Patient numérique et santé

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Digital Orthopaedics
Digital Twins for Patient Care & In-Silico trials

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Edouard Lété, CEO
Content

- Digital Orthopaedics company’s foundation & the 3DOXpert Platform
- From digital twin to therapeutic prediction in orthopedic surgery
- In Silico Trials in medical device development & certification
Are we successful today in Foot & Ankle surgery?

Only 15% of patients categorized recovered/resolved!

Are we considering patient’s variability & expectations enough?

If we personalize medical treatments and anticipate their results ... > we can improve patient care.
Digital Orthopaedics company’s foundations

Founded in 2016 & +20 people
Stable Shareholders
Financially Supported by the Walloon Region
ISO 13485 - 2016

A Team
Combines management, engineering, regulatory & in-depth medical expertise provided by founders Dr. B. Ferré & Dr. T. Leemrijse

Medical Expertise
Recognized experts in Foot & Ankle surgery, members of our Expert Committee

A 3D0Xpert Platform
To digitally integrate & capitalize the Knowledge & the Knowhow

Key Partners

Recognized experts in Foot & Ankle surgery, members of our Expert Committee
Digital twin for therapeutic prediction in orthopedic surgery
Build a suitable twin (ex: Foot & Ankle)

- From Scan of the patient
  - To network of points (or orphan mesh)
  - To CAD model (mathematical surfaces)

- From CAD model
  - To MBDS models (Multi-body)
  - To FEM models (Finite Element)
From imagery to Mathematical (CAD) surface
What brings a parametric CAD Surface?

- From Manual extraction to Automatically proposed
- From 2D Static Image to 3D Real-time Animation
- From Geometry to Realistic Simulation by CAD/FEM Integration
- From Bones Only to Complete Foot behavior
- It is a Path to PLM adoption (open many other possibilities)
We complete the foot with soft tissues in the 3DEXPERIENCE

- A joint is Bones … + cartilages + ligaments + Tendons
- Difficult to get shapes of soft tissues in imagery
- We use a morphing technique to place the soft tissues
Simulate the pathologic patient

Reconstruction of Muscular Activation Scheme

Cause-effect Relationships

Virtual Pathology: all clinical signs included
Simulate the post-surgery

- To view the improvement on stress & test variations
In Silico Trials for the development & certification of medical equipment's
Value of Simulation for MD Companies

- Simulation as a Tool
  - Verification Tool
- Simulation as a Process
  - Optimize, Improve & Extend life of new Devices
- Simulation for Virtual Testing
  - Product-Model interaction with Realistic conditions
- Personalized Surgery Simulation
  - Product-Patient Interaction to Guide the Surgeon

Value of Simulation

Adoption of Simulation

- Analyst
- Project team
- Enterprise
- Extended Enterprise
In Silico Clinical Trial supported by the FDA

Reliance on Evidence from Different Models

TODAY

FUTURE

Concept of “In Silico Clinical Trial”

Advancing Regulatory Science with Modeling and Simulation at FDA

Tina Morrison, Ph.D.
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Chair, FDA Modeling and Simulation Working Group
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In silico Clinical Trials

Base: A. et al., J of Med Dev, 2020
Modified: Original by Mark Palmeri, Medtronic, Inc.
Total Ankle Replacement (TAR) Wear Test «As-Is »

- Time : ~10 months (testing + implant manufacturing) ... for 1 implant
- Cost : ~100k€ (tooling, testing, time & materials)
- How close to reality
TAR Wear Test «To-Be »

- Time < 1 month
- Cost << 100k€
- And more …
  - Variant Study to cover more protheses
  - TAR in digital model …
TAR Workflow + product-model interaction

TAR workflow example

Total Ankle Replacement (TAR) System

ISO22622

Wear Map

Mass loss

Total Ankle Replacement (TAR) System

ISO22622
Benefits of Digital Twins

For the Surgeon & the Patient
- A Clinical decision support platform to help the surgeon capture patient data, confirm the pathology & treatment in a guided way
- Simulate the surgery & evaluate variations in order to find the best options for the treatment based on the digital twin of the patient

For the Development of implants & prosthetic ankles
- Provide Realistic Conditions for the analysis of new devices
- Provide a Virtual Models to experience & teach on device usages.
- A Virtual Testing Workshop for the development, certification and improvement of devices.