

A background image showing a person's legs running on a treadmill. A 3D anatomical model of a human foot and lower leg is overlaid on the right leg, showing the bones and joints in a glowing orange and yellow color. The text 'DIGITAL ORTHOPAEDICS' and 'Case Study' is overlaid on the left side of the image.

# DIGITAL ORTHOPAEDICS

## Case Study

Photo © Yuri Arcurs

### Challenge:

Digital Orthopaedics, a surgical planning services provider to the healthcare industry, transforms highly complex orthopaedic surgeries and treatment by personalizing precision medicine. Placing the patient at the core of its approach, the company wants to create an innovative system to reshape the way surgeons are planning and simulating medico-surgical treatment, and help them analyze musculoskeletal pathologies and evaluate the operation's success.

### Solution:

As part of the **3DEXPERIENCE** Lab program, Digital Orthopaedics uses the **3DEXPERIENCE** platform on the cloud to model and simulate surgery scenarios before treatment starts to ensure the success of the procedure. Digital Orthopaedics is using the Concurrent Equipment Engineering solution.

### Benefits:

- Provide orthopedic surgeons with an efficient clinical decision support service
- Develop, test and deploy personalized solutions
- Allow patients to better understand the process and treatment
- Collaborate and exchange within a user community of physicians and engineers
- Provide a framework for information and process flow automation, from medical imaging to realistic simulation and 3D modeling
- Enable a connection to hospital imaging systems



**"It's a complete revolution, since we are moving from reporting a possible complication to anticipating it."**

– Thibaut Leemrijse, Medical Director and cofounder, Digital Orthopaedics

## A NEW SURGICAL APPROACH

The results of a surgery can be radically different from one patient to another, even when suffering from the same condition. Performing ever-increasingly complex operations, the surgeon must offer treatments that aim to preserve the patient's functions and meet their post-surgical expectations. In this context, predictive personalized medicine and targeted therapies are transforming the medical industry.

The Belgium-based start-up Digital Orthopaedics has developed a cloud-based clinical decision support system that transforms and personalizes the planning and treatment of foot bone and joint issues with surgical intervention using modeling and simulation tools. This innovative technique can help surgeons identify the correct diagnosis for each patient and then custom-design the best treatment for their specific problem.

"Today, if you come to see me with osteoarthritis in your ankle, I would examine the x-rays and decide if you needed an operation, without being sure how you will respond to stressful situations such as running, walking and climbing," explained Bruno Ferré, orthopedic surgeon, medical director and cofounder of Digital Orthopaedics. "With our tool, we're able to simulate and test the operation in all of these situations prior to the surgery, and predict if it will have the expected results," added Thibaut Leemrijse, medical director and cofounder. "It's a complete revolution, since we're moving from reporting a possible complication to anticipating it."

Digital Orthopaedics creates the required structure to develop specific 3D digital models using scanners and patient MRI results. This 3D model enables physicians to make a diagnosis, define optimal treatments and simulate in silico (computer model-based) surgery on a virtual twin of each patient. The system consists of a knowledge base of diagnostic support, a personalized 3D surgical simulation tool, and a library of clinical cases.

This approach changes the current one-type-treatment fits all model to a personalized, therapeutic approach that takes into account the patient's unique anatomy and functional entities.

## SIMULATING COMPLEXITY

The anatomy of the human foot and ankle comprises 28 bones interfacing with cartilages around 40 joints defined by more than 100 ligaments and driven by more than 30 tendons. Functionally, foot movement varies a lot depending on the muscular activation of each patient for every gait scenario—walking, running, jumping and so on. The literature currently available on physiology and biomechanics is insufficient to understand the dynamic behavior of all the functionalities of the the human foot.

"Geometry used to be the only mean for surgeons to perform simulation," Ferré said. "The patient was assessed in a static way, and the surgeon operated without visualizing what would happen from a dynamic point-of-view. The solutions Dassault Systèmes offers help us to leverage all our knowledge by structuring it using algorithms. For years, these solutions focused on the laws of physics and processes used to simulate how cars and airplanes operate. This collected intelligence is now being extended to other applications and offers my team many solutions to help us plan and perform orthopaedic surgery."

To implement the diagnostic support system, develop their simulation tools and build their databases, Digital Orthopaedics teams benefited from the support of the **3DEXPERIENCE**® Lab, the Dassault Systèmes' accelerator program.

Digital Orthopaedics uses the **3DEXPERIENCE** platform with CATIA and SIMULIA to customize the modeling of each patient's foot and ankle by performing a virtual biomechanical clone. "I've recently started working with CATIA and it's really magic for creating geometries," Ferré said. "Creating 3D models of complex joints based on their actual behavior and then, using SIMULIA to simulate complete multi-body systems, helped us understand the overall movement of the foot. The joint kinematics data was then used for modeling, using the finite element method, to simulate the complexity of the foot behavior in contact with the ground, including pressures sustaining the articular cartilage and tissue stress levels."

Digital Orthopaedics and its partners also rely on ENOVIA to collaboratively manage the design process, flows and process automation, especially ones involving integration of patients' medical imaging.

## THE POWER OF THE CLOUD

The **3DEXPERIENCE** platform on the cloud gave Digital Orthopaedics the ability to harness the power of high performance computing with state-of-the art tools. Most surgeons are unable to invest in specific onsite equipment but can access Dassault Systèmes' platform on the cloud through a simple web interface on their computer that gives them quick access to Digital Orthopaedics services .

"Providing access to our services on the cloud is essential to be fully functional and profitable," said Edouard Lété, Digital Orthopaedics CEO. "The **3DEXPERIENCE** platform on the cloud



**"Modeling and simulation are the foundation of tomorrow's medicine."**

– Bruno Ferré, Orthopedic Surgeon, Medical Director and Cofounder, Digital Orthopaedics

has the powerful computing capacity we needed. It facilitates close collaboration among engineers and medical staff gathered within a multidisciplinary team, which is key to the group's success. With the platform, we share techniques and best practices among surgeons and hospitals all over the world—the cloud offers unique advantages."

Digital Orthopaedics' services, powered by Dassault Systèmes cloud-enabled platform, include a knowledge base designed to enable medical practitioners to enhance their skills and facilitate clinical decision-making.

Thanks to different levels of access, **3DEXPERIENCE** enables managers, doctors, surgeons and healthcare professionals to collect and analyze clinical signs and patients' medical imaging, and define the most appropriate treatment options based on algorithms created in conjunction with international experts that serve as members of the company's scientific committee. Patients are also able to connect to the **3DEXPERIENCE** platform to get a comprehensive view and a better understanding of the process set up for his/her surgery and the postoperative medical follow-up, promoting patient accessibility to information.

A surgical planning support service helps orthopedic surgeons validate their surgical plans after an in-depth etiological analysis of the pathology. All of this structured data feeds a library of clinical cases that enriches the knowledge base of foot and ankle pathologies, managed on the **3DEXPERIENCE** platform. In turn, these clinical cases make it possible to refine the expert system recommendations and surgical simulation, while reducing mistakes and costs.

### CUSTOMIZING FOR BETTER CARE

Digital Orthopaedics sees itself as a key player in the radical shift in medicine, leveraging the power of digital technology to serve patients. They are invested in passing on their acquired knowledge to future generations through the best and most efficient means possible.

"As a doctor, my duty is to provide excellent care and do everything to improve the human condition. That's why collaboration is so important," Ferré said. "A lot of surgeons still don't fully understand the power of simulation and part of my role is to convince them of how essential it is to the advancement of medicine overall. As a surgeon myself, I can explain to them the multiple benefits of predictive simulation."

Ferré is clear on the value this approach brings—the ability to pinpoint the correct diagnosis, adapt it to each patient, and then submit a customized treatment. "The influence of basic science has grown in recent decades," he added. "We have reached a point where the power of using data can be harnessed by evidence-based medicine. While being careful with personal data protection of each patient, we can use their digital data to improve analysis of specific issues to offer the most appropriate therapy approach."

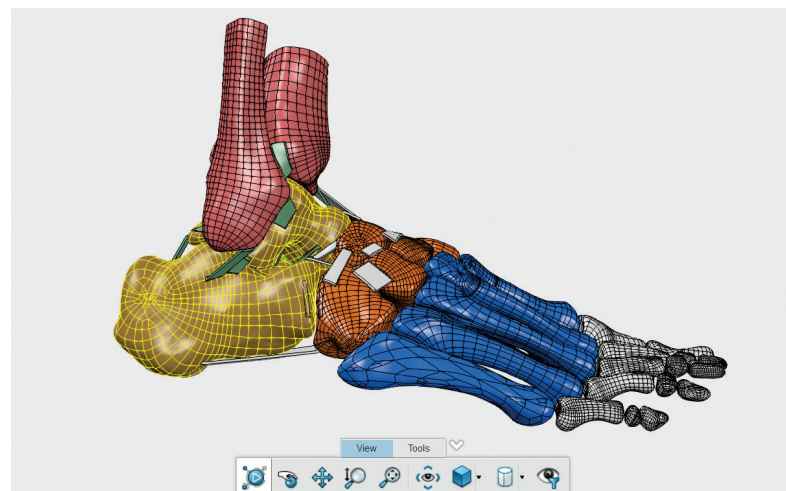
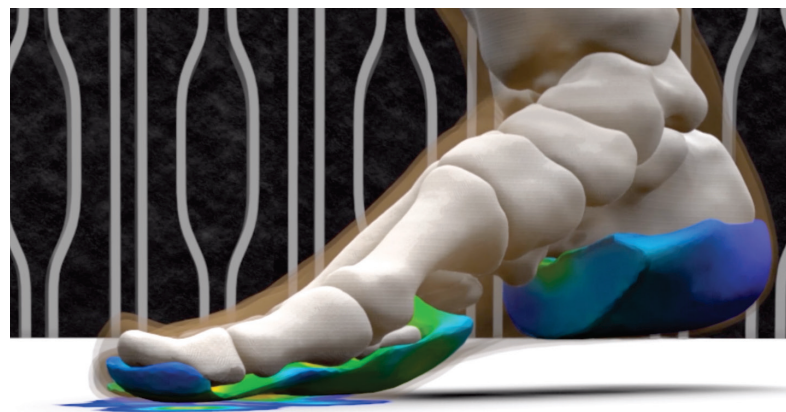
For many surgeons, this paradigm shift also stems from the value of simulation in a clinical decision support system. "For example, the calculation on the virtual twin can precisely show the stress flows and the specific constraints hampering the movement of the foot," Lété said. Once surgeons see the added value of the system, Lété believes they'll be much more inclined to adopt it. In addition, practitioners already using advanced tools—such as surgical robots—are already convinced that simulation can help them prepare a surgical plan beforehand, or even practice the procedure. "However, while we can help surgeons consider all the surgical options, the final decision is still theirs in the operating room. That's crucial," Lété said.

#### More about the solution:

Concurrent Equipment Engineering provides the digital continuity needed to manage all engineering, simulation and manufacturing information consistently. It serves to break the information silos between these and other business disciplines, improving collaboration and accelerating the pace of operations.

#### Benefits:

- True concurrent engineering
- Fast and robust product development
- Performance driven design
- Quality by design



**Top image:** Simulation of foot behavior in contact with the ground with SIMULIA

**Bottom image:** 3D modeling of a foot designed with the **3DEXPERIENCE** platform



## About Digital Orthopaedics

Digital Orthopaedics has developed a Clinical Decision Support System to target diagnoses and personalize therapeutic treatments for the foot and ankle, tailored to each patient's profile.

**Date founded:** 2016

**Employees:** 22

**Headquarters:** Mont-Saint-Guibert, Belgium

**More information:** [www.digital-orthopaedics.com](http://www.digital-orthopaedics.com)

## About the 3DEXPERIENCE Lab

The 3DEXPERIENCE Lab is Dassault Systèmes' innovation laboratory that provides special access to the 3DEXPERIENCE platform and customized support to start-ups, to incite the creation of innovative, sustainable products and accelerate the development of their concepts.

**More information:** <https://3dexperienclab.3ds.com>

## PATIENT FIRST

Digital Orthopaedics is committed to solutions that put the patient at the core of the healthcare system. Education is an important aspect of this evolution to ensure patients take an active role in their recovery. "In the future healthcare system, the role of the patient will be increasingly important," Lété confirmed. "Patients are often well informed, mainly because of the Internet," Ferré added. "With simulation, the doctor can demonstrate exactly what's wrong and the purpose of the surgery. And, patients immediately understand and appreciate the value of a treatment tailored to their own body. This further strengthens their confidence in their surgeon. Modeling and simulation are the foundation of tomorrow's medicine."

"Digitalization has improved many trades and will significantly change surgery," Ferré concluded. Instead of individual practitioners handling a case from diagnosis to therapy to surgery, an entire team will rely on a state-of-the-art process. Algorithms and Big Data will improve the chances of recovery. Each new case will generate data and will enrich the existing knowledge base."

## Our 3DEXPERIENCE® platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the 3DEXPERIENCE Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating 'virtual experience twins' of the real world with our 3DEXPERIENCE platform and applications, our customers push the boundaries of innovation, learning and production.

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