

Emerging Medical Technologies (EMT)[®] Innovator of the Month - June 2014



Fred Khosravi

With his roots at stent pioneer Advanced Cardiovascular Systems and medical device experience spanning almost 30 years, Silicon Valley entrepreneur Fred Khosravi founded EndoTex Interventional Systems, and is the co-founder of 10 more medical companies to date through his device incubator, Incept LLC: Confluent Surgical, Embolic Protection, MarketRx, AccessClosure, Ostial Corporation, Sadra Medical, Ocular Therapeutix, HotSpur Technologies, Nextplane and Claret Medical.

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Years in the Device Industry: 27

Hometown: Los Altos, CA

Education: B.S., Mechanical Engineering, and M.S. in Mechanical Engineering (cum laude), Tennessee Tech University

Introduction

Khosravi, Kurdish by heritage, moved to the U.S. from Iran when he was 16, at the urging of his parents, just as the Iranian revolution was beginning. He was introduced to the device world at Tennessee Tech University, where his mechanical engineering Master's thesis focused on the design of spatial joints that could be used to replace human joints. After graduation, many of his fellow students headed for jobs in the defense industry, but Khosravi was drawn to the medical field; an

unusual choice for a mechanical engineer in the 1980s.

In 1987, Khosravi took his first job out of college in the device industry, at **CooperVision/Cilco**, a developer of intraocular lenses for cataract patients. The ophthalmic field was booming at the time, and CooperVision developed a technology that reduced the incision size for lens replacements from 12 to 4 millimeters, vastly improving recovery time and decreasing complications. **Alcon Surgical** bought the company in 1989, and Khosravi got his first taste of the device market-defining merger and acquisition (M&A) process.

In late 1989, Khosravi accepted an offer from **Advanced Cardiovascular Systems** (ACS), a Silicon Valley company owned by **Eli Lilly** that developed percutaneous catheter systems for angioplasty. Khosravi was anxious to be part of the new wave of

cardiovascular innovation, including stenting, in collaboration with Prof. Ulrich Sigwart, a Swiss cardiologist and ACS clinical advisor, who in 1986, was the first ever to implant a coronary stent in a human. Here, he helped manage the development of ACS's first implantable stent, the *Multilink*, which became a commercial success under **Guidant Corporation**.

In 1993, Khosravi was recruited to join a start-up device company, **Focal Therapeutics**, with Mark Levin (who later co-founded Third Rock Ventures), and Amar Sawhney, Ph.D. Focal was looking to develop a drug delivery system for applications in the cardiovascular and obstetrics and gynecology (OB/GYN) fields. At Focal, Levin mentored Khosravi on what it takes to be an entrepreneur and raise money. Khosravi also spent a lot of time in the lab with Sawhney, and it was here that he developed his

fondness for the scientific side of device development (he has now authored or co-authored more than 100 issued or filed patent applications, involving unique and novel medical devices).

In 1994, Focal's cardiovascular business was sold to **Roche**, and the company then switched gears to develop lung-sealing products, after the OB/GYN product failed its clinical endpoints. Focal eventually went public and was finally sold to **Genzyme Corporation**.

In 1995, Khosravi founded his first device company, **EndoTex Interventional Systems**, with Sigwart and Dr. Mark Wholey, Chairman of Radiology at Pittsburgh University and a pioneer in interventional radiology. Khosravi and the EndoTex founders decided to develop self-expanding stents for use in the carotid arteries, made of the flexible, nickel titanium-based alloy, nitinol. A second application would allow for treatment of aortic aneurysms from within the vascular system, decreasing the need for invasive surgery.

However, EndoTex encountered a number of challenges. Most importantly, the company took its eye off the ball and lost its competitive edge, and Khosravi came close to shutting the doors. EndoTex rebooted, built a new competitive platform, brought new leadership on board, and turned it into a success. Through this, EndoTex's original investors, New Enterprise Associates (NEA) and ONSET Ventures, stuck with the company. EndoTex was eventually acquired by **Boston Scientific** in January 2007. The profound lessons that Khosravi learned from a near-failure with this, his first start-up, fueled the rest of his career, he tells LSI.

In Khosravi's view, the one thing that drives entrepreneurs is that they don't want to screw up, they want to be known in the industry for being successful. "While this is a good driver, when it becomes the main goal, it could actually cause an entrepreneur to make the wrong decisions. The minute it becomes all about you, all bets are off," he says.

In 1998, Khosravi moved on to start a technology incubator, **Incept, LLC**, in partnership with Sawhney, his respected colleague from Focal. They started Incept with the plan of spinning off companies—funded initially by Sawhney, Khosravi and a small network of physician investors—based on Incept-developed technologies. In starting their venture, the two agreed on three important principles. For one, if they were going to get into the challenging device space, the goal was to focus only on leadership-category technologies in areas of large unmet clinical need, and achieve the number one or two share positions in the markets in which they operate. Second, they will only develop "built to last" companies; they may exit early in the process if they're lucky (as some of Incept's portfolio companies did), but they wouldn't be built just to "flip." The third principle was leadership cultivation: Sawhney and Khosravi can only run one or two companies at a time, and so if they're going to build out many companies they have to cultivate a group of strong, motivated, tested leaders, who share Incept's dictum of creating lasting and meaningful technologies.

Khosravi says he and Sawhney could not have built Incept's companies without these and other important team members along the way. With these three principles, they started Incept, and 16 years later, these

principles are still the guiding force behind the many successes that the incubator has had.

Khosravi says that for Incept, success isn't measured in the sum of its transaction values, such as in exits, but rather by the number of products in the marketplace, and how broadly they touch patients — even years after companies have been acquired. "The approach we have is, did we accomplish what we set out to do? Did we contribute a consequential and lasting innovation?" says Khosravi.

He also points out that starting and successfully running a device business is very difficult; he has never had a success that hasn't gone to the brink of a failure or two along the way. The conviction that an entrepreneur is creating something good becomes the lever for him or her to navigate out of the many troughs that the entrepreneur will likely encounter.

The first Incept company, **Confluent Surgical**, was started by Sawhney in late 1998 to develop *in situ*-polymerized biomaterials. It eventually created the first FDA-approved dural sealing product that prevented fluid leaks during cranial surgery. Confluent was acquired by **Tyco Corporation/ Covidien** in 2006.

Within a year, with help from others and based on a clinical need he identified with Dr. Nick Hopkins, Chief of Neurosurgery at SUNY in Buffalo, and Wholey, relationships he fostered while at EndoTex, Khosravi founded what was to be one of his biggest successes, intravascular filter company **Embolic Protection (EPI)**. Despite the experience at EndoTex, Rob Kuhling from ONSET Ventures put money into EPI without hesitation, as he had confidence in Khosravi's abilities. According to Khosravi,

Kuhling said, “Fred, there aren’t too many people we work with who border on failing and still make a success out of things. That’s the kind of experience we invest in.” Kuhling and ONSET Ventures continued on to invest in many of Khosravi's companies.

Determined to learn from the past, Khosravi and EPI came up with a strategy to develop an embolic protection filter that would be far superior to that of its competitors, and there were several in development. Khosravi acquired a private prototype development group, **Sobek Medical**, run by Amr Salahieh, his former ACS colleague from 1990, for approximately \$1 million. Salahieh, who developed the first EPI devices, which were successful, later became VP of research and development for EPI. Within 18 months, EPI had offers from two companies to be acquired. During the negotiations, Khosravi was able to raise a second round of financing—roughly \$5 million—from ONSET and Pequot Ventures. After just two years in operation, and with the help of his mentor, Hank Plain, now General Partner at Lightstone Ventures, in February 2001, EPI was acquired by Boston Scientific for a \$75 million up-front payment and \$125 million in earn-outs — an excellent return (24-25x) for the company's Series A investors. Boston Scientific went on to have great success with the EPI filter. Today, more than a decade later, the EPI filter is still a leading embolic protection device worldwide, says Khosravi.

Khosravi even convinced Boston Scientific management to acquire EndoTex, which at the time had offers from several potential suitors. The deal was structured so that Boston Scientific invested in the stent technology, and once EndoTex

received premarket approval from the FDA, Boston Scientific would have to exercise the option to buy the company for roughly \$250 million (in upfront payments and earnouts).

Khosravi's incubator, led by Sawhney then seed-funded **MarketRx**, founded by its CEO, Jassi Chada, Ph.D., a world-renowned expert in market analytics. MarketRx was a marketing informatics company providing software-based products and services and its proprietary analytical models to pharmaceutical, biotechnology, and medical device manufacturers. This company was acquired in 2007 by **Cognizant Corporation** for \$150 million in cash on a total investment of less than \$7 million. Today MarketRx remains the important component within Cognizant that supports the entire spectrum of life sciences commercial operations and allows CTS clients to benefit from improved efficiency, effectiveness, higher productivity and lower total cost of operations.

In 2002, Khosravi's incubator founded **AccessClosure**, which markets *in situ* polymerization-based puncture site closure technology originally developed and patented by Sawhney. Designed to be superior to the market-leading *Angio-Seal* device from **St. Jude Medical**, the company's *Mynx* product family of vascular closure devices seal the femoral artery using a secure sealant which dissolves within 30 days, leaving nothing behind but a healed artery. Initial funding for AccessClosure came from ONSET and a small group of private investors. AccessClosure received FDA PMA approval for its flagship Mynx technology in 2007. To date, the technology has been used in over 3 million patients in the U.S. and globally, having become a leading extra-vascular solution for closure in cathlabs around the world. The

company's sales exceeded \$80 million in 2013, and it was just acquired by **Cardinal Health** for \$320 million.

In addition to Confluent, EPI, and AccessClosure, Incept has spawned several other medical companies. These include **Ostial Corporation**, which is developing a new technology for treatment of aorto-ostial disease (AccessClosure/Cardinal is the exclusive distributor of the company's *Flash Ostial System* - Dual Balloon Angioplasty Catheter in the U.S.); **Sadra Medical**, acquired by Boston Scientific, which is developing a repositionable/retrievable percutaneous aortic valve; **Ocular Therapeutix**, which recently gained FDA approval for its *ReSure Sealant*, indicated for the prevention of postoperative fluid egress from ocular incisions with a demonstrated wound leak following cataract surgery; **HotSpur Technologies**, a seed-stage device company focused on the development of technologies for treatment of dialysis grafts (acquired by **Teleflex**); and **Nextplane**, an angel-funded company providing secure and scalable federation and management solutions for unified communications (UC) platforms.

The most recent Incept start-up, **Claret Medical**, founded by entrepreneur Randy Lashinski, and currently led by a highly seasoned CEO, Azin Parhizgar, is developing dual-filter cerebral vascular protection systems to minimize stroke rates in transcatheter aortic valve replacement (TAVR), surgical aortic valve replacement, and other endovascular procedures. This February, Claret received Investigational Device Exemption (IDE) approval from the FDA for a multicenter study of the company's CE mark-approved *Sentinel Cerebral Protection System* (CPS) for embolic protection during TAVR. Khosravi is

very excited about the potential of this technology to reduce the incidence of debilitating embolic stroke during interventional procedures, believing that Claret will change the way TAVR is performed, minimizing costly complications for the healthcare system and patients.

In addition to his Incept companies, Khosravi also sits on the board at **Cibiem**, run by Ken Martin, former CEO of Sadra Medical through its acquisition by Boston Scientific, where Fred and Ken got to know each other in the trenches. Cibiem is developing carotid body modulation technology that holds promise for the treatment of high-prevalence conditions such as hypertension, heart failure, diabetes and renal failure. He is also working with his colleague from EPI and former founding President and CEO of Sadra Medical, Amr Salahieh, on the atrial fibrillation start-up **Apama Medical**, started out of Salahieh's medtech incubator, **Shifamed, LLC**.

He is also working as interim CEO with his Incept partner, Sawhney as chairman, at the Boston-based start-up **Augmenix**, which is utilizing another of Sawhney's hydrogel technologies to improve outcomes in radiation oncology and surgery, including prostate cancer therapy.

Additionally, Khosravi has served on the boards of **Kerberos Proximal Solutions**, which developed a mechanical thrombectomy device for the vascular system, utilizing a technique known as "rinspiration" (rinsing plus aspiration); before its acquisition by **FoxHollow Technologies** in 2006, and **Advanced Stent Technologies** prior to its acquisition by Boston Scientific.

He is also a member of the Board of Trustees at the Center for Strategic & International Studies, a bipartisan

Washington think tank focused on policy initiatives dedicated to finding ways to sustain American prominence and prosperity. Moreover, he is a Convening Board Member for a nonprofit called Technology for America, with a strategic vision to engage and create bridges between the technology community and the government, focusing on American competitive leadership.

The following is part of the conversation Life Science Intelligence had with Khosravi regarding his thoughts about the device industry and investment climate, both today and looking out into the future.

Perspective on the Device Industry and Investment Climate

Q. What do you feel are the main attributes that characterize today's medical device industry, and how do you feel it is changing or evolving?

A. "We're coming into a stage where the kinds of investments that are going to be made in the device industry have to take out cost from the overall healthcare expenditure. If we're not doing that, it doesn't matter what problem we're solving, it's going to be difficult to fund those technologies. That said, the healthcare expenditure problem can't simply get resolved by making medical devices more inexpensive. Medical devices in and of themselves don't add very much to the total hospital spend— 4-5%, according to Mark Leahey of the Medical Device Manufacturers Association (MDMA).

But, it's the impact of medical devices that can move the needle on healthcare costs: offering preventative solutions, taking out complications, sending patients home earlier, ensuring that you need less hands in the hospital to take care of patients. The medical devices that can make that kind of impact are the ones that will be funded in the future.

I feel the next ten years in the device industry are going to be very different from the last ten years. Of course, a lot of the basic principles of running a business we've learned in the past will apply, but I think the technologies of the future really need to be congruent with the way the healthcare ecosystem is going to work.

Q. What do you feel are the biggest challenges to the device industry, looking out the next few years?

A. "It's very encouraging to see the FDA climate changing to accept more engagement from industry.

In terms of reimbursement and CMS, I feel that there's a lot more work to be done to foster the same kind of public-private partnership that we've seen over the last few years with the FDA. The industry needs to impress upon CMS that we have the same objectives as they do. Their oars need to row in the same direction to essentially establish congruency between the reimbursement regime and the innovation ecosystem of the future, both focused on reducing cost of healthcare."

Q. What's next for you, what can we look forward to seeing in the coming months?

A. "I'm hoping to continue to be able to make an impact in maintaining the innovation culture that we have in the United States, which differentiates us from the rest of the world, and in line with the our evolving healthcare system." *LSI*

**Comments on our Innovator
of the Month series?
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feedback!**

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