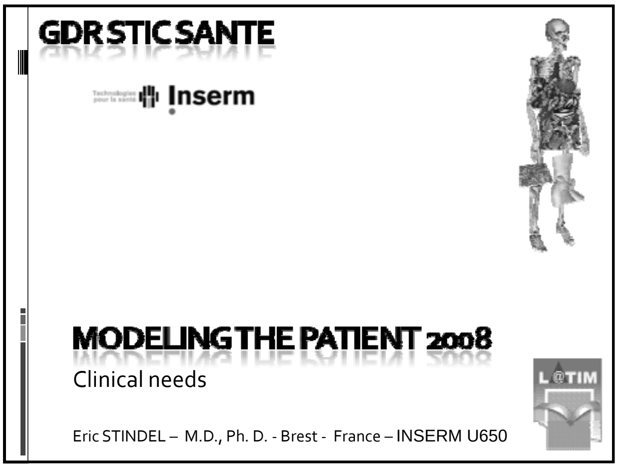
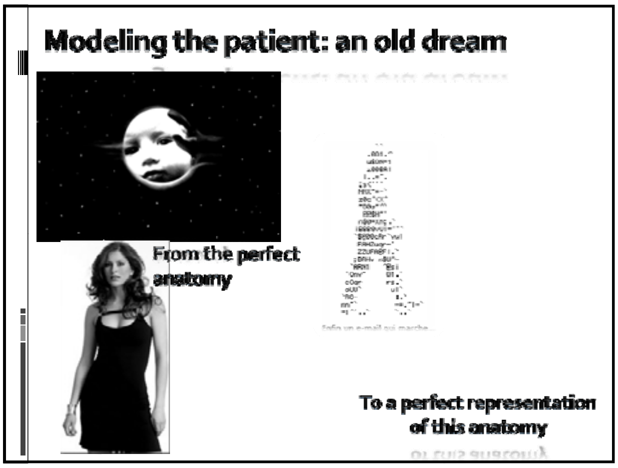
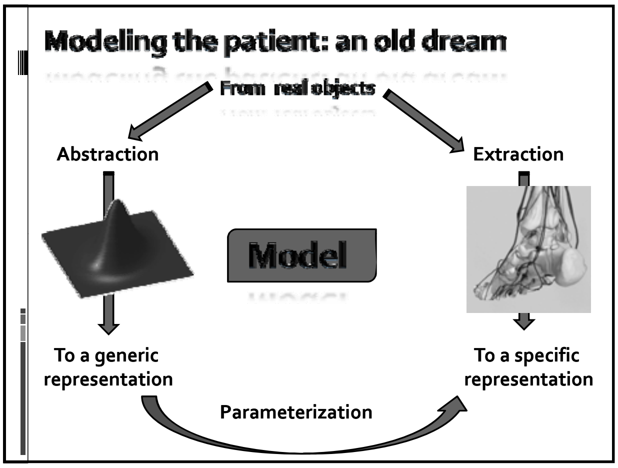
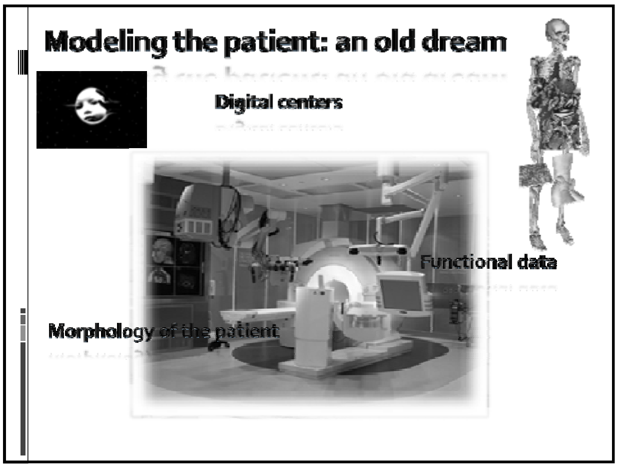
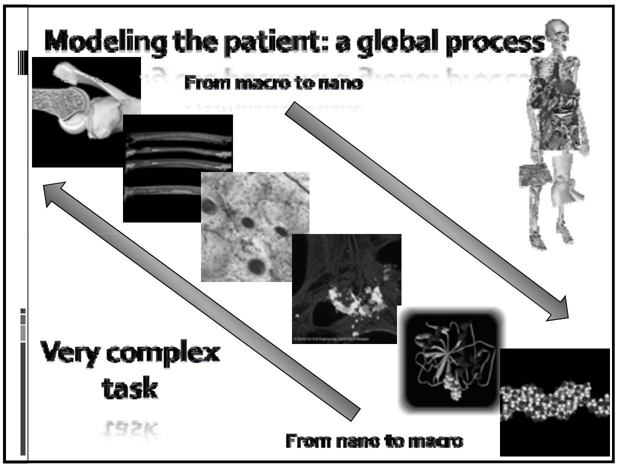
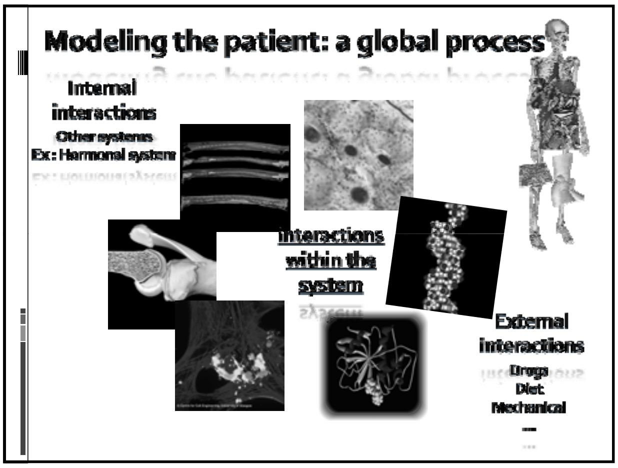

GDR STIC SANTE
Inserm
MODELING THE PATIENT 2008
Clinical needs
Eric STINDEL – M.D., Ph. D. - Brest - France – INSERM U650
L@TIM


Modeling the patient: an old dream
From the perfect anatomy
To a perfect representation of this anatomy


Modeling the patient: an old dream
From real objects
Abstraction
Extraction
Model
To a generic representation
To a specific representation
Parameterization


Modeling the patient: an old dream
Digital centers
Functional data
Morphology of the patient


Modeling the patient: a global process
From macro to nano
Very complex task
From nano to macro


Modeling the patient: a global process
Internal interactions
Other systems
Ex: Hormonal system
Interactions within the system
External interactions
Drugs
Diet
Mechanical
...

Modeling the patient: a global process

From simple models to complex system

A **complex system** is a system composed of interconnected parts that as a whole exhibit one or more properties (behavior among the possible properties) not obvious from the properties of the individual parts.

Systems can be too complex to be useful

Systems can be too complex to be integrated in clinical practice

What do we really need as clinicians ?

What do we really use as clinicians ?

What are our whishes in this domain as clinicians ?

The clinical workflow: an old process

- Perception
- Decision
- Action

The clinical workflow: an old process

- Perception

Pre-operative data

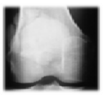
Collect data

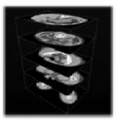
A priori knowledge

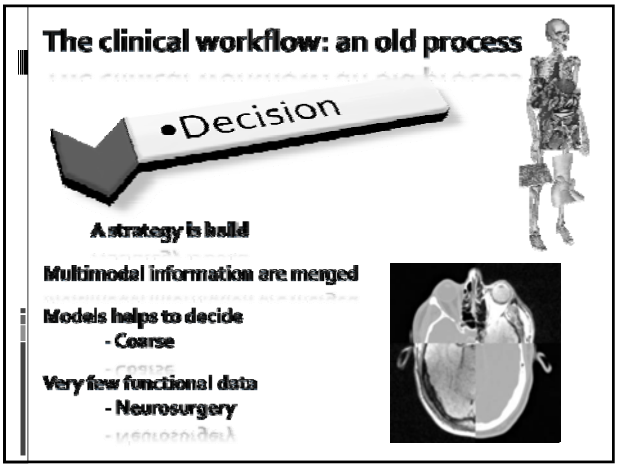
Statistical data

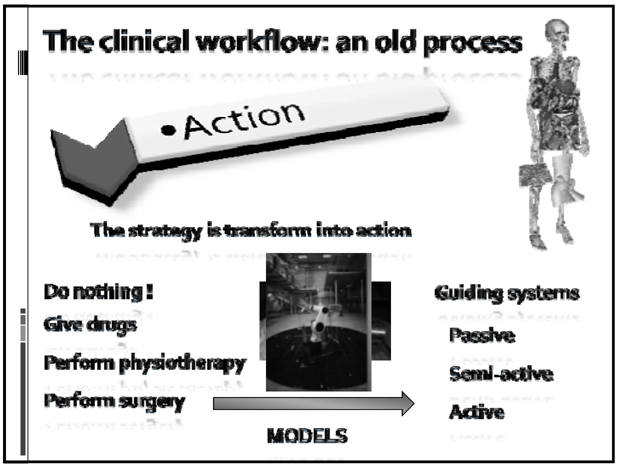
Questions to the patient

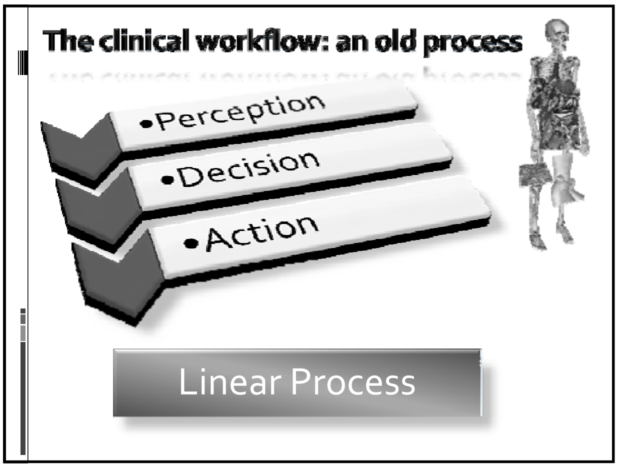
Clinical examination





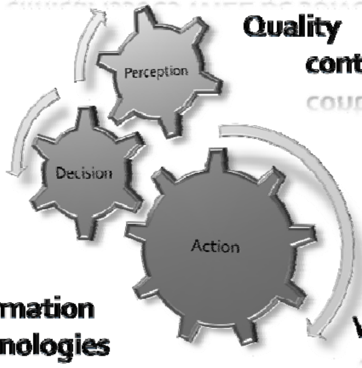

The clinical workflow: an old process
•Decision
A strategy is build
Multimodal information are merged
Models helps to decide
- Coarse
Very few functional data
- Neurosurgery


The clinical workflow: an old process
•Action
The strategy is transform into action
Do nothing !
Give drugs
Perform physiotherapy
Perform surgery
MODELS
Guiding systems
Passive
Semi-active
Active


The clinical workflow: an old process
•Perception
•Decision
•Action
Linear Process

How clinical issues WILL be solved ?

Quality control



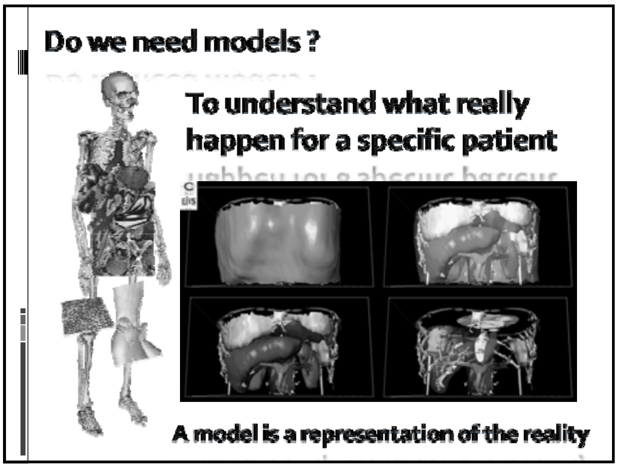
Information Technologies

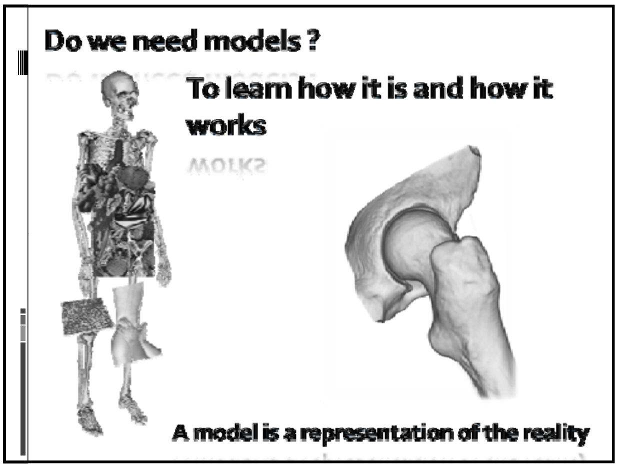
Validation

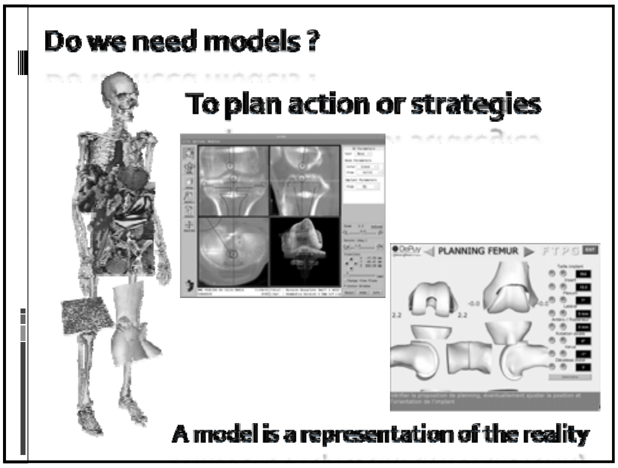
DO WE NEED MODELS ? AND FOR WHAT ?

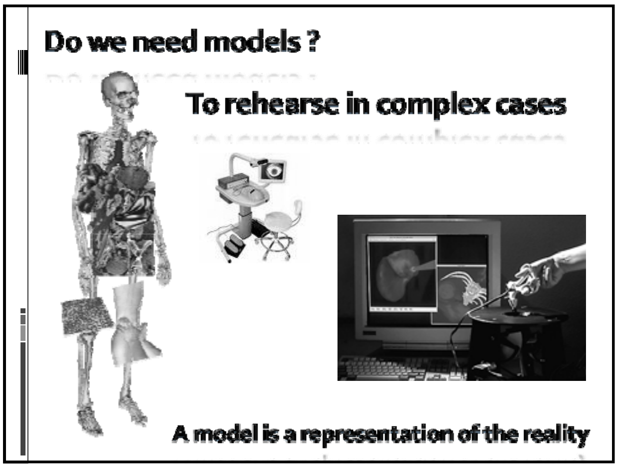
Do we need models ?

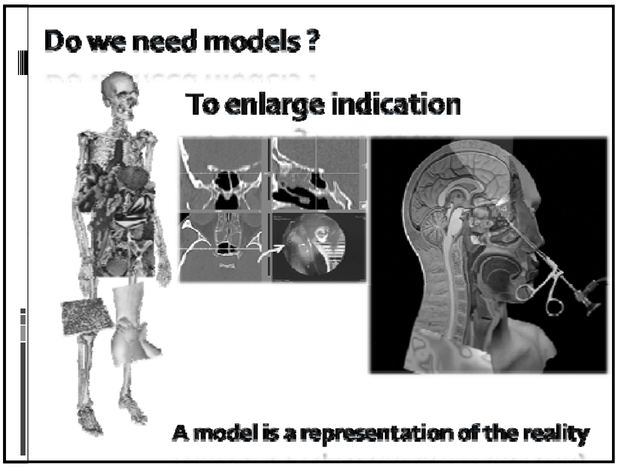
- To understand
- To Learn
- To Plan actions
- To guide actions
- To rehearse
- To enlarge indication
- To predict results
- To control the cost

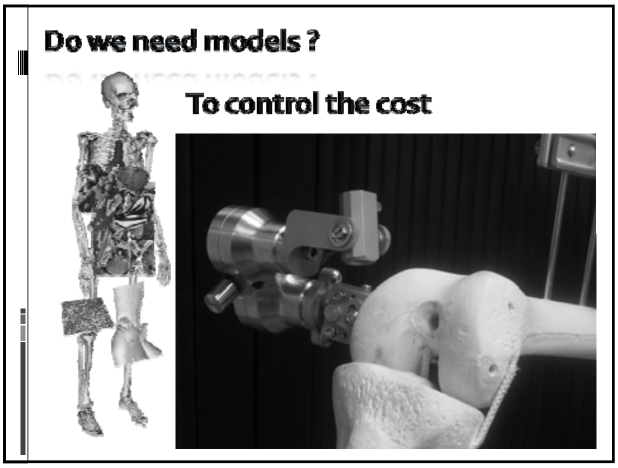

Do we need models ?
To understand what really happen for a specific patient
A model is a representation of the reality


Do we need models ?
To learn how it is and how it works
A model is a representation of the reality


Do we need models ?
To plan action or strategies
PLANNING FEMUR
A model is a representation of the reality

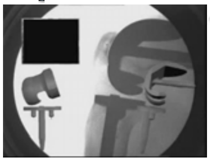

Do we need models ?
To rehearse in complex cases
A model is a representation of the reality


Do we need models ?
To enlarge indication
A model is a representation of the reality


Do we need models ?
To control the cost

Do we need models ?

To predict functionnal results



A model is a representation of the reality

WHAT KIND OF MODELS ARE REALLY NEEDED BY CLINICIANS ?

Models for real clinical applications

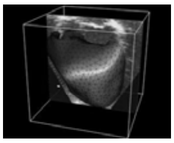
No need for research tools
- **Bring clinical added value**
- **Models that have been evaluated CLINICALY**
- **Cost is not the real issue**

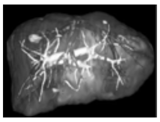
MR imaging

CT imaging

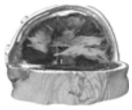
Models for real clinical applications

A lot of models





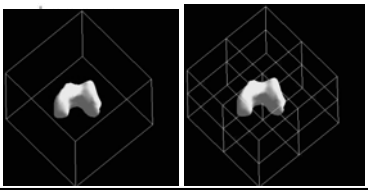
- Very sophisticated
- Statistical models
- Not specific / Realistic
- Not real time and time consuming



Models for real clinical applications

There is no meaning to the mean

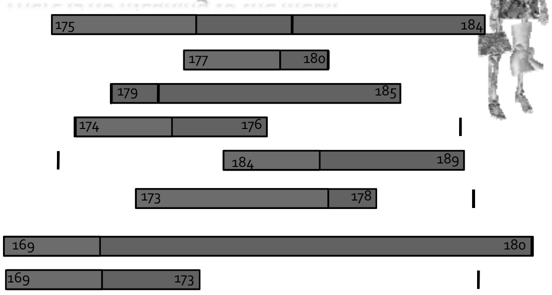
- Mean anatomy means nothing for a specific patient
- Models must be adjustable for each patient



Healthy and sick are different

Models for real clinical applications

There is no meaning to the mean

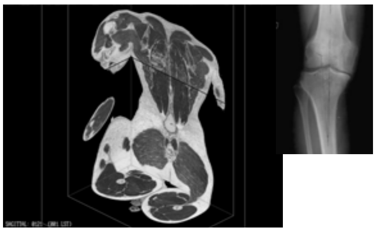


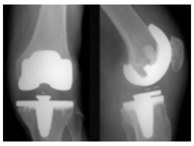
Healthy and sick are different

Models for real clinical applications

Humans are 3D objects for a 4D function

Inaccuracy of 2D approaches





A model is a representation of the reality

Models for real clinical applications

Humans are standing and moving 3D objects

Models for real clinical applications

Time is money

- There is no convenient time
  - Preop planning is time consuming
  - Intra-op planning increase O.R. costs

The faster is the better

May be room for new jobs or new levels of qualifications

Models for real clinical applications

Simplicity means adoption

- Light workflow is mandatory

Models for real clinical applications

Answer to a real clinical issues

- Quickly
- Accurately
- Safely
- With high reproducibility
- Specific of one patient

Transparency = Maturity

Keep them simple for the patient and the clinician

The school or chapel effect !!!

THE PROOF OF SUCCESS IN CAOS

The proof of success in CAOS

Really introduced applications

Computer Assisted Orthopedic Surgery

Real time

Statistical models are merge with patient data

Specific anatomy

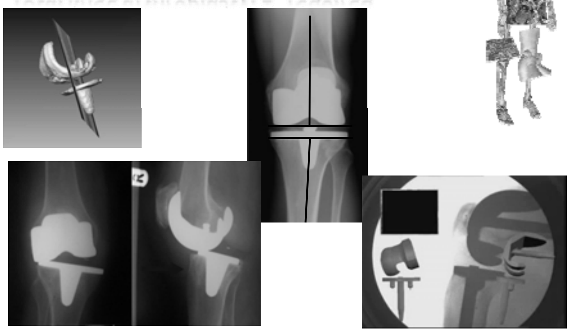
Limited

Clinically oriented to answer to narrow issues

Several hundreds of thousand of patients

The proof of success in CAOS

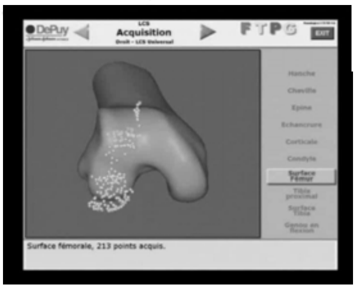
Total knee arthroplasty: 1° required



The proof of success in CAOS

Total knee arthroplasty: 1° requirement

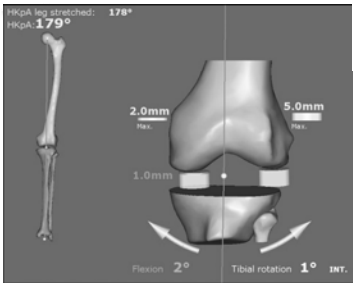
Bone morphing approach



The proof of success in CAOS

Total knee arthroplasty: 1° requirement

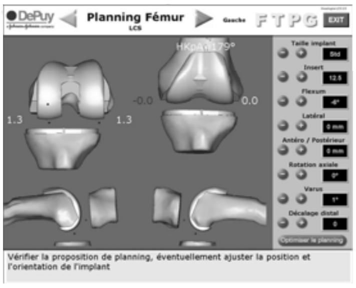
Integration of dynamic data



The proof of success in CAOS

Total knee arthroplasty: 1° requirement

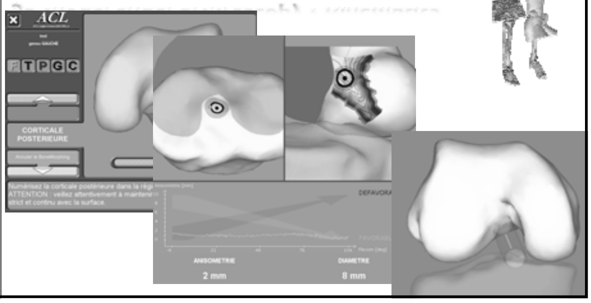
Implant planning



The proof of success in CAOS

ACL replacement: 1mm requirement

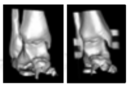
3D model under arthroscopy + Kinematics

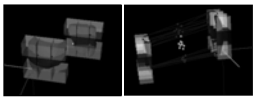


The proof of success in CAOS

Many others applications = BRICKS

Total hip arthroplasty
Total hip resurfacing
High tibial osteotomies
Spine surgery
….
….





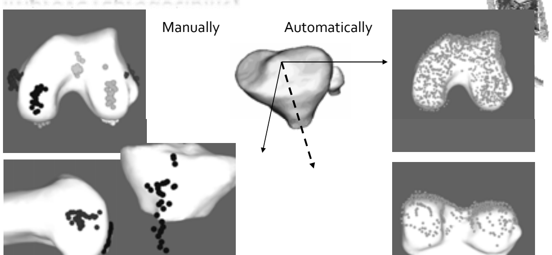
The proof of success in CAOS

Clinical results

- Jenny JY – n = 80 (0 to 3°) 83% Navigation – 78% Manually
  Zeitschrift für Orthopädie und ihre Grenzgebiete, April 2001 117-119
- Miehlke RK – n =60 (0 to 2°) 63% Navigation – 57% Manually
  Zeitschrift für Orthopädie und ihre Grenzgebiete, April 2001 109-129
- Kiefer H – n =60 (0 to 2°) 75% Navigation – 45% Manually
  European Journal of Trauma, 2001, E-Suppl.1, Urban & Vogel, 128-132

The role of models

Improve reproducibility



	A N=8	B N=5	C N=6	D N=10	E N=6	ALL
Pointer	1.2°	1.0°	1.3°	2.3°	1.7°	1.6°
BM	0.9°	0.5°	1.0°	0.4°	1.2°	0.9°

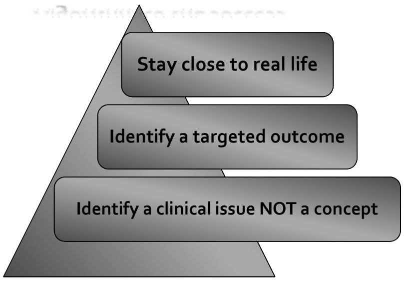
CONCLUSION

Modeling the patient

Absolutely useful (see orthopedic story)

Under certain conditions

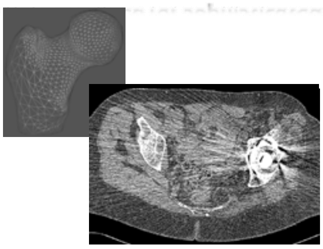
Algorithm to the success

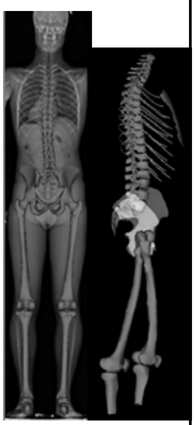


Modeling the patient

Develop more sophisticated models

There is a need for sophisticated tools





Modeling the patient

We are there for that:

- **To Merge clinicians and researchers**
- **To fight against real targets and not philosophic ideas**
- **To find solution for patients and clinicians**

Lot of conferences and very few clinical integration ???

Perform validation in the real world !!!!