

Merging medicine and technology, ArthroLense is shaping the future of orthopedic joint replacement

The creators of a 3D spatial mapping device are revolutionizing the accuracy and drastically reducing the cost of traditional joint replacements with holographic technology.



Two preeminent orthopedic surgeons partnered with Toptal to develop technology that brings unparalleled insight and real-time coordinates to high-volume surgical procedures.



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—

David Backstein
MD, MEd, FRCSC,
Co-founder, Arthrolense

The Client

Arthrolense is a pioneering innovator of image-guided surgical-assist technologies. With a focus on high-volume procedures, such as hip and knee arthroplasty, Arthrolense enables physicians to make treatment decisions based on patented, augmented-reality hologram technology.

The Challenge

With a bleeding-edge idea and the need for technological and design expertise, Arthrolense partnered with Toptal to make their innovative idea come to fruition.

The Services

[Toptal Projects](#)

[Toptal Developers](#)

[Toptal Designers](#)

The Result

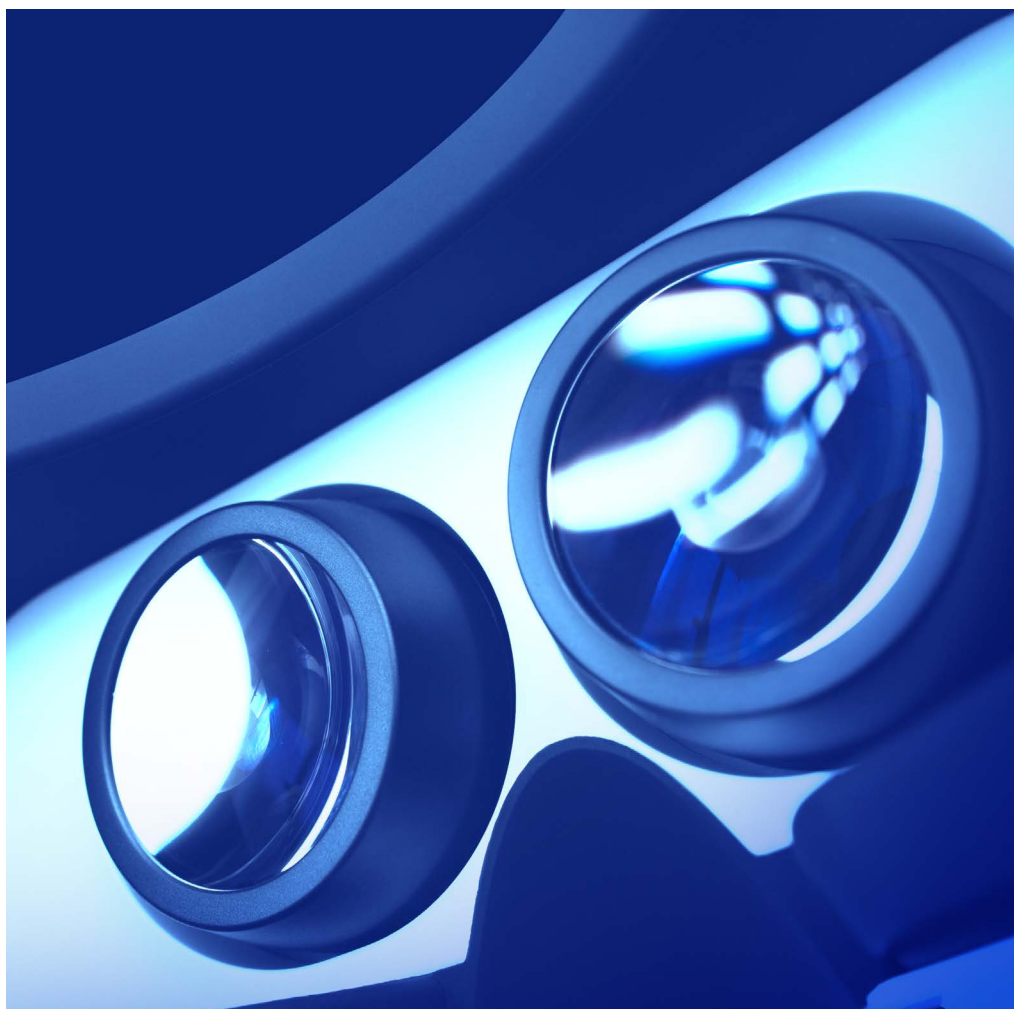
The state-of-the-art augmented and mixed-reality surgical guidance system is poised to take the medical world by storm.

Evolving eyeglasses for streamlined surgeries

Drs. Russell Nevins and David Backstein are high-volume orthopedic surgeons who specialize in knee replacements. Nearly 1 million such procedures are performed in the US annually, a number that is projected to grow to 3.5 million procedures per year by 2030. Historically, these surgeries are performed using reusable metal jigs, which are expensive, cumbersome, and difficult to clean and transport.

When the surgeons first met at a conference several years ago, their chemistry was instantaneous. That spark led the duo to partner on multiple patented design and development projects over the years. So, when Nevins approached Backstein with a seemingly outlandish idea, Backstein was quick to see the potential. “Orthopedics is very right-angle oriented and has a very mechanical nature,” Nevins says. “And I have this funny little obsession with eyeglasses.” Struck by a revelation, he asked his eyeglass purveyor if he could create lenses with built-in right angles that could be utilized in surgery, referencing the transparent head-up display feature available in many contemporary cars.

Inigorated by the idea, Nevins began to research the world of virtual reality. He came upon Microsoft’s HoloLens,



an immersive mixed-reality headset that embeds holographic imagery and applications into physical surroundings. Nevins then reached out to Backstein and asked, “David, what do you think of this crazy idea? There’s nothing like this out there at all about using these goggles that can give you these right angles and tell you that you’re putting

everything in the right place.”

Backstein immediately saw the prospective value, and the pair conceived a solution. They wanted to create a way to overlay hologram imagery with physical reference points in a patient’s body, giving surgeons unparalleled real-time insights.

Building a business case

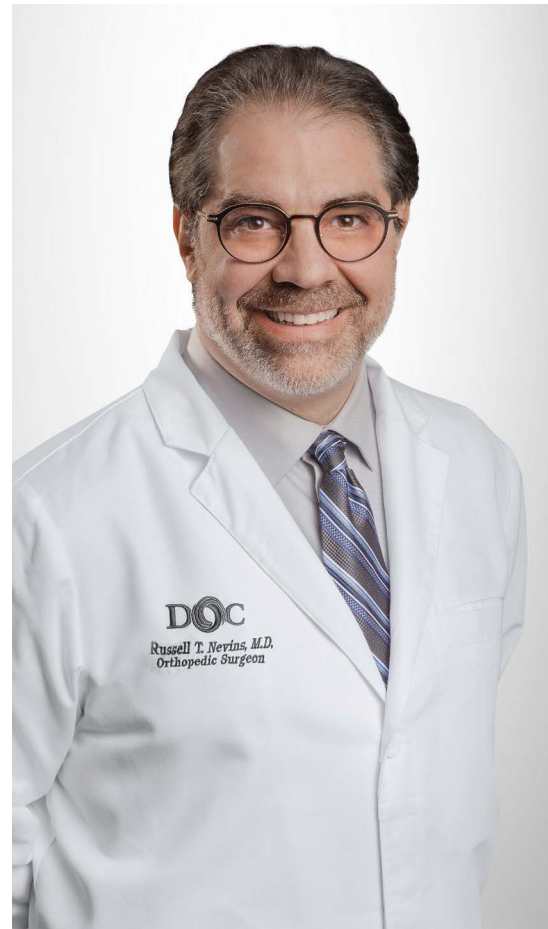
The two surgeons knew they'd need support to advance their idea, so Backstein contacted his friend, Brad Nathan, President of Lynx Equity Limited, a private equity firm focused on investing in midmarket companies.

Backstein recalls, "It wasn't just a matter of a phone call, to be quite honest. Brad was in San Diego that winter. I went down to San Diego. We had about three days of discussions. He probed and prodded a lot to figure out what we were really talking about, what the potential upside was, and to his credit, he saw that." Despite the friendship with Backstein, Nathan knew the idea needed to be thoroughly vetted, as it was outside of Lynx's traditional customer profile. "One of the things that stands out in this kind of investment world is where

there's a demonstrative and clear-cut value, and you're able to make the business case for it pretty clearly," says Nathan.

"Russell and I have 20-plus years of background in joint replacement, particularly knee replacement, so we're acutely aware of all the surgeon-cited issues," says Backstein. "But because we also do a lot of consulting for orthopedic companies, we're aware of what impacts the commercial side of it [the business] and the vendors. So, I think what appealed to Brad was that we had a good argument to make for the potential upside of this, both for surgeons and for the industry. As a business manager, Brad saw the benefit to commercial companies as a potential big winner for us."

Nathan brought aboard his colleague Daniel Lisus, a mergers and acquisitions analyst, to help support the surgeons' initiative, and the foursome set out to make their vision a reality.



Dr. Russel Nevins
MD, Co-founder, Arthrolense



Dr. David Backstein
MD, MEd, FRCSC, Co-founder, Arthrolense

Seeking a solution

While the team had unparalleled expertise in their areas of focus, they had no idea how to proceed with building a brand-new technology. Having required development support on previous projects, the Arthrolense team reached out to a freelancer they'd used in the past. After a preliminary discussion, they knew they needed to continue their search for the right partner. They began to search online, discovered Toptal, and scheduled a meeting.

"The price would have been triple what it ended up being with Toptal,"

said Nevins. "What he was asking was just outrageously crazy. Also, I don't know if we would've gotten it done in a timely manner because there was nobody in charge that was pushing it through."

The Toptal talent network delivers

After one conversation with the Toptal team, the Arthrolense creators knew they'd found the partner they needed. Toptal had the technological expertise, the design proficiency, and the project management structure necessary to complete their vision. Leveraging the Toptal Projects offering gave the Arthrolense team the fully curated and managed support system required to realize

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their vision.

“Any project that we do, we run a discovery at the beginning, usually two weeks,” explains Alexander Weekes, a project manager in the Toptal network. “It’s to understand and identify the blocks that we can use to build the idea. Their vision was really clear. It was based around improving efficiency and costs for orthopedic surgery. As it was then, they have these big metal jigs that they use. It costs a fortune to clean

them, a fortune to transport them; it makes knee surgery very expensive. And there’s a lot of human input, which obviously allows for human error as well. They saw a better way of doing that using augmented reality. We’re talking about literal surgical precision here, because 1 millimeter makes a massive difference when you’re operating on someone’s knee.”

A project with monumentally high stakes required a team of subject matter experts at the top of their fields who could work together across an array of time zones. “As you can imagine, there aren’t many projects like this globally anywhere, so there aren’t that many people who have this skill set,” says Weekes. Drawing on the breadth of expertise in the Toptal talent network, the Toptal Projects team enlisted Hovhannes Sargsyan, an accomplished C++ developer in a league all his own.

“We were worried because it was very difficult to find somebody who actually knew how to do that kind of software program, because it was so early in its infancy,” states Nevins.

“And then we got hooked up with Hovo who’s been with us now for two years. He’s our main guy. And he’s just phenomenal.”

Backstein adds, “One thing that informed our perspective about Toptal is the fact that they had a person like Hovo available. I mean, he’s a unique talent in many different ways. And I think the whole thing was made or could have been broken by whether or not Hovo was any good. To Toptal’s credit, they had this unbelievable talent ready for us to go.”



Alexander Weekes, Toptal Project Manager

Harnessing a vision

With the development portion of the project well underway, the team needed a designer to create a cohesive aesthetic for both the HoloLens interface, as well as the application that would accompany the device. It needed to be a HIPAA-compliant and user-friendly UI that doctors could easily navigate. “They’d almost worked reverse in the aspects of what they’d done,” recalls Toptal talent network designer Clarke Noone. “They started developing the product from a code perspective, and then thought about design afterward. I think that was done purely because it’s such a groundbreaking product that they needed to know whether it was even possible first, from a code point of

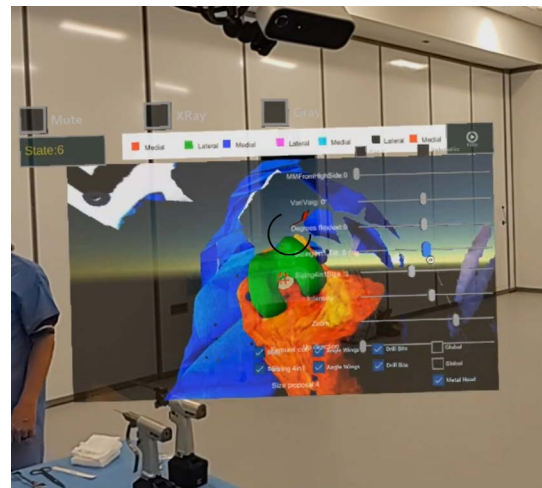
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– Clarke Noone
Designer, Toptal

view, before they even thought about what it might look like visually.”

Noone continues, “It was an interesting project because it wasn’t just a straightforward kind of design. There was obviously an app that goes with it, which is for your iPhone or your Android, but the important part is that it connected through to the HoloLens glasses, which was a new challenge. So, there was a bridge of communication that

needed to be thought about in the product. When I started to create a design, it was necessary to think about how that was applied in a 360-degree manner.”



The long and winding road

The Toptal Projects team held a showcase every two weeks where they’d present their progress in a staging environment and get the surgeons’ feedback before pushing it into production.

“Both Russell and David were really great,” says Weekes. “They were on hand to respond to things. If they weren’t in surgery, they were working with us.” The entire team made themselves available to keep the project on track and on time. “Hovo lives in Armenia. He basically changed his life, so he was working nocturnally. The output that he provided was incredible.”

Originally the team sought speed in getting the device to market, but as the project progressed, they found

themselves in a world of intellectual property and regulatory approvals they hadn’t anticipated. “The timeline for actually developing the software was faster than we expected,” says Backstein. “But the regulatory part of it? We really were novices.”

Nevins agrees. “Everything had just fallen into place when we needed it. The regulatory stuff is a different world which we had no idea about. But again, Toptal is helping; now we have this whole team to get it through the FDA and approved, and it’s a massive undertaking in itself, and Toptal is helping us get through all of that.”

The team also discovered that they would need to wait for the second iteration of the Microsoft HoloLens

device due to system requirements of the hardware. However, they’d had an important realization: Speed to market was not a true concern. Weekes states, “We realized that it was more about getting it right, because if we get this right and it works, it’s cutting edge and impossible to copy,” says Weekes. “Not many people will have the skill set to be able to do this. Let’s get it right, and get in front of the right people.”

Hitting their mark

Their patience was merited—the state-of-the-art Arthrolense surgical guidance system surpassed their initial vision. “It allows a surgeon to have visualization of a knee, or pretty much any joint,” says Backstein. “It gives you a degree of visualization that has never been possible before, an ability to manipulate information before you actually make any irreversible cuts to a patient’s bone. It is going to give us much better accuracy, reproducibility, and it’s going to do it all at a much lower cost than other attempts at doing the same thing.”

The benefits of the device are numerous. Not only will surgeons be able to operate with an accuracy threshold of under 1 millimeter, but they will also be collecting invaluable data every time the device is

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used. As biometric data accumulates, surgeons will be able to make data-driven decisions about bone preparation, implants, and equipment placement in real time, improving the outcome of surgeries on a varied patient population.

The cost savings derived from the Arthrolense device are extraordinary too. It eliminates the expensive instrumentation, transportation, and sterilization of old-fashioned jigs, cutting the total cost of surgery by 75%. “From a technology standpoint, the only thing that comes close to what we do is using robotics and navigation,” says Nevins. “A robot to do a knee replacement right now is anywhere between \$500,000 and a million dollars just to buy the product, and they take up a massive footprint in the surgical center.”

Compared to the cost of robotically navigated surgery, the Arthrolense device will save hospitals and surgical centers hundreds of thousands of dollars.



Looking to the future

The future looks incredibly bright for the Arthrolense founders, as they prepare to file for their first US Food and Drug Administration 510(k) package. “We believe this is going to be a real game changer in the orthopedic industry,” says Backstein. “We think that knee replacement is probably going to be just the first iteration of it. There’s nothing about the technology that couldn’t be applied to virtually any kind of surgery.”

“Toptal enabled us to succeed beyond our vision.”

– Russell Nevins

The partnership with Toptal was critical to the project’s success, according to the surgeons. “I think we had a vision for what we had hoped it would be at the end,” states Backstein. “And to be honest, I think it’s actually turned out better than what we expected, and that’s a result of collaboration with the Toptal Projects team.” Nevins agrees. “Toptal enabled us to succeed beyond our vision. That’s been the one main factor in this whole thing that we’ve never worried about,” he says. “That’s where we got very lucky—every step has seemed to work out. And Toptal was one of the fundamental reasons. We’re very grateful.”



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