sold Osteocel to NuVasive, Inc. in 2008.

Orthofix then partnered with MTF to co-develop an allogeneic stem cell product. Orthofix had been introduced to MTF in mid-2007, as part of a plan to co-develop and introduce an MTF processed tissue form. Trinity Evolution, the new MTF supplied tissue form, was launched on July 1, 2009, immediately following their rights to market Trinity Matrix.

In mid-2013, MTF and Orthofix commercialized their next generation tissue form, Trinity ELITE, which has all the properties of Trinity Evolution, but with putty like handling characteristics.

To date, according to the company, there have been more than 135,000 procedures using Trinity Evolution and Trinity Elite. — *WE*

LARGE JOINTS

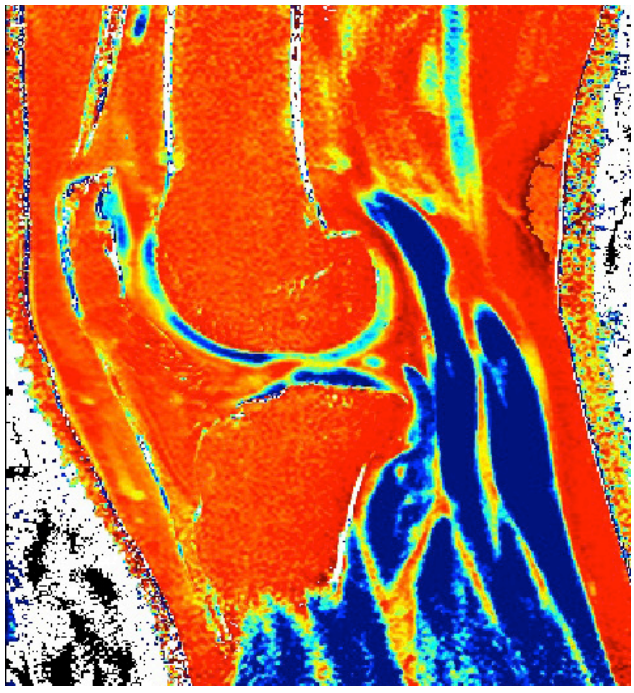
How Motion Causes Cartilage to Resorb Leaking Liquid

David Burris, Ph.D., an assistant professor in the Mechanical Engineering Department at the University of Delaware, has found some answers to the question, "Why doesn't cartilage deflate over the course of days, months or years?"

Working from the idea that the cartilage was able to reabsorb the fluid that leaks out when we're stationary, Dr. Burris hypothesized that the reabsorption process was driven by hydrodynamic pressurization. As indicated in the October 12, 2015 news release, the researchers "placed oversized cartilage samples against a glass flat to ensure the presence of the necessary wedge. They found that at slow sliding speeds cartilage thinning and an increase in friction occurred over time, but as the sliding speed increased toward typical walking speeds, the effect was reversed."

Dr. Burris told *OTW*, "From biphasic modeling, we know that cartilage loses fluid during loading over time, but in vivo measurements show that although this is true in static conditions, articulation actually drives fluid back into the tissue. The community has not understood this mechanism and given the importance of the fluid in the tissue for mechanical and biological function, we felt this was an absolutely critical scientific question to answer. To date the only hypotheses have been that migration limits time in contact and articulation exposes the contact to the bath, which enable it to imbibe fluid to recover. We were shocked to find the same recovery mechanism others observe in the natural joint in a contact that did not involve migration and bath exposure. The results suggest that hydrodynamic pressure develops during articulation, but instead of creating fluid films as described in biomechanics textbooks, these external pressures combat the exudation process associated with interstitial pressurization. We believe this 'tribological rehydration' mechanism is critical for sustaining joint function and health and can be leveraged to provide unprecedented control in cartilage studies while maintaining physiological fluid pressures."

Asked what orthopedic surgeons should know about this work, Dr. Burris commented, "First, the results con-



Map of cartilage/Wikimedia Commons and Michael.durkan

tradict the conventional wisdom that articulation causes wear. The mechanism we propose based on our results suggest that the mechanical intensity felt by the solid is far less when active than when inactive. It suggests that obesity, inactivity, and low amplitude oscillations are more damaging mechanically than normal activity. In other words, we expect recommendations of 10,000 steps per day to also benefit joint health (in addition to cardiovascular, etc.)."

"Second, most textbooks focus on lubrication during articulation and suggest that fluid films are responsible for exceptionally low friction and wear. The problem with this mental model is that it fails to address how our joints deal with static conditions in which there are no fluid films. This is critical since our joints are static ~95% of the time. Our research suggests that the joint excels because it is designed specifically to address inactivity. Cartilage acts as a buffer to the inevitable 'crash landing' when motion stops. The extremely slow exudation process ensures negligible losses of lubrication over ~1 hour of inactivity. When activity resumes, this buffer is quickly refilled to prepare cartilage for the next crash landing. Joint replacement devices do not possess such a buffer and therefore experience the full brunt of the crash landing, poor lubrication, surface damage, wear, and the biological consequences thereof. If we want reliable joint replacement devices, we must stop striving to create fluid films during articulation at all cost and start focusing on mitigating stresses and damage during long periods of static loading; we need to leverage the interstitial lubrication that nature exploits so effectively." — *EH*

Low-Weight Training DOES Increase BMD

Calling into question the standard thinking that training with heavy weights is necessary to build bone mineral density (BMD), researchers from Pennsylvania State University have found that low-weight, high-repetition resistance training *does* increase BMD

Wikimedia Commons and GeorgeStepanek

in adults. The research, published in *The Journal of Sports Medicine and Physical Fitness,* indicated that participants who completed the study experienced up to 8% bone mineral density increases in the legs, pelvis, arms and spine. The researchers also found that postmenopausal women and osteopenic individuals would benefit most from a low-weight, high-repetition exercise regimen. The study was funded by Les Mills International, the creator of 13 global group fitness and team training programs.

"These findings challenge the traditional thought that high-weight, low-repetition exercise is the ideal way to increase bone mineral density," said Jinger Gottschall, associate professor and lead researcher of the study conducted at Penn State, in the October 26, 2015 news release. "This is such a profound finding because low-weight, high-repetition exercise is easily attainable by anybody and everybody. This approach could help at-risk populations minimize the risk of osteoporosis."

In the study, 20 untrained adults completed a 27-week group exercise program. Participants were assigned to one of two groups that either completed full-body weight-training workouts or workouts focused on building core muscles, in addition to cardiovascular workouts. The weight-training group completed two to three BODYPUMP classes per week. BODYPUMP is a low-weight, high-repetition resistance training program in which the participants used a bar and self-selected weights.

The team found a positive correlation between squat strength and pelvis bone mineral density, something the researchers think may decrease the risk of a hip fracture. In the study, people in the weight-training group experienced 25% greater increase in leg strength than those in the core group.

Dr. Gottschall told *OTW*, "Overall, the most surprising and encouraging aspect of the results was the magnitude of change we measured in bone density at multiple sites with low load, high repetition weight training. In addition, the correlation between leg strength and hip bone density was a novel finding. This singular detail can be extremely beneficial to persons with low bone density as well as older adults due to the tragic consequences of hip fracture due to falling. Our results are important for orthopedic surgeons in order to educate their patients on the benefits of low load, high repetition weight training to assist in the prevention of fractures."

"My continued goal at The Pennsylvania State University and in collaboration with Les Mills International is to enhance and improve the current physical activity guidelines for specific populations. Together this research is a critical component of personalized medicine and how to develop an exercise program that is ideal for each individual." — *EH*

$18.5 Million to Cleveland Clinic, Case Western!

Cleveland Clinic and Case Western Reserve University School of Medicine have received generous grants from the Richard J. Fasenmyer Foundation in the past…and now they have been awarded $18.5 million in new grants meant to support collaborative research efforts, physician recruitment and sustain into perpetuity the Richard J. Fasenmyer Center for Clinical Immunology at Cleveland Clinic.

The award supports the longtime collaboration between immunologists Leonard Calabrese, D.O., of Cleveland Clinic and Michael Lederman, M.D., of Case Western Reserve University School of Medicine, two nationally recognized investigators of HIV/AIDS who were among the first researchers to study the virus. The researchers will continue their nearly 40-year collaboration to investigate potential relationships between autoimmune, inflammatory diseases, such as rheumatoid arthritis, and HIV/AIDS.

The grant will also provide funding for recruitment and support of junior faculty, as well as the development of a peer-reviewed *Journal of Interesting Immunology and Infectious Diseases* at the School of Medicine and Cleveland Clinic. The gift will also make possible the creation of a dual-track training program in rheumatic and immunologic infectious diseases.

"This grant recognizes 36 years of dedication and collaborative research of Drs. Calabrese and Lederman and between Cleveland Clinic and Case Western Reserve University—the

Leonard Calabrese, D.O., John Baechle, Michael Lederman, M.D., courtesy of Cleveland Clinic and Case Western Reserve University School of Medicine

visionary institutions that support their work. Our investment affirms not only the concern for others that our founder, Richard Fasenmyer, showed during his lifetime, but also that the interplay of research and clinical care are critical to creating a future without infectious disease," said John Baechle, board president of the Richard J. Fasenmyer Foundation, in the October 26, 2015 news release.

Dr. Calabrese told *OTW*, "The Fasenmyer gift is, first and foremost, a stimulus for collaborative research. Given that our focus is autoimmune and auto inflammatory diseases and in particular the influence of infections, this could be a stimulus to explore a wide variety of diseases of importance to the orthopedic community including the immunopathogenesis of inflammatory arthritis, the immunopathogenesis of joint and prosthetic infections and beyond."

Asked what biologic therapies they will pursue, he noted, "We are currently focused on trying to understand how to predict responses. We now practice in an environment with multiple biologics for conditions such as RA, psoriatic arthritis, ankylosing spondylitis and other conditions. While they are highly effective and even transformational to many patients, they don't work for everyone and we are unable to predict responses. Developing a biomarker for response is a holy grail that we would like to pursue."

"We are so proud of our close relationship with the orthopedic community in our institute and we believe that we both have much to offer each other. I think our multi-disciplinary arthritis clinic with shared space, personnel, imaging and therapy is exemplary. We want to build onto the research end of this relationship." — *EH*

Opiates Receptors Increase to Battle Arthritis

New research from The University of Manchester has shown for the first time that the number of opiate receptors in the brain increases to combat severe pain in arthritis sufferers. By applying heat to the skin using a laser stimulator, Christopher Brown, Ph.D. and his colleagues showed that the more opiate receptors there are in the brain, the higher the ability to withstand the pain.

Dr. Brown said in the October 23, 2015 news release, "As far as we are aware, this is the first time that these changes have been associated with increased resilience to pain and shown to be adaptive. Although the mechanisms of these adaptive changes are unknown, if we can understand how we can enhance them, we may find ways of naturally increasing resilience to pain without the side effects associated with many pain killing drugs."

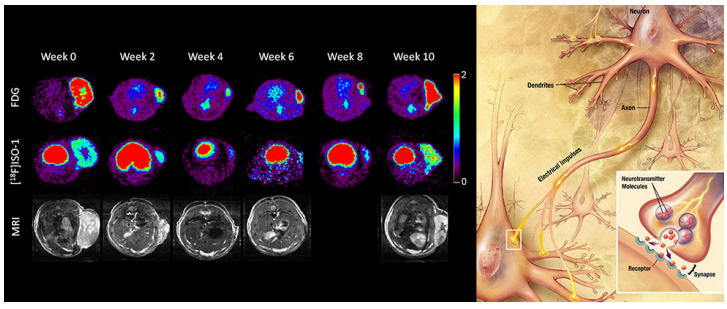
As indicated in the news release, "The study used Positron Emission Tomography (PET) imaging on 17 patients with arthritis and nine healthy controls to show the spread of the opioid receptors. This suggests that the increase in opiate receptors in the brain is an adaptive response to chronic pain, allowing people to deal with it more easily."

Professor of Cognitive Neuroscience at the University, Wael El-Deredy said, "Receptor imaging is challenging and requires the co-ordination of a large team to collect and analyse the images. We are very lucky to have this technique in Manchester. There are very few places in the world where this study could have been done."

Dr. Brown told *OTW*, "There was already evidence from animal studies that opioid receptor upregulation may occur in response to chronic pain, and we helped confirm this in people with arthritis. However, it was a surprise that this upregulation would have a relationship to pain threshold, and this has led to us speculating that opioid receptor upregulation may be an adaptive response to chronic pain that helps sufferers cope with it more easily."

"It is important for any clinician treating chronic pain patients to understand that brain neurochemistry has an effect on the amount of pain the patient feels, and that this neurochemistry can be altered with experience. This may help explain why some patients recover better than others after arthroplasty."

Asked about future research, Dr. Brown noted, "We are interested in whether brain neurochemistry can be altered for the better with lifestyle changes such as exercise and relaxation, or through psychological interventions. If so, we might be able to improve outcomes from many types of treatment including pharmaceutical and surgical treatments." — *EH*



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EXTREMITIES

Cartilage Repair Translational Research: Guidelines Being Ignored

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What is the use of having recommendations if no one follows them? A team led by researchers from the Perelman School of Medicine at the University of Pennsylvania, has plunged into the issue of regulatory guidance documents and cartilage repair. Indicating in the October 21, 2015 news release that there is "little to no" adherence to the recommendations published by U.S. and European regulatory agencies on how translational research is conducted and reported in large animal models used to study cartilage repair, the researchers undertook an evaluation of 114 large animal studies.

The team analyzed three sets of regulatory guidance documents published by the U.S. Food and Drug Administration, the European Medicines Agency, and the American Society for Testing and Materials. The team looked at cartilage repair studies published over the past two decades and scored the studies based on adherence to 24 categories appearing in the guidance documents (such as animal age and gender, study duration) and to the methods used for determining successful outcomes, and whether a follow-up MRI or clinical evaluation were performed.

"When we started this project, we assumed that there would be strong positive correlation between the publication of the guidance documents and the level of adherence to these guidelines following publication," said Robert Mauck, Ph.D., an associate profes-

sor of Orthopedic Surgery and Bioengineering and director of Penn's McKay Orthopaedic Research Laboratory. "However, when we completed our analysis, we were surprised to find that for the large animal studies we examined, most did not follow the guidelines to any great extent. This got us thinking about the reasons behind the lack of adherence, and the steps that could be taken to help the field more closely align with these recommendations."

The research team also included Christian Pfeifer, M.D., of the Regensburg University Medical Center and Matthew Fisher, Ph.D., of North Carolina State University and the University of North Carolina at Chapel Hill, former postdoctoral fellows in the McKay Orthopaedic Research Laboratory.

Dr. Mauck told *OTW,* "We were quite surprised to discover that the publication of the guidance documents from regulatory and standards organization had little impact on the field of pre-clinical large animal models of cartilage repair, and how poor overall the adherence to these guidelines was. This made us consider the reasons for this low adherence to and lead to a broader discussion on the ways in which these guidelines could be more widely implemented and adopted by the field."

"Orthopaedic surgeons should consider these guidance documents as they develop and participate in translational studies that involve pre-clinical testing in large animal models. They should also participate in the formulation of these documents, so that those assays and outcomes most relevant to clinical translation are represented in these documents. Ultimately, the goal is to improve the rate at which ideas transition to products, with the potential to transform musculoskeletal regenerative medicine." — *EH*

Shoulder Dislocation: Forget Surgery?

According to a new study in the *Journal of Orthopaedic Trauma*, patients who are treated non-surgically have fewer complications and return to work sooner.

"For severe AC [acromioclavicular] joint dislocations, surgery is the common practice but there's not much evidence to suggest this is actually the best treatment," said Michael McKee, M.D. an orthopedic surgeon with St. Michael's Hospital in Toronto, Ontario, in the October 22, 2015 news release.

The study involved 83 patients with moderate to severe AC joint dislocations who received either plate-and-screws surgery followed by rehabilitation or non-surgical treatment with sling and rehabilitation. Those not undergoing surgery showed greater mobility than the surgical patients at follow-up sessions six weeks and three months after their injury. There were no significant differences between the groups at six months, one year or two years after their injury.

"Three months after the initial injury, more than 75% of the patients who did not have AC joint surgical repair were able to return to work, whereas only 43% of those who underwent surgery were back at work," said Dr. McKee.

"The main advantages of surgery are that the joint is put back in place and the shoulder appears more symmetrical and pleasing to the eye," said Dr. McKee. "The long-term implications of surgery for AC joint dislocation remain unclear when compared to non-operative treatment."

As indicated in the news release, "Because the non-operative patients did not have the dislocation put back into place with surgery, they were more likely to be dissatisfied with the appearance of their shoulder compared to the group who'd received surgery. After one year, five per cent of the surgical patients reported dissatisfaction with the appearance of their shoulder compared to 16% of the non-surgical patients. That gap widened after the second year, when more than 21% of non-surgical patients had issues, compared to four per cent of those who'd received surgical repair."

Dr. McKee told *OTW,* "The biggest surprise to me was the fact that patients treated with surgical stabilization did not improve more quickly than those treated non-operatively. In our other studies, for example of clavicle fractures, the surgical group showed dramatically better improvement early, compared to non-operative treatment. There is obviously an intrinsic difference to how the body recovers from an AC joint injury."

"I think surgeons will use this information properly. We don't say you should never operate, we simply say that in the short term, the operation provided little benefit and should not be performed routinely. However, there are some specific circumstances where it may be warranted. In general, our study supports a non-operative approach to this particular shoulder injury." — *EH*

Michael McKee, M.D., courtesy of St. Michael's Hospital

SPINE

Uniquely Osteoconductive and Porous PEEK Device Gets FDA Nod

Vertera Spine has received U.S. Food and Drug Administration 510(k) clearance for a uniquely osteoconductive and porous PEEK Cervical Interbody Fusion Device called simply COHERE.

The implant's proprietary surface technology is porous and is based on Zeniva PEEK resin from Solvay Specialty Polymers.

Several PEEK implants with porous or rough metal coatings are in use today. But COHERE is the first FDA cleared spinal implant manufactured entirely out of PEEK which also is porous.

Co-founder and CEO of Vertera Spine Chris Lee, Ph.D., told *OTW*, "Our primary development objective for COHERE was to address the biologic challenges associated with current PEEK devices while keeping manufacturing costs low. Numerous companies have tried to make PEEK more osteoconductive by adding materials like titanium to the implant surface or hydroxyapatite to the bulk material. These offerings have several inherent problems related to their mechanical durability and cost associated with added material."

"We took a fundamentally different approach by growing a porous PEEK network directly from COHERE's surface, thus maintaining PEEK's advantageous mechanical properties, while also allowing bone to mechanically interlock directly within the porosity without eliciting fibrous encapsulation. In the end, we believe we have developed an elegant, more cost-effective solution with superior mechanical and biological performance that can also be advantageous for implants outside of spine."

The underlying technology for COHERE, PEEK Scoria, "represents a breakthrough in how surface technologies are applied to medical devices," according to Dr. Lee. The PEEK Scoria technology came from research conducted at Duke University and the Parker H. Petit Institute for Bioengineering and Bioscience at Georgia Institute of Technology.

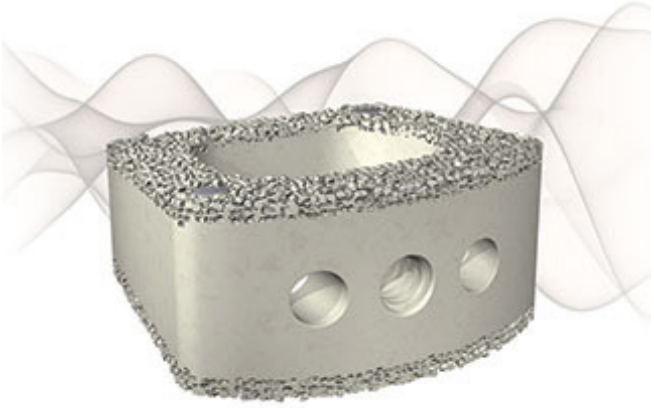
Unlike other PEEK surface treatments that are coated onto the device, Scoria is grown directly out of the solid PEEK Zeniva material. As a result, the implant has a seamless surface-to-solid material interface. The company believes that this type of PEEK implant surface is more durable than metal coatings and two times stronger under shear loading than trabecular bone.

Because PEEK Scoria can be fabricated onto the device without using any additive material, manufacturing costs are lower than metal-coated implants which should result in more competitive pricing as compared with more traditional coated PEEK implants or even titanium-coated fusion devices.

"The FDA clearance of COHERE represents a significant milestone for Vertera Spine and fusion devices in spine," said Dr. Lee. "Given the new economics of healthcare, market demands are shifting towards more effective implant technologies at a better price. COHERE, featuring surface porous PEEK Scoria, will be the first in a new generation of biomedical implant innovations to meet this demand."

Vertera Spine is a privately held medical device company working to develop and commercialize a portfolio of surgical solutions that use or complement its patented porous surface technology to address critical clinical needs in spine procedures.

Solvay Specialty Polymers is a global supplier of high-performance thermoplastics offered for use in permanent and prolonged exposure implants and limited exposure devices. Solvay is an international chemical group headquartered in Brussels. Its companies employ about 29,400 people in 55 countries. — *BY*



Courtesy of Vertera Spine

Lumbar Spine Surgery in Parkinson's Patients: Good Results

Researchers from New York and Israel have taken on an unusual topic… lumbar spine surgery in patients with Parkinson's disease. The investigators, from Hadassah Hebrew University Medical Center in Jerusalem, and Beth Israel Medical Center and Hospital for Special Surgery (HSS) in New York City, found that Parkinson's patients fared well after undergoing lumbar spine surgery, and experienced a decrease in pain.

Wikimedia Commons, Andrew Huth and RRY Publications, LLC

According to the study, the team identified 96 patients who underwent lumbar spine surgery between 2002 and 2012. Of these, 72 had spinal stenosis, 17 experienced spondylolisthesis, and 7 suffered from coronal and/or sagittal deformity. The visual analog scale for back pain improved from 7.4 cm preoperatively to 1.8 cm postoperatively. The visual analog scale for lower-limb pain improved from 7.7 cm preoperatively to 2.3 cm postoperatively. The Oswestry Disability Index score dropped from 54.1 points to 17.7 points at the time of the latest follow-up.

Josh Schroeder, M.D., an orthopedic surgeon with Hadassah Hebrew University Medical Center, told *OTW*, "The study was prompted by several patients who suffered from Parkinson's disease. We tried to locate existing data on the topic, but could not find any large study on Parkinson's, despite this being a disease that affects 5% of the elderly population."

"I was surprised to see that most patients do well after surgery. Sometimes less is more, and doing a smaller surgery might be better for the patient. Ours is the first large study on Parkinson's patients, and it taught us to divide the patients into groups from mild to severe Parkinson's disease."

"In the future, a large prospective study is mandated, if possible to include neurodegenerative diseases such as muscular dystrophy and more. The important message is, 'See the patient, tailor the procedure to the patient and understand that input from a neurologist is critical.'" — *EH*

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Robin R. Young, CFA
Editor and Publisher
robin@ryortho.com

WRITERS

Elizabeth Hofheinz, M.P.H., M.Ed.
Senior Writer
elizabeth@ryortho.com

Walter Eisner
Senior Writer
walter@ryortho.com

Biloine W. Young
Senior Writer
bgwy@msn.com

ADVERTISING

Tom Bishow
Vice President of Sales
tom@ryortho.com

PRODUCTION

Suzanne Kirchner
Production Manager
suzanne@ryortho.com

Jayme Johnson
Email, Web, & Conference Coordinator
jayme@ryortho.com

Dana Bader
Graphic Designer
dana@ryortho.com

---

116 Ivywood Lane • Wayne, PA 19087
TOLL FREE: 1-888-749-2153
www.ryortho.com