

# AM in orthopedic surgery; current applications within



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<https://www.youtube.com/watch?v=YyntrRs7xKE>



<http://symptomat.de/images/thumb/Anlaufschmerz.jpg/400px-Anlaufschmerz.jpg>

<https://gelenk-klinik.de/orthopaedie-freiburg/hueftschmerzen/Hueftschmerzen-Hueftarthrose.jpg>

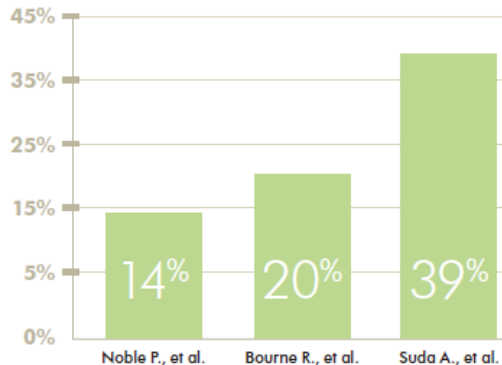
## Focus from sports medicine to arthroplasty surgery

- Diagnostics, inpatient or outpatient treatment and/or accompanying therapies are controlled by one person
- High performance and innovative medicine
  - Minimally invasive surgery
  - Joint preserving operations
  - Biological treatment options, functional rehabilitation
  - Hip and knee arthroplasty

# AM – ECOM<sup>®</sup>'s application

## How good are our knee prostheses really today?

- 41% of patients live with moderate to severe pain
- 20% of patients are not satisfied



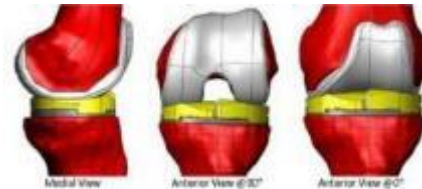
**"Knees fall short of expectations."**

**"Knee doesn't feel normal."**

Pennington et al. 2003, Cartier et al. 1996, Price AJ et al. 2010, Mahoney OM, Kiney T 2010, Murray DW, Frost SL 1999, Marx RG et al. 2005, Jevsevar 1993, Bullens PHJ et al. 2001, MacDonald SJ et al. 2008

## Individualization of endoprosthesis

- Instruments
  - Patient-matched instrumentation, patient-specific instrumentation
- Surgical technique
  - Individual implant alignment (e. g. kinematic alignment)
- Implants
  - Customized implants



# AM – ECOM<sup>®</sup>'s application with ConforMIS



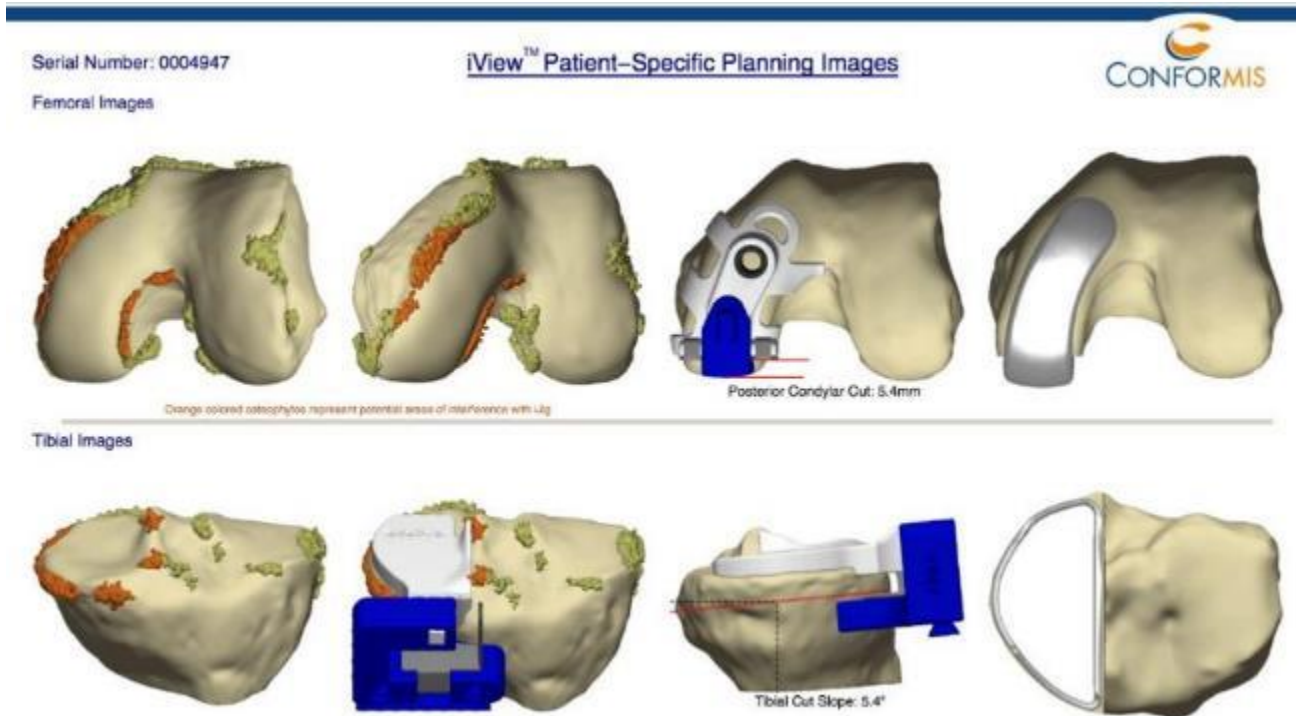


## Individual prosthesis: X-ray



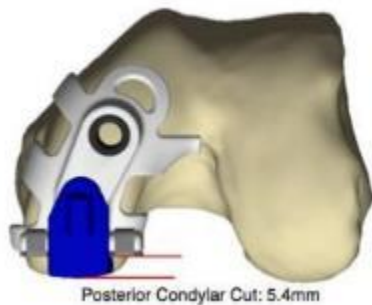
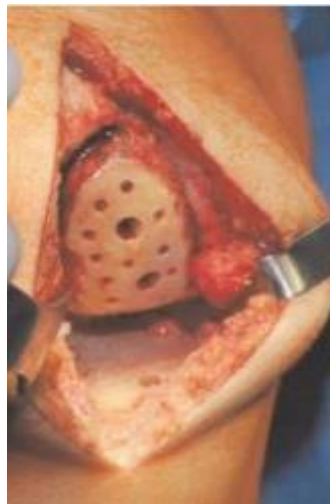
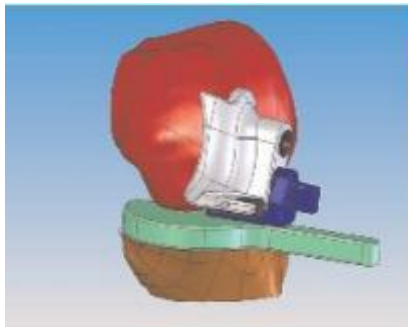
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## Individual prosthesis: Planning



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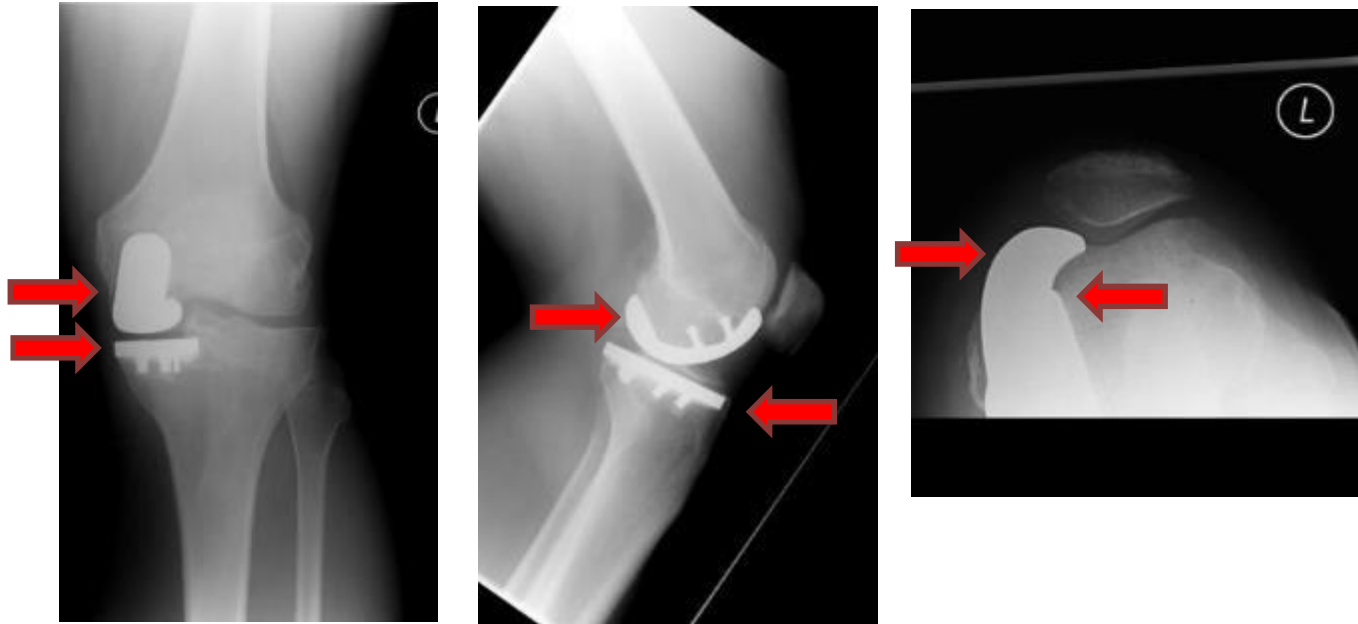
## Surgical technique: Surface replacement



Fitz W 2009  
JBJSvAm

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## Individual prosthesis: Perfect fit!



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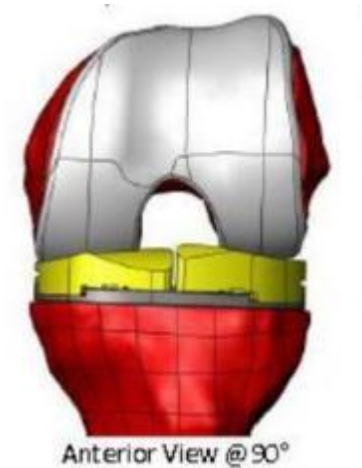
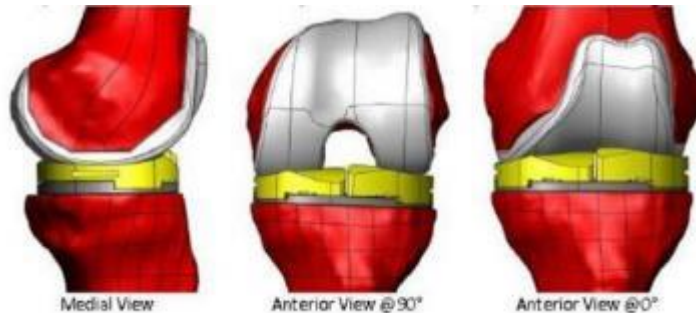
## Individual prosthesis: Five weeks after surgery



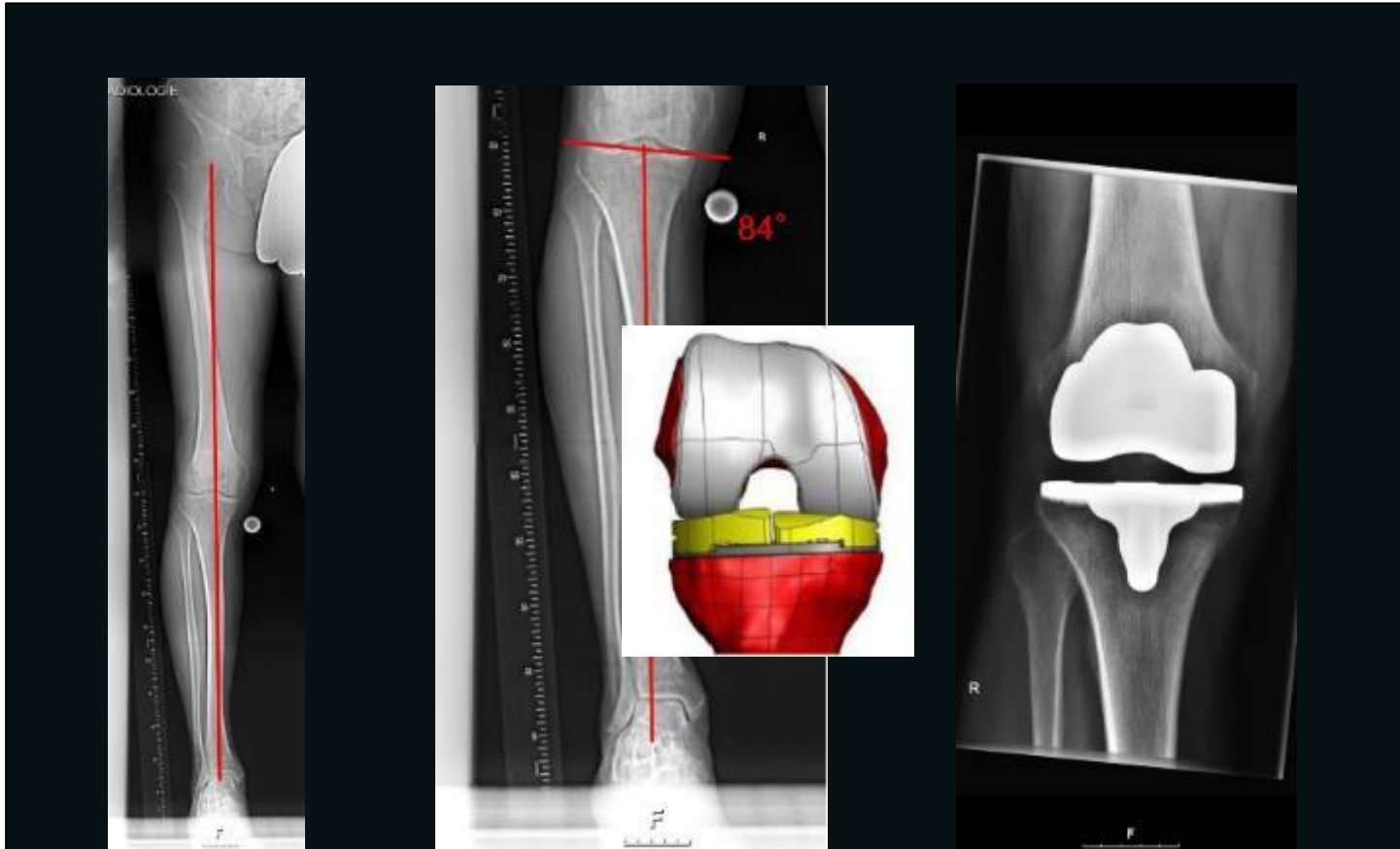
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## iTotal

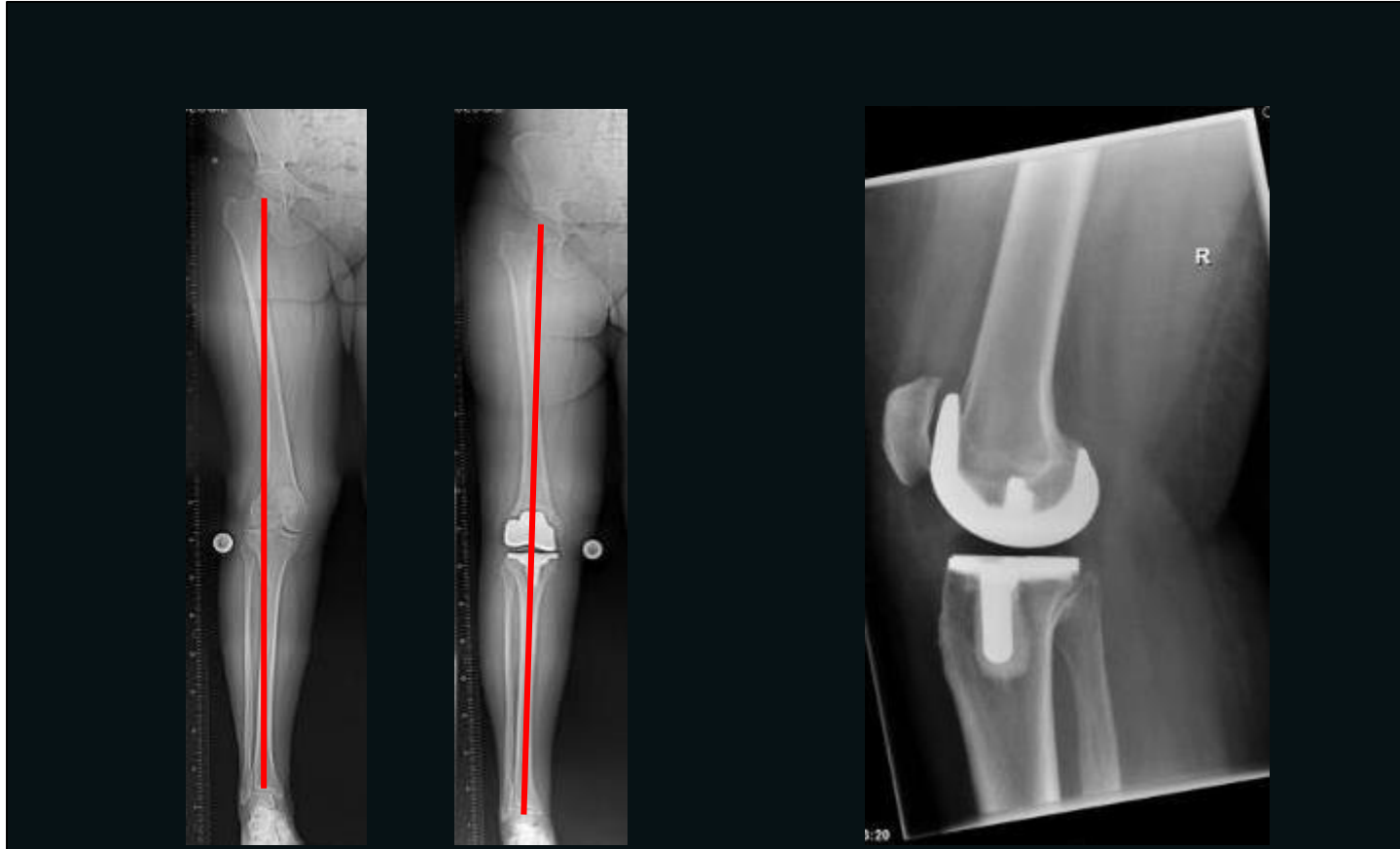
- Reconstruction of the physiological joint line
- Tibial plateau 90° to the mechanical axis of the tibia
- Different inlay heights
- Patient-specific cutting blocks



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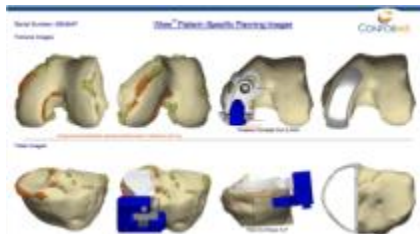


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## Advantages of arthroplasty surgery with iFit-technology

### Preoperative:

- Planning
- Fewer instruments
- Storage management
- Less storage place and costs



### Postoperative:

- Perfect fit
- Axis alignment
- No ACL impingement
- Max. cortical covering
- No sterilization in clinic
- More cases per day

### Intraoperative:

- Fewer instruments
- Simple operating technique
- Less bone resection
- Less blood loss



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## Disadvantages of arthroplasty surgery with iFit-technology

- CT necessary for planning
- Long manufacturing time
- Soft tissue tension not included in planning
- Fewer intraoperative correction options
  - Limited possibility of ligament-balancing
  - No isolated change of bending/stretching gap
- No antiallergic implants
- Technical errors possible
- High costs

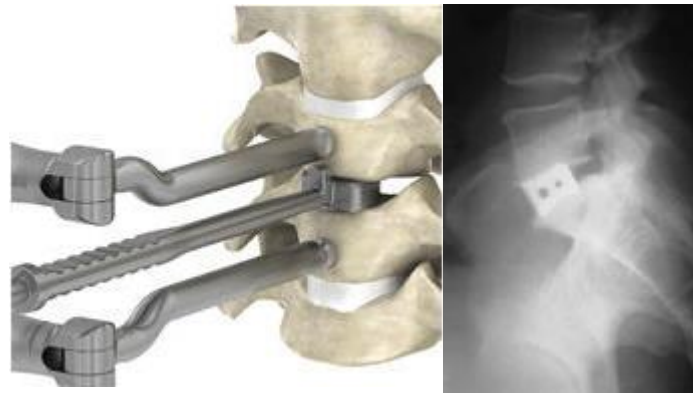
# AM – today's serial production

## Serial production – lumbar spine cage

Serial product



Medical application



# AM – limitations

## Currently there are several challenges limiting the use of AM

- Limited precision in 3D-print
- Limited amount of materials on the market
- Limited known material-mix
- Bulk-material is different compared to material-mix
- Material properties have to be explored

## Difficult joints

Great toe prosthesis



## Difficult joints

Ankle joint



## Difficult joints

Finger joint



## Difficult joints



Partial arthroplasty surgery





# AM – necessary technical developments

## Challenges to improve AM-technology in medicine

- Easier data acquisition
- Alternative to CT and MRI → X-ray and sonography/ultrasound
- Manufacturing companies become software companies?
- AM-technique should allow operations in minimally invasive techniques
- Life-time guarantee for material
- Speed of AM-manufacturing
- Size and quality of printers
- Flexibility during surgery

## Bioprinting?



[https://abm-website-assets.s3.amazonaws.com/rdmag.com/s3fs-public/featured\\_image/2017/06/rd1706\\_bioprinting.jpg](https://abm-website-assets.s3.amazonaws.com/rdmag.com/s3fs-public/featured_image/2017/06/rd1706_bioprinting.jpg)

## The ultimate goal

- Substitution of every joint in AM-technology in highest anatomic quality!
- The “forgotten” joint!
- Possibility to do high demand sports!

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