RECENT DEVELOPMENTS IN TKR

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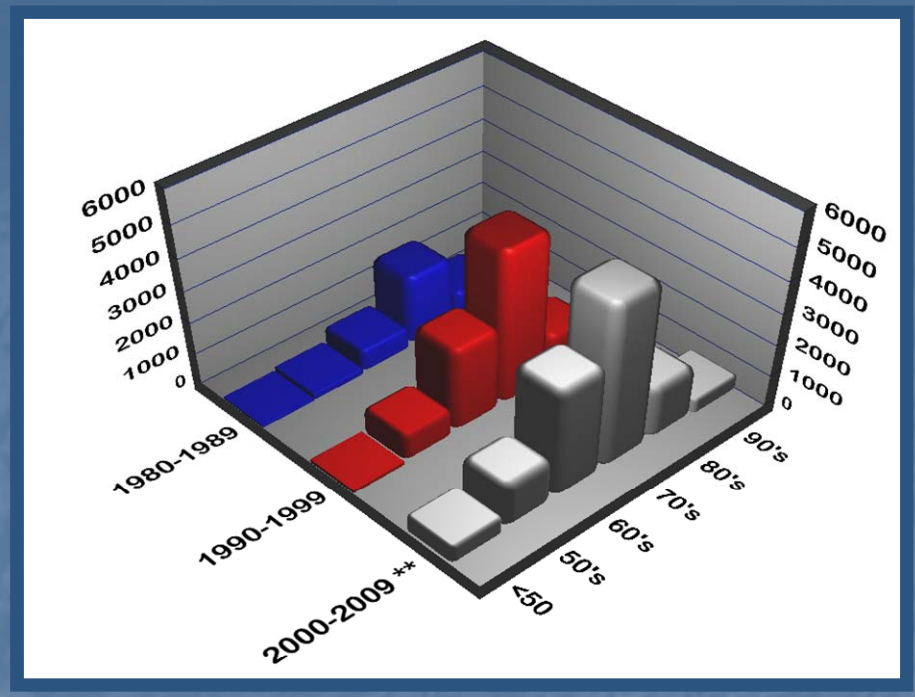
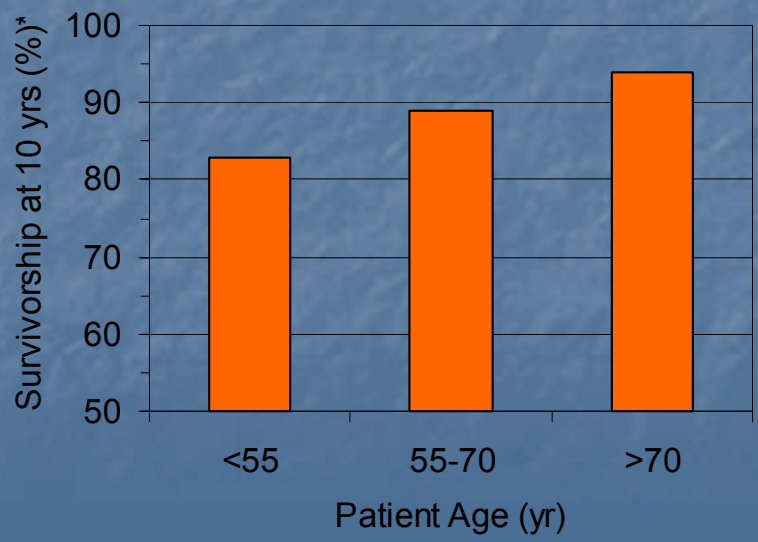
AFISO 2006

AREN'T WE HAPPY ?

- GOOD RESULTS (> 90 % AT 15 YEARS)
  - LCS, IB II
  - >< Interax
- BUT…
  - NOT A NORMAL KNEE >< HIP
  - FLEXION LIMITED
    - SQUAT AND KNEE DOWM DIFFICULT

- MORE AND MORE YOUNG PEOPLE
- DEMANDING NORMAL KNEES

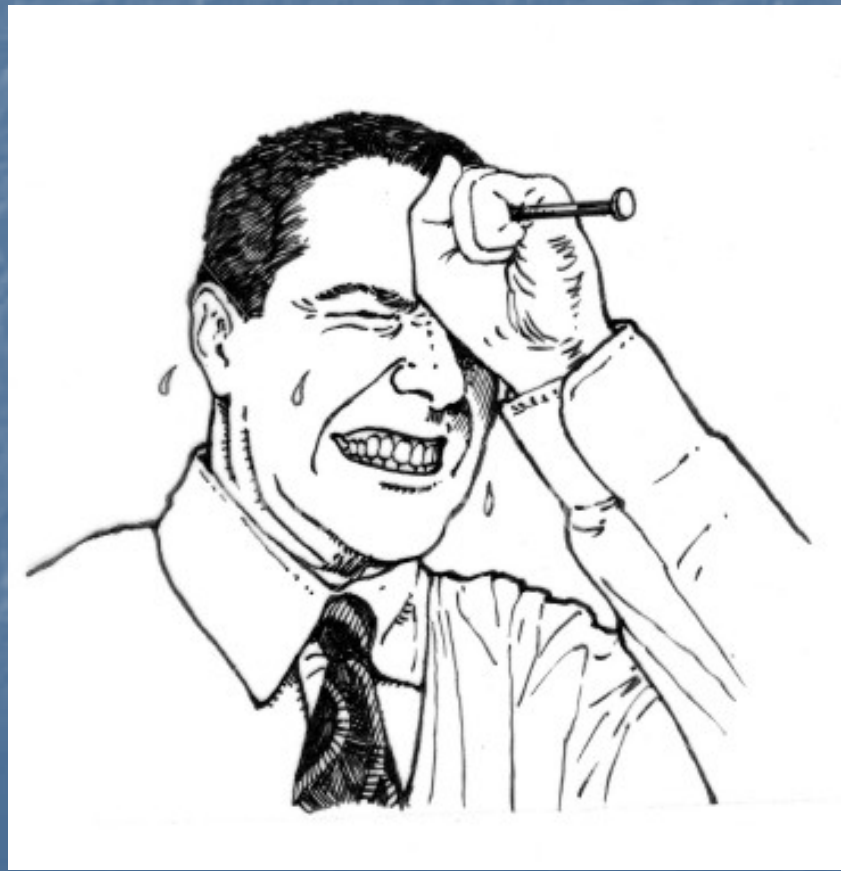




- NEW DESIGNS
- NEW MATERIALS
- NEW TECHNIQUES OF IMPLANTATION
- PAIN MANAGEMENT

PAIN MANAGEMENT

- Epidural
- Femoral nerve block
  - Decreases use of Morphine by 30%
  - Less pain
  - Physio earlier and easier



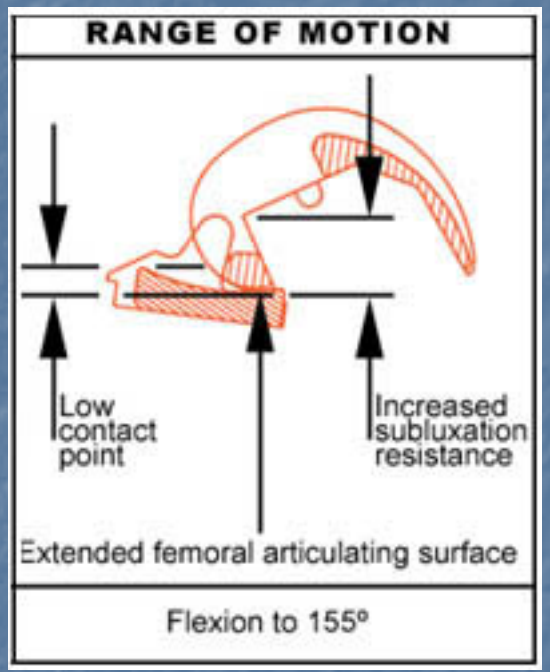
Inconveniences

- Quads control delayed
- SLR difficult or impossible the first days post-op.

→ Conclusion :better experience of surgery

NEW DESIGNS

- HIGH KNEE FLEXION
  - Posterior design
  - Rotating platforms
  - Tibial post



High –Knee Flexion

- Kim & Al.: 50 patients
  - One side: « normal TKR »
  - Other side: HKF

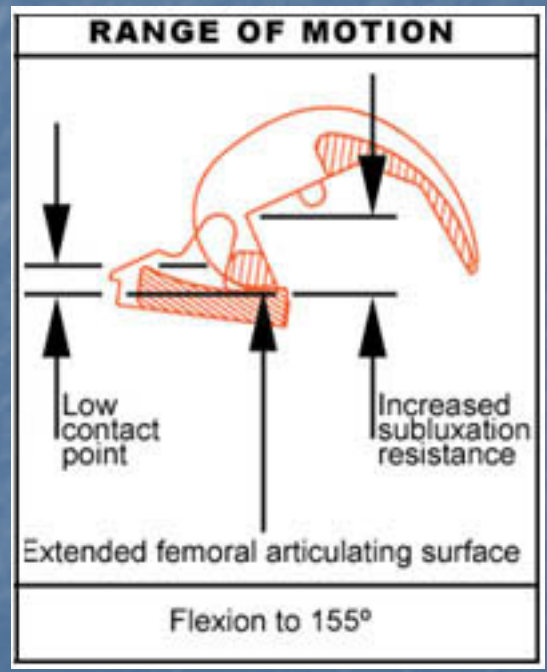
→ 2,1 years: no significant difference in the mean amount of flexion

High- Knee Flexion

- Other studies:
  - Significant improvement (>10°)

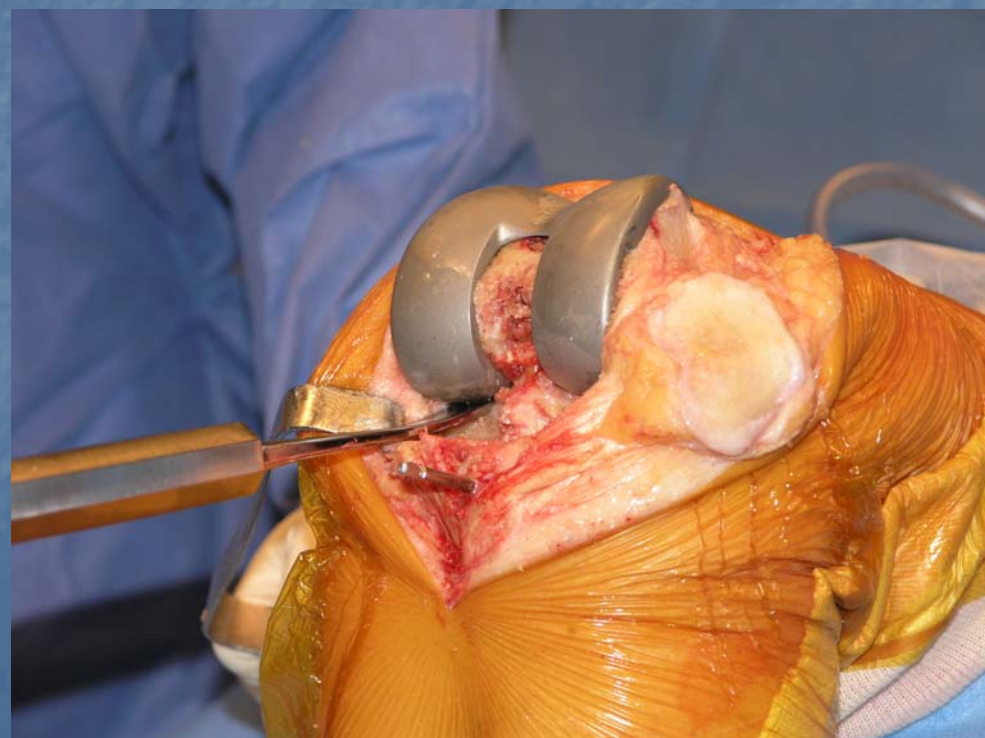
BUT: long-term??
Wear
Fracture of the post

MARKETING!!



FLEXION MAINLY DEPENDS UPON:

- Pré-op. Flexion: on average>10°
- Surgical Technique



NEW DESIGNS

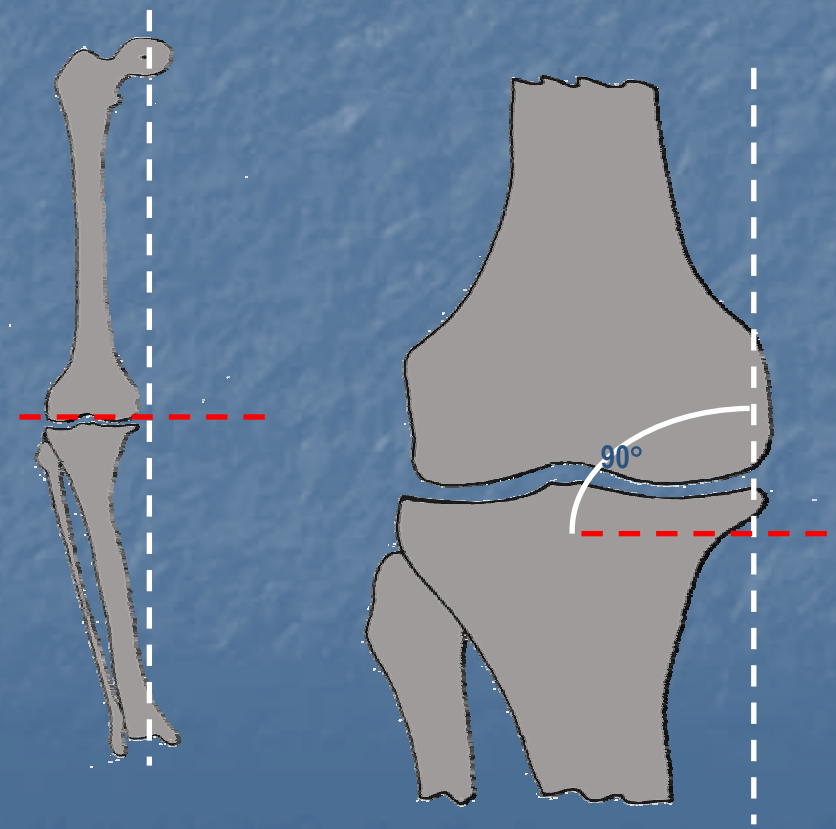
- UNICOMPARTMENTAL KNEES
  - « More normal » knee
    - Better flexion
    - I forgot my knee = hip

UNICOMPARTMENTAL KNEES

- BUT…
  - Higher rate of revisions especially among patients <65 y… and it'made for them…

UNICOMPARTMENTAL KNEES

- Higher rate of failure if malaligned



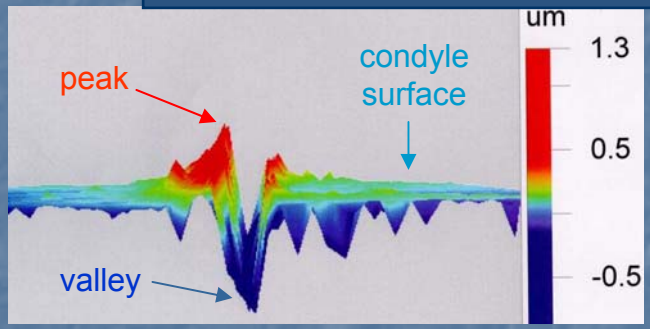
advantage of navigation

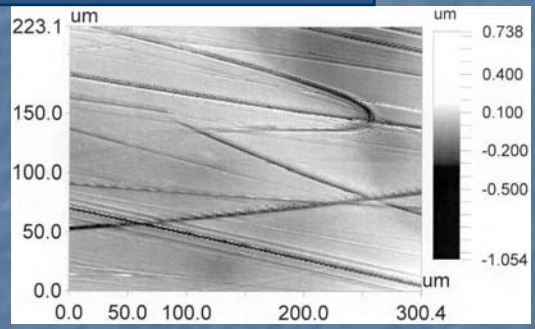
NEW MATERIALS

BEARING SURFACE:
Co-Cr/ Poly

One Limitation of CoCr Knees

Scratches on Retrieved Condyles (Levesque et al., ORS 1998)





- Metal bearing surfaces roughen
  - Retrieved CoCr femorals exhibit clinical roughening
  - Abrasive wear (scratching by hard particles)
  - Oxidative wear (shearing of sliding surface)
- Counterface roughening increases wear

Limited Alternatives to CoCr

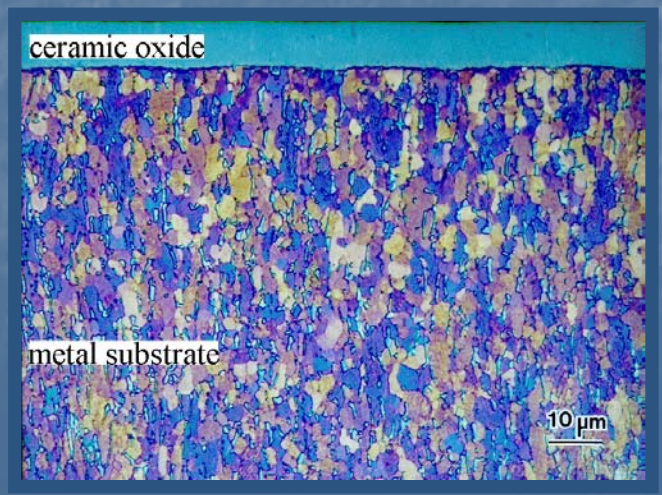
- Hardened metals (ion implant; diffusion harden)
  - Benefit inferior to ceramics and short-lived at best
- Ceramic coatings (titanium nitride; diamond)
  - Limited durability, especially if damaged
- Monolithic ceramics (zirconia; alumina)
  - Risk for brittle fracture

Oxidized Zirconium Description Oxinium

- Metal alloy with surface transformed to ceramic
  - Zirconium: metal element in same family as titanium
  - Zr-2.5Nb: metal alloy with niobium and oxygen
  - Zirconia: ceramic compound (zirconium oxide)

Oxidation Process

- Wrought zirconium alloy device is heated in air
- Metal surface transforms to ceramic; not coated
- Oxide is about 5 μm thick, with oxygen-rich zone



Quality Control

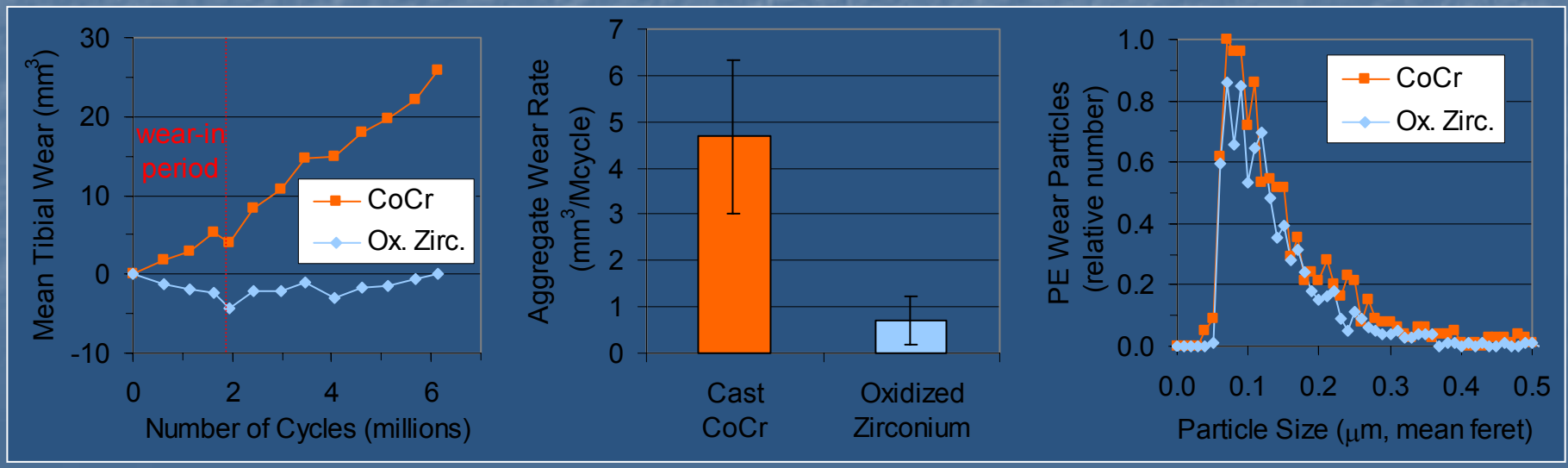
- Incoming material inspection
- Critical processes
  - Pre-oxidation preparation
  - Oxidation process
  - Post-oxidation burnishing
- Oxide thickness inspection (all parts)

Advantages over CoCr

- Wears like a ceramic...
  - Resists roughening
  - Less friction
- ...but it's a metal device...
  - Same strength; less stiff; not brittle
  - Proven design and polyethylene
- ...with an extra benefit
  - Excellent biocompatibility

Polyethylene Wear - Clean

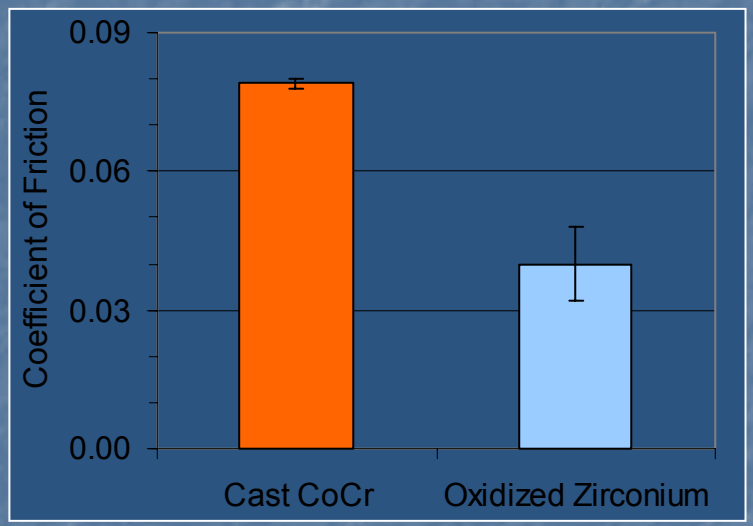
- Reduces polyethylene wear rate by 85%
- Generates same or fewer sub-micron particles
  - Simulated 6 years of physiological motion



*Spector et al., AAOS 2001

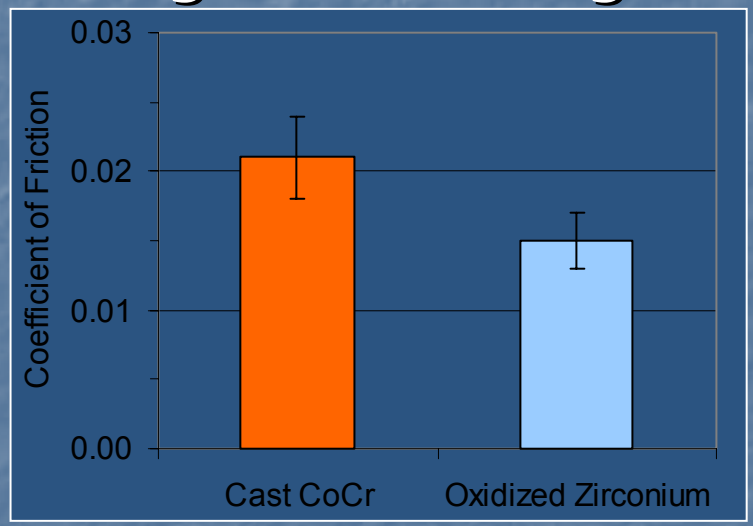
Friction

- Slides with less resistance:
  - Against polyethylene*



*Poggie et al., ASTM STP 1145

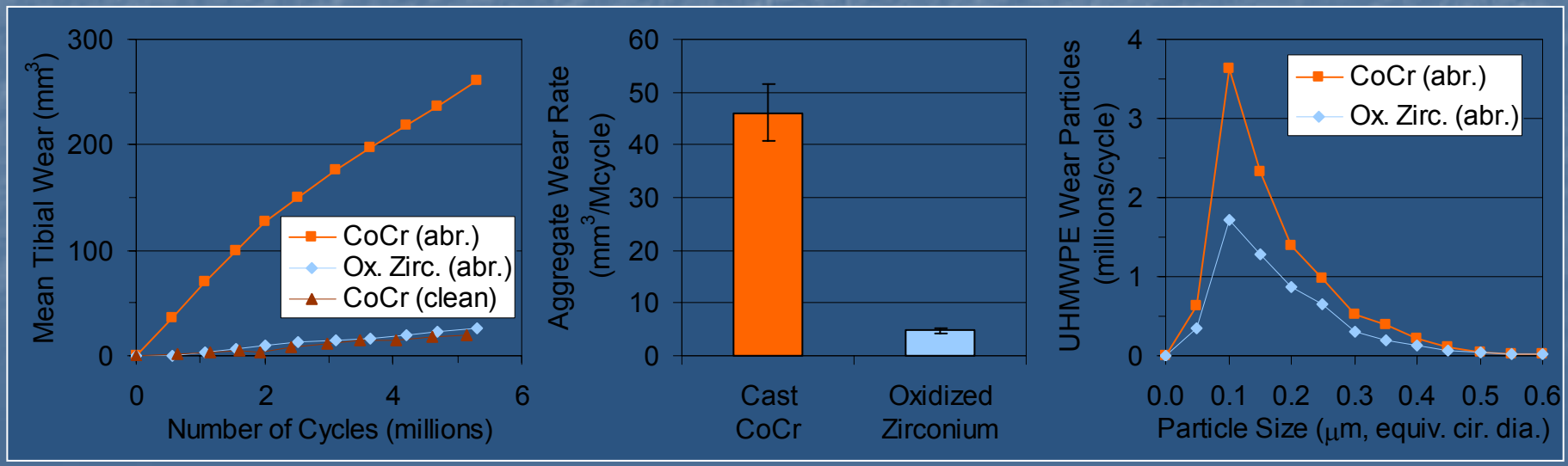
  - Against cartilage*



*Patel and Spector, Biomaterials 1997

Polyethylene Wear - "Abrasive"

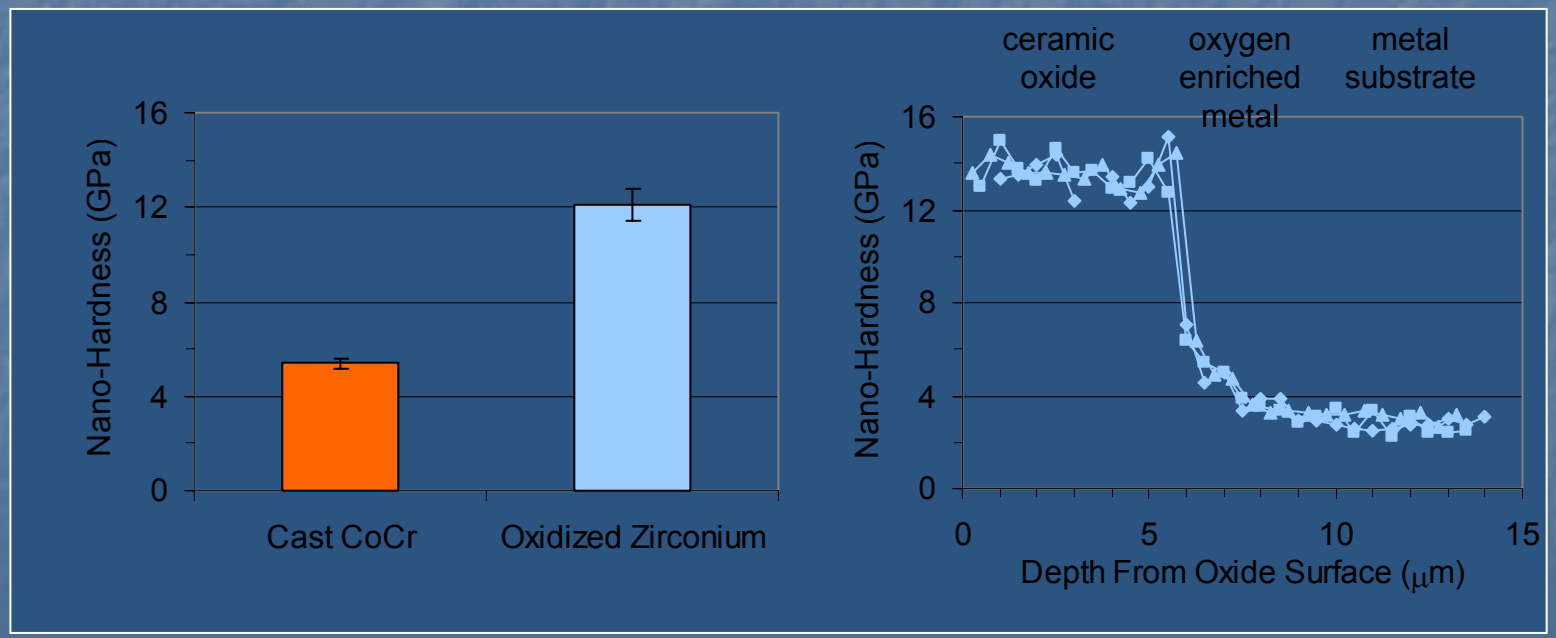
- Roughens less when tumbled in alumina
- Reduces wear rate by 89% and particles by 44%
  - Simulated 5.5 years of physiological motion



*Ries et al., AAOS 2002

Hardness*

- Increases surface hardness over 2X



Strength*

- Maintains equivalent device fatigue strength
  - Supports 4.4 kN (1000 lbf) in 10 Mcycle fatigue test
  - Tested worst-case: thin condyle, no bone, full flexion
  - Bends with 19.8 kN (4500 lbf) steady load

*Tsai et al., SFB 2001

Stress Shielding

- Reduces stiffness
  - Decreases potential for stress shielding of bone
  - Maintains cement stresses below fatigue strength

Biocompatibility*

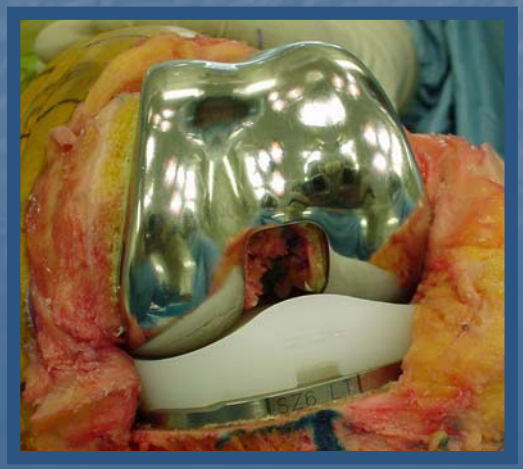
- Exhibits excellent biocompatibility
  - Zirconium: one of five most biocompatible metals
    - Other four metals: niobium, titanium, tantalum, platinum
    - Ranked on self-passivation and lack of biological function

Metal Allergy

- Reduces potential for metal hypersensitivity
  - Very low impurity content in alloy
    - Nickel content not detectable (below 0.0035%)
  - Immune to oxidative wear

Clinical Experience

- Over 4000 devices implanted to date
  - First knee in 1997; no material-related complaints
- Randomized, prospective study started in 1999
  - Multiple US centers, led by Dr. Laskin (HSS)



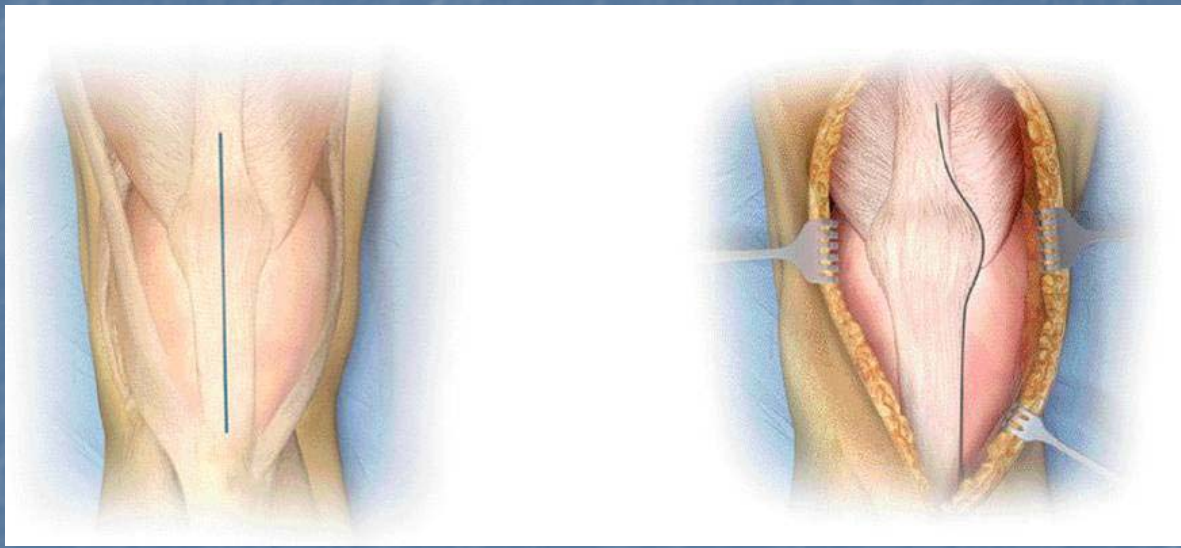
Oxidized Zirconium Summary

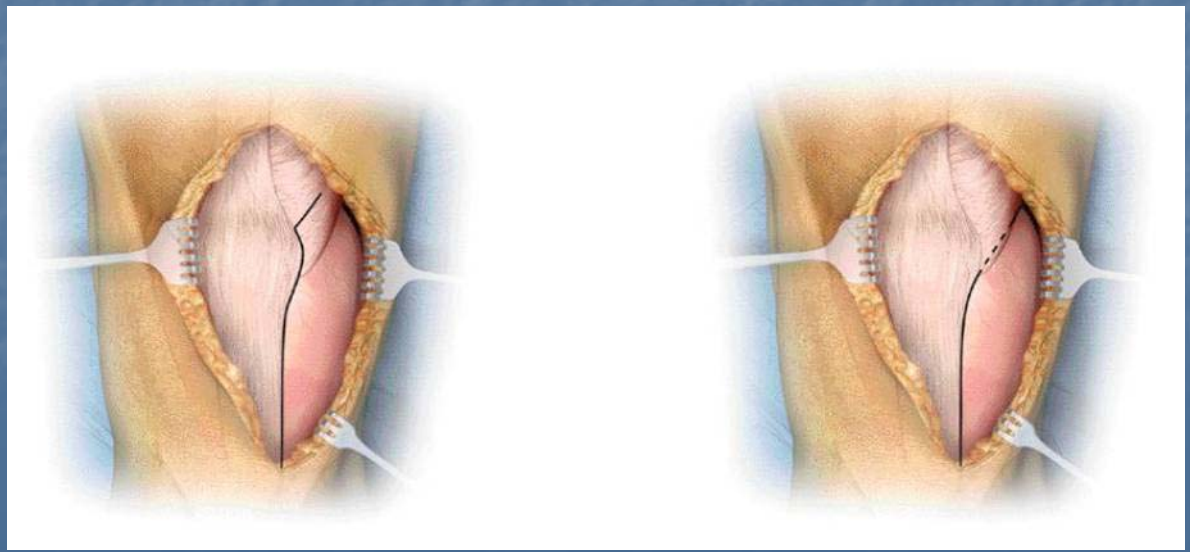
- Less polyethylene wear than CoCr
- More resistant to roughening than CoCr
- Less friction than CoCr
- Excellent biocompatibility
- Strong and durable
- Promising clinical results

NEW TECHNIQUES

- MINI- INVASIVE SURGERY
- NAVIGATION

MINI-INVASIVE SURGERY





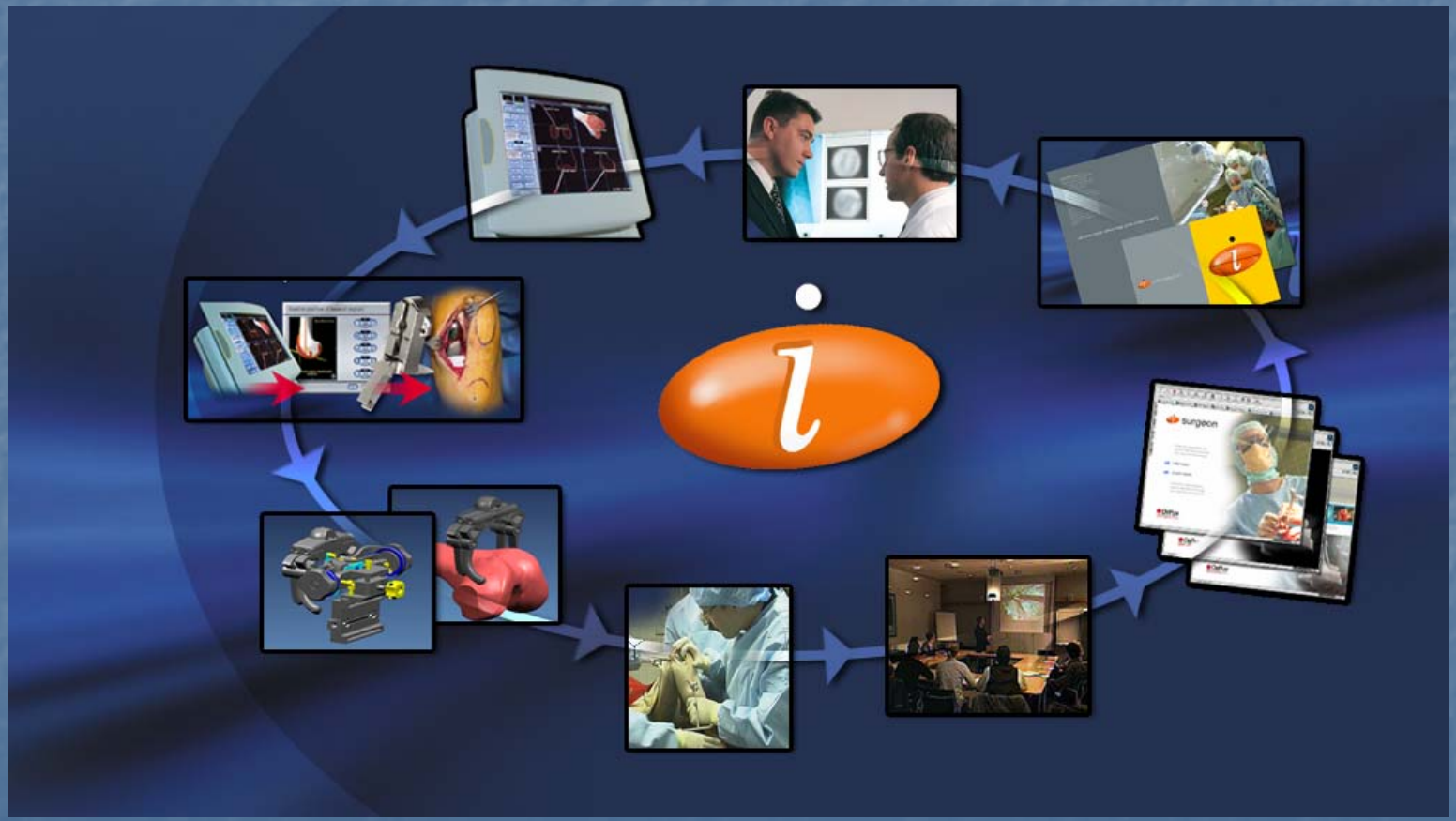
MINI-INVASIVE SURGERY

- UNI:
  - Higher rate of aseptic Loosening
  - Higher rate of revision
  - Except navigaion
- TOTAL:
  - Same results except promoters of the technique (Laskin)
  - No difference after 3 months post-op

IS IT WORTH IT?

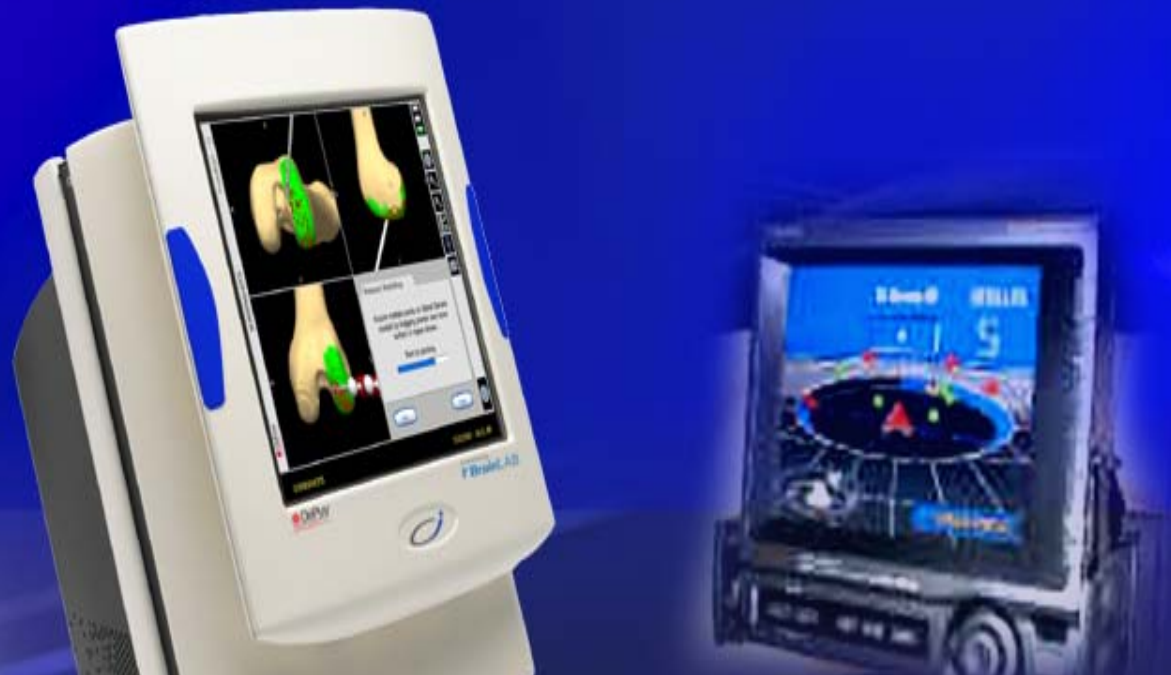
MARKETING

NAVIGATION



How does it work?

- **System can be compared with a GPS for automobile navigation.**



How does it work?

- **The camera replaces the satellite**

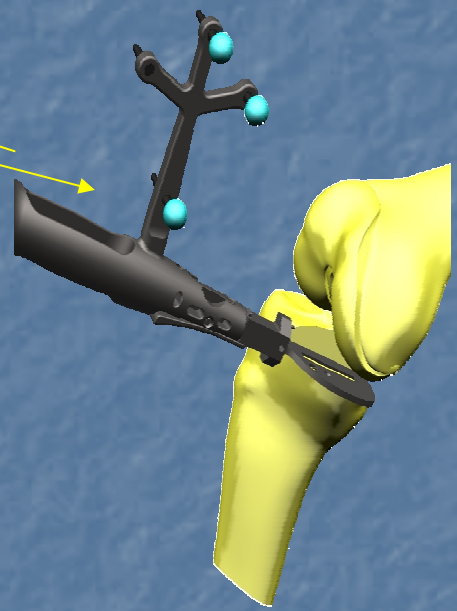
How does it work?

- **The surgical instruments replace the car.**

How does it work?

- **Patient Anatomy compares with roadmap.**

How does it work?



optical tracking

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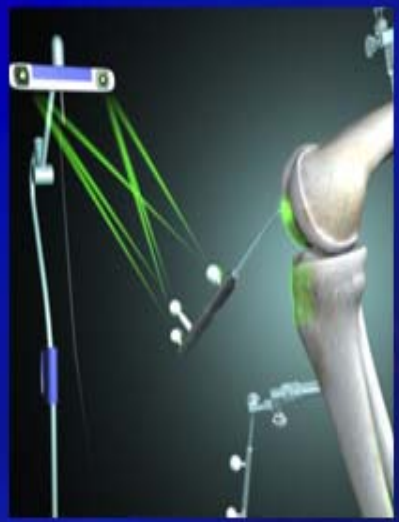
Passive : patient = reflectors =source

Active: patient = source…cables….

- The computer calculates the position data and displays the information to the screen



COBP

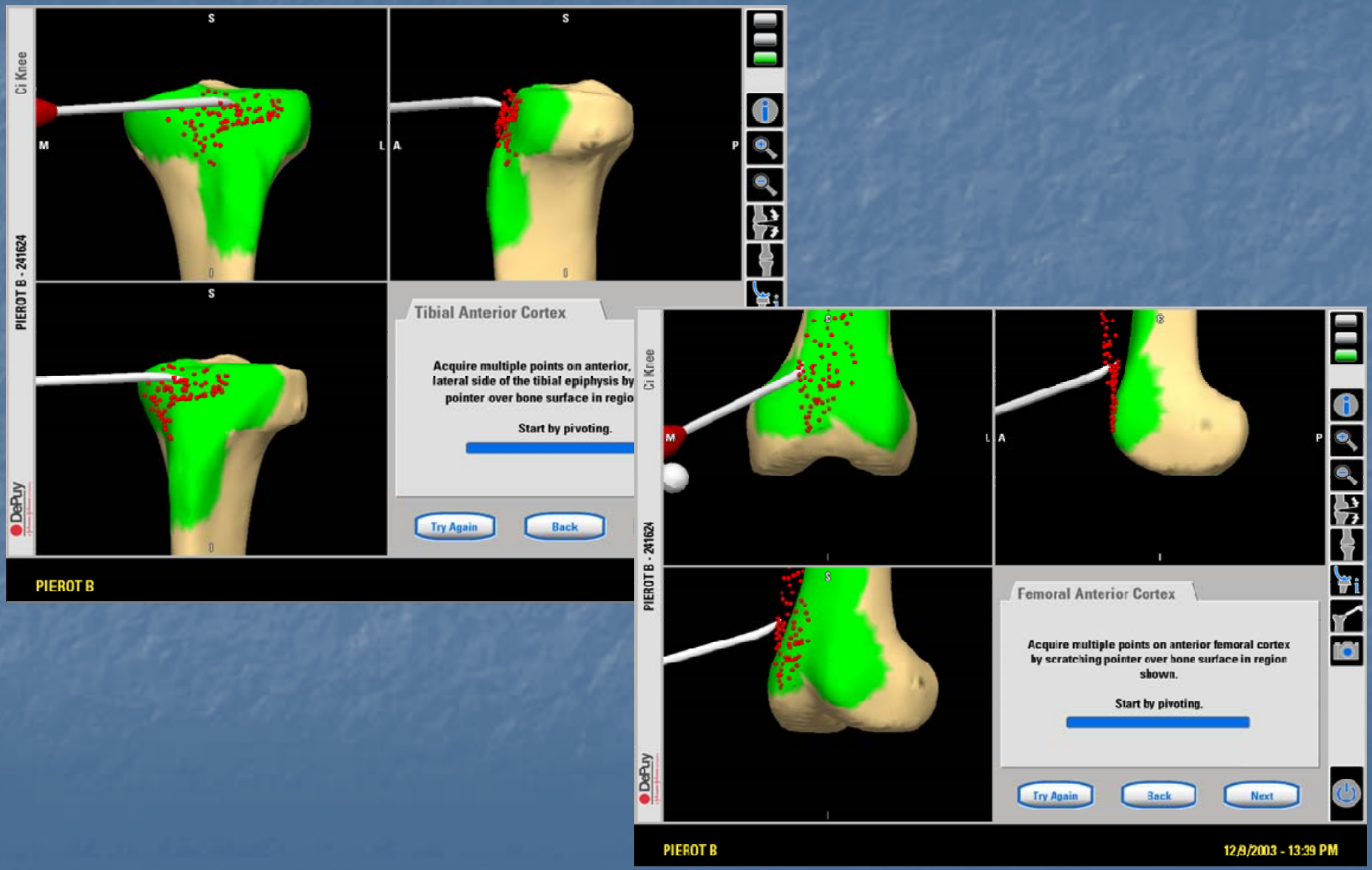
The system calculates, based on the acquired points, hip, knee and ankle centres.

COBP

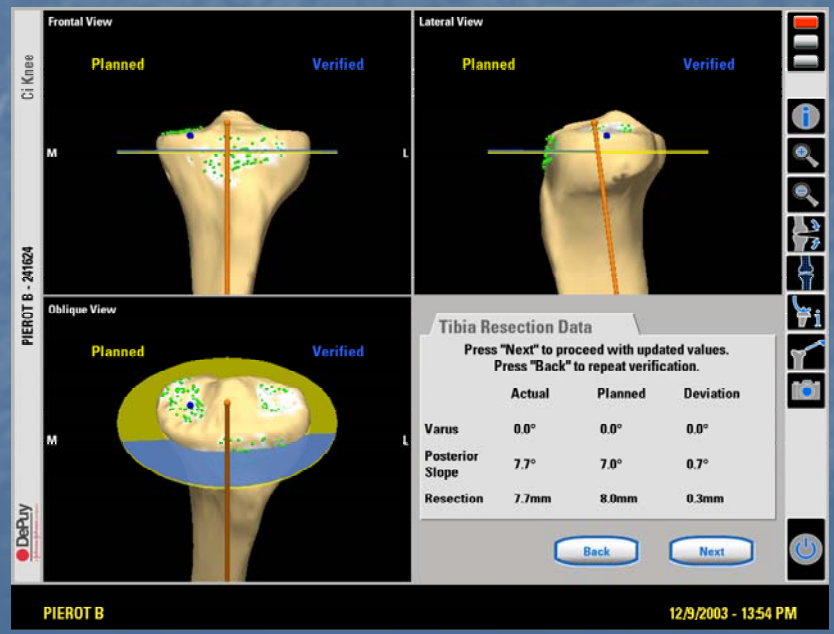
The location of these centres defines the mechanical axis for femur and tibia.

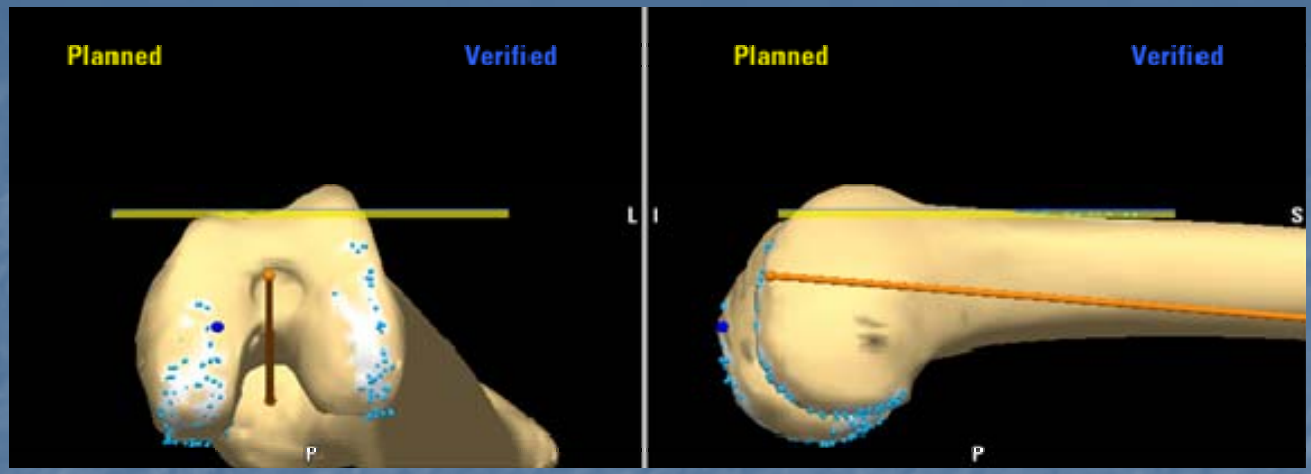
COBP

BONE MORPHING



- Tibial cut


Ci Knee
PIEROT B - 241624
DePuy
Frontal View
Planned
Verified
M
L
Lateral View
Planned
Verified
Oblique View
Planned
Verified
M
L
Tibia Resection Data
Press "Next" to proceed with updated values.
Press "Back" to repeat verification.
Actual
Planned
Deviation
Varus
0.0°
0.0°
0.0°
Posterior Slope
7.7°
7.0°
0.7°
Resection
7.7mm
8.0mm
0.3mm
Back
Next
PIEROT B
12/9/2003 - 13:54 PM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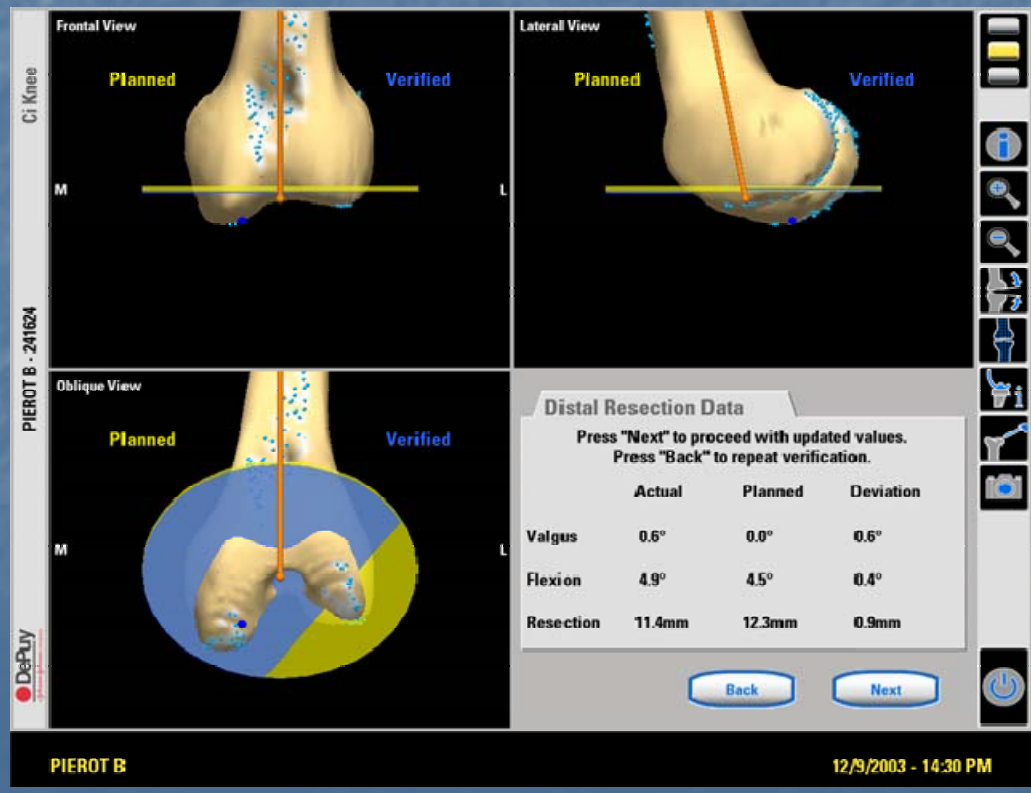
- Femoral cut


Ci Knee
PIEROT B - 241624
DePuy
Frontal View
Planned
Verified
M
L
Lateral View
Planned
Verified
Oblique View
Planned
Verified
M
L
Distal Resection Data
Press "Next" to proceed with updated values.
Press "Back" to repeat verification.
Actual
Planned
Deviation
Valgus
0.6°
0.0°
0.6°
Flexion
4.9°
4.5°
0.4°
Resection
11.4mm
12.3mm
0.9mm
Back
Next
PIEROT B
12/9/2003 - 14:30 PM

What Are the Clinical Benefits of CAS?

- Improved Surgical Accuracy
- Enables Minimal Access Procedures
- Fewer Steps & Faster Procedures
- More Informed & Flexible Surgical Decisions
- Educational/Surgical Teaching Tool

- BUT… ADMINISTRATION NOT KEEN
  - Save time: NO
  - Better reimbursement: NO
  - More maintenance: YES

ANSWER: NO!!

CONCLUSIONS

- Still lots to be discovered
- Avoid temptation of « Knee Fashion »
- Avoid the www. advises
- Better have a prosthesis with well-known long-term results performed by a surgeon used to it