



ICJR – Beijing COA 2016



Robot or not ?

Sébastien LUSTIG MD, PhD, Prof *

**Albert Trillat Center- Lyon, France*



Orthopaedic surgery has always been on step behind ...

21 July 1969

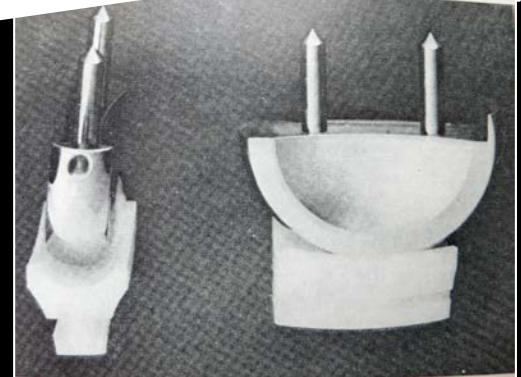
1st man walking on the moon



BRYAN PETERSON / Polycentric

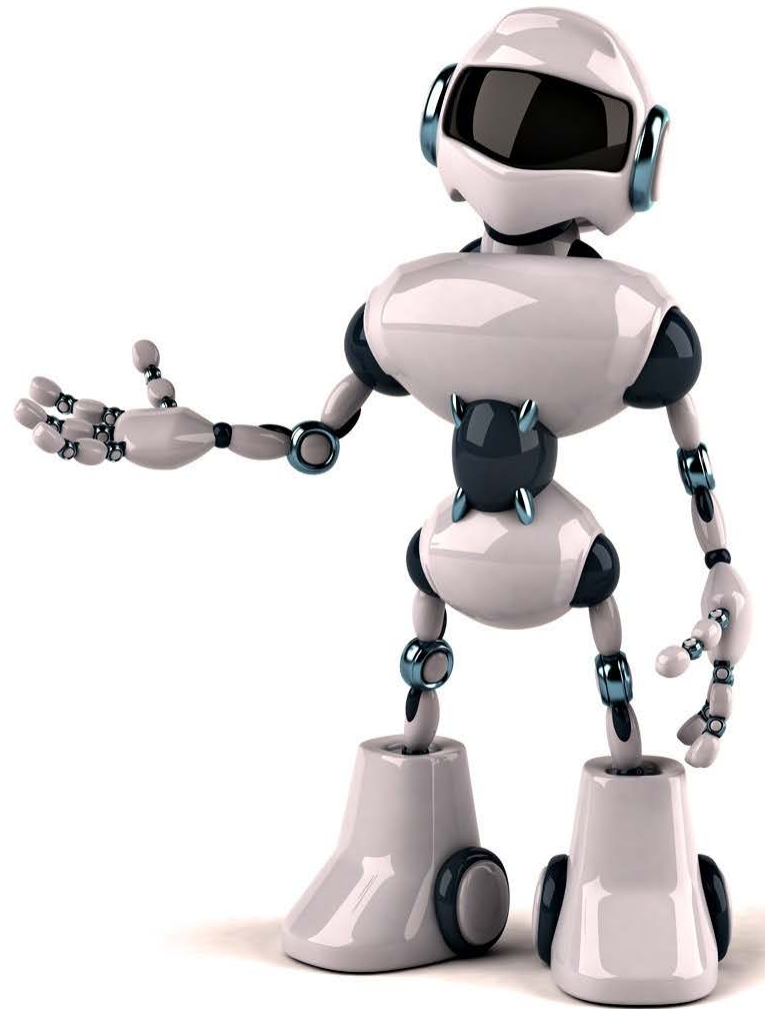


« TKA » with only one size !!



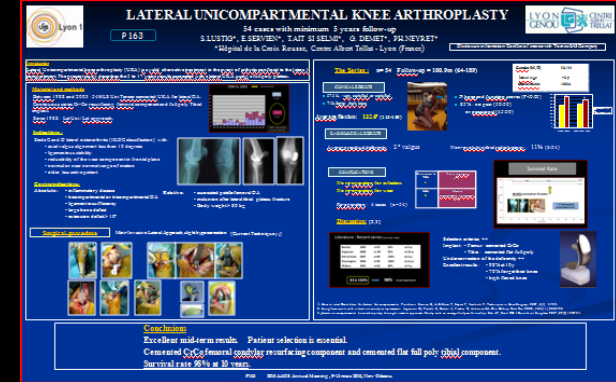


WHY A ROBOT
COULD BE HELPFUL
IN ORTHOPAEDIC
SURGERY ?



WHY?

« Perfect » surgery
is the key to success



Poster 163 –
AAOS New Orleans March 2010



Unicompartmental or total knee replacement

THE 15-YEAR RESULTS OF A PROSPECTIVE RANDOMISED
CONTROLLED TRIAL

MODERN UNICOMPARTMENTAL KNEE ARTHROPLASTY WITH CEMENT

A THREE TO TEN-YEAR FOLLOW-UP STUDY

5- to 16-Year Follow-Up of 54 Consecutive Lateral Unicondylar Knee Arthroplasties With a Fixed-All Polyethylene Bearing

Sebastien Lustig, MD, PhD,*† Ahmed Elguindy, MD,*‡
Elvire Servien, MD, PhD,*‡ Camdon Fary, FRACS,§ Edouard Munini, MD,*
Guillaume Demey, MD,*† and Philippe Neyret, MD*†

D JEAN-MANUEL AUBANIAC, MD
x-Marseille University,

ELSEVIER

Progression of medial osteoarthritis and long term results of lateral
unicompartmental arthroplasty: 10 to 18 year follow-up of 54 consecutive
implants

Sébastien Lustig^{a,*}, Timothy Lording^{a,b}, Florent Frank^a, Caroline Debette^a, Elvire Servien^a,
Philippe Neyret^a



Perfect ?

Alignment
Rotation
Contact point
Sizing
Sagittal positioning
Joint line



No overcorrection



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

The Knee



Progression of medial osteoarthritis and long term results of lateral unicompartmental arthroplasty: 10 to 18 year follow-up of 54 consecutive implants

Sébastien Lustig^{a,*}, Timothy Lording^{a,b}, Florent Frank^a, Caroline Debette^a, Elvire Servien^a, Philippe Neyret^a

alignment after lateral UKA [46]. Our philosophy is to correct only the articular wear, respecting any extra-articular constitutional deformity. All three cases of medial progression in our series had a post-operative varus femorotibial alignment, signifying overcorrection.

With regards to the patellofemoral joint some authors

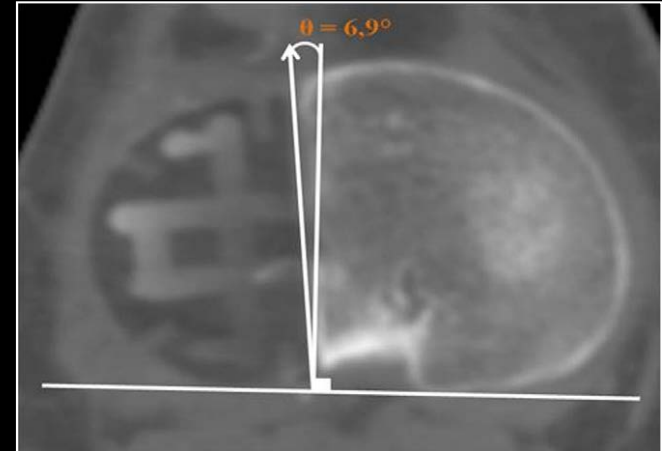
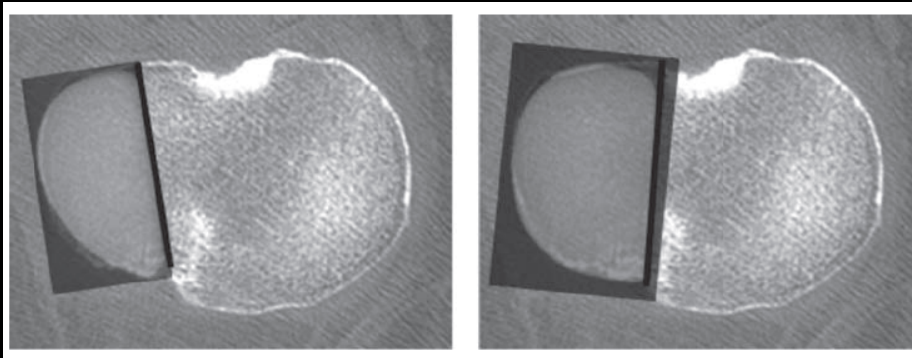
Rotation

Knee Surg Sports Traumatol Arthrosc (2008) 16:1141–1145
DOI 10.1007/s00167-008-0620-0

KNEE

Lateral versus medial tibial plateau: morphometric analysis and adaptability with current tibial component design

E. Servien · M. Saffarini · S. Lustig ·
S. Chomel · Ph. Neyret



ORIGINAL ARTICLE

Tibial component rotation assessment using CT scan in medial and lateral unicompartmental knee arthroplasty

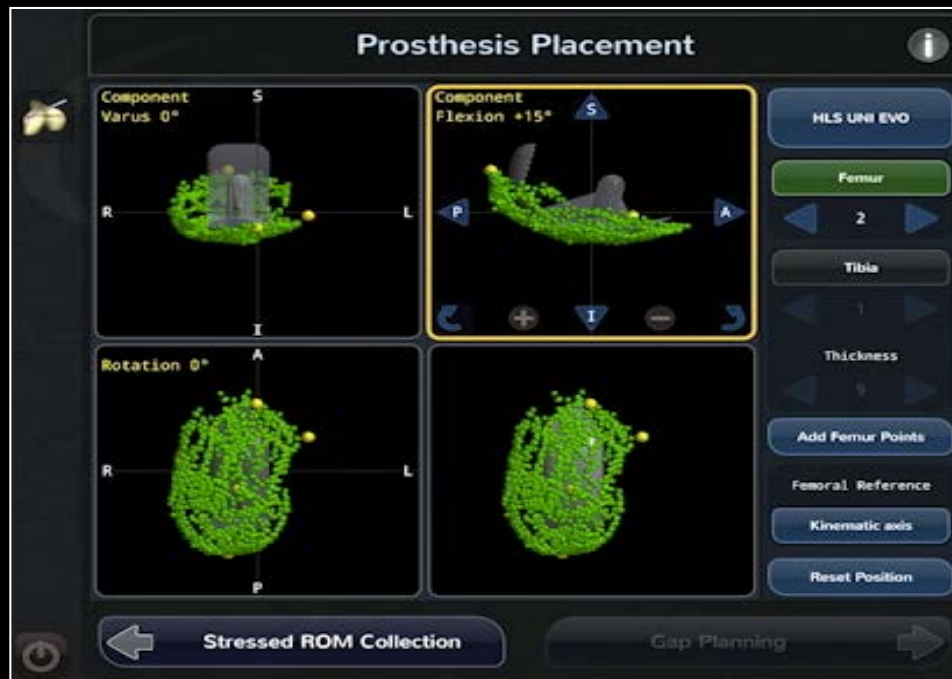
E. Servien^{a,*}, C. Fary^d, S. Lustig^a, G. Demey^a, M. Saffarini^b,
S. Chomel^c, P. Neyret^a

Sagittal positioning

KNEE

Sagittal flexion angle of the femoral component in unicompartamental knee arthroplasty: is it same for both medial and lateral UKAs?

Elcil Kaya Bicer • Elvire Servien •
Sebastien Lustig • Guillaume Demey •
Tarik Ait Si Selmi • Philippe Neyret



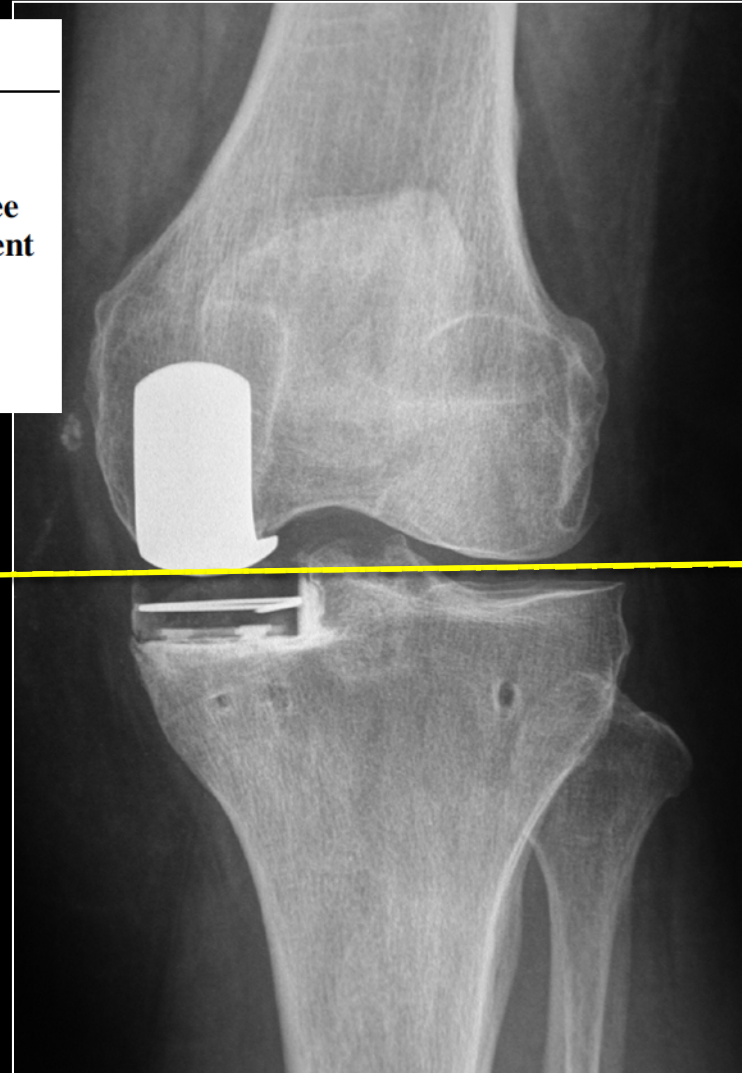
Joint line level

Knee Surg Sports Traumatol Arthrosc (2013) 21:2468–2473
DOI 10.1007/s00167-013-2617-6

KNEE

Joint line reconstruction in medial unicompartmental knee arthroplasty: development and validation of a measurement method

Patrick Weber · Christian Schröder · Rüdiger Paul Laubender · Andrea Baur-Melnyk ·
Christoph von Schulze Pellengahr · Volkmär Jansson · Peter E. Müller



CT based Semi Active Robots



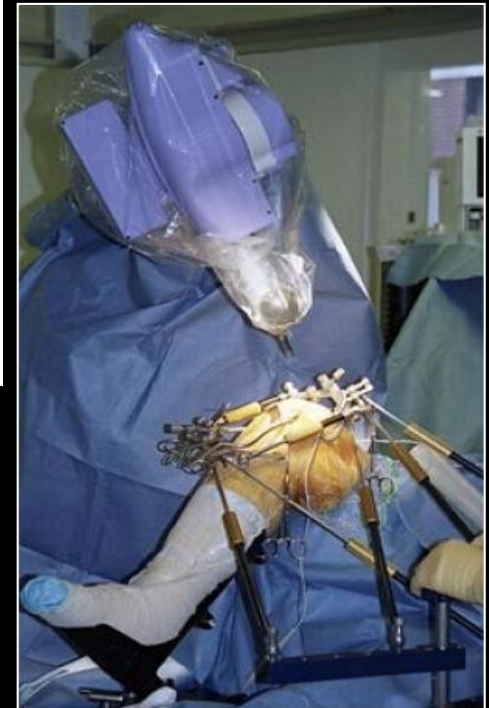
Hands-on robotic unicompartmental knee replacement

A PROSPECTIVE, RANDOMISED CONTROLLED STUDY OF THE ACROBOT SYSTEM

J. Cobb,
J. Henckel,
P. Gomes,
S. Harris,
M. Jakopiec,
F. Rodriguez,
A. Barrett,
B. Davies

We performed a prospective, randomised controlled trial of unicompartmental knee arthroplasty comparing the performance of the Acrobot system with conventional surgery. A total of 27 patients (28 knees) awaiting unicompartmental knee arthroplasty were randomly allocated to have the operation performed conventionally or with the assistance of the Acrobot. The primary outcome measurement was the angle of tibiofemoral alignment in the coronal plane, measured by CT. Other secondary parameters were evaluated and are reported.

All of the Acrobot group had tibiofemoral alignment in the coronal plane within 2° of the

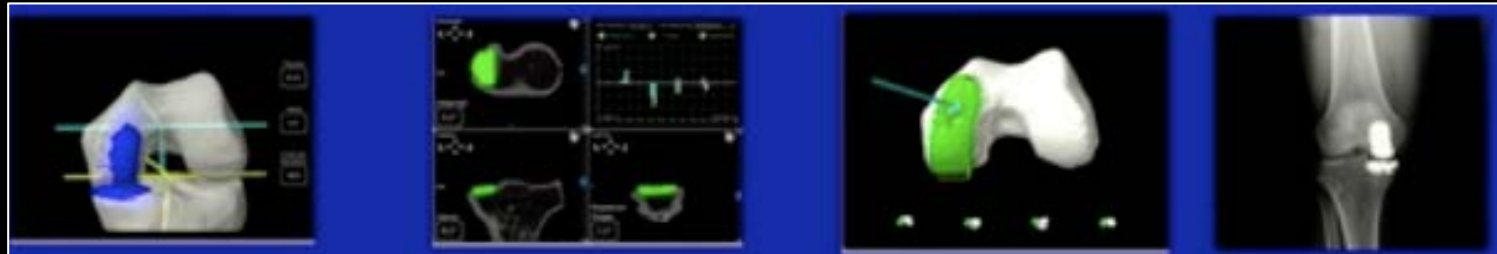


Acrobot

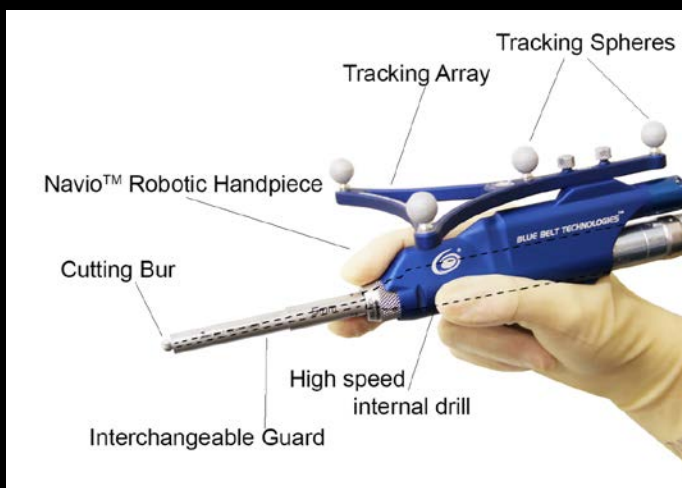


Accuracy of Dynamic Tactile-Guided Unicompartmental Knee Arthroplasty

Nicholas J. Dunbar, BSc,* Martin W. Roche, MD,† Brian H. Park, BSc,*
Sharon H. Branch, BSc,‡ Michael A. Conditt, PhD,‡ and Scott A. Banks, PhD*



Navio™



ROBOTIC SURGERY : EXPERIENCE WITH UNICONDYLAR KNEE ARTHROPLASTY

S. LUSTIG, P. NEYRET



Surgical robotics has been shown to improve the accuracy of bone preparation and soft tissue balance in unicondylar knee arthroplasty (UKA). However, although extensive data have emerged with regard to a CT scanbased haptically constrained robotic arm [1], little is known about the accuracy of a newer alternative, an imageless robotic system.

The Navio™ Precision Freehand Sculpting system (Navio™ : Blue Belt Technologies Inc, Plymouth, MN, USA) is an imageless handheld robotic tool (fig. 1). Implant planning and development of the cutting zone take place entirely intraoperatively without the need for a preoperative CTscan. The system continuously tracks the position of the patient's lower limb and the handheld robotic device using an infrared navigation system. The system is imageless in as much as it does not use a CT or MRI to map the femoral and tibial condylar surface. It therefore relies on accurate registration of intraoperative knee kinematic assessment, anatomic landmarks, and surface mapping of the knee using a calibrated optical probe designed for use with this robotic system.

After percutaneous insertion of bicortical partially threaded pins into the proximal tibia and distal femur and attachment of optical tracking arrays (fig. 2), mechanical and

rotational axes of the limb are determined intraoperatively by establishing the hip, knee, and ankle centers. Either the kinematic, anteroposterior (Whiteside) or transepicondylar axes of the knee are identified and selected to determine the rotational position of the femoral component. The condylar anatomy is mapped out by "painting" the surfaces with the optical probe. This registration process takes approximately 5 minutes on average. The intraoperative data then are used by the system's software algorithms to determine the coronal, sagittal, and axial bone axes and morphology. A virtual model of the knee is created. Implant planning for component sizing, alignment, and volume of bone removal takes place intraoperatively (fig. 3). The surgeon selects the implant size that best fits the patient's anatomy

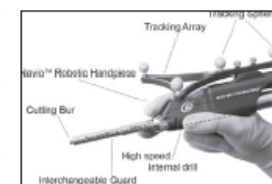


Fig. 1 : Navio™ handpiece





Does it work ? Lab study

Table 2. Root mean square errors of robotic systems and conventional techniques in unicondylar knee arthroplasty

Direction	Navio™ (Blue Belt Technologies Inc, Plymouth, MN, USA; current study)	MAKO Rio (MAKO Surgical Corp, Fort Lauderdale, FL, USA) [7]	Acrobot (MAKO Surgical Corp) [5]	Conventional techniques [5]
Flexion/extension (degrees)	1.7	2.1	1.7	6.0
Varus/valgus (degrees)	2.4	2.1	2.1	4.1
Internal/external rotation (degrees)	1.7	3.0	3.4	6.3
Medial/lateral (mm)	1.3	1.2	1.0	2.6
Anterior/posterior (mm)	1.3	1.6	1.8	2.4
Proximal/distal (mm)	1.0	1.0	0.6	1.6

- Robotic systems
 - Errors up to 3° and 2mm
- Conventional Systems
 - Errors up to 6° and 3mm

Clin Orthop Relat Res
DOI 10.1007/s11999-014-3764-x

Clinical Orthopaedics
and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

SYMPOSIUM: 2014 KNEE SOCIETY PROCEEDINGS

High Degree of Accuracy of a Novel Image-free Handheld Robot for Unicondylar Knee Arthroplasty in a Cadaveric Study

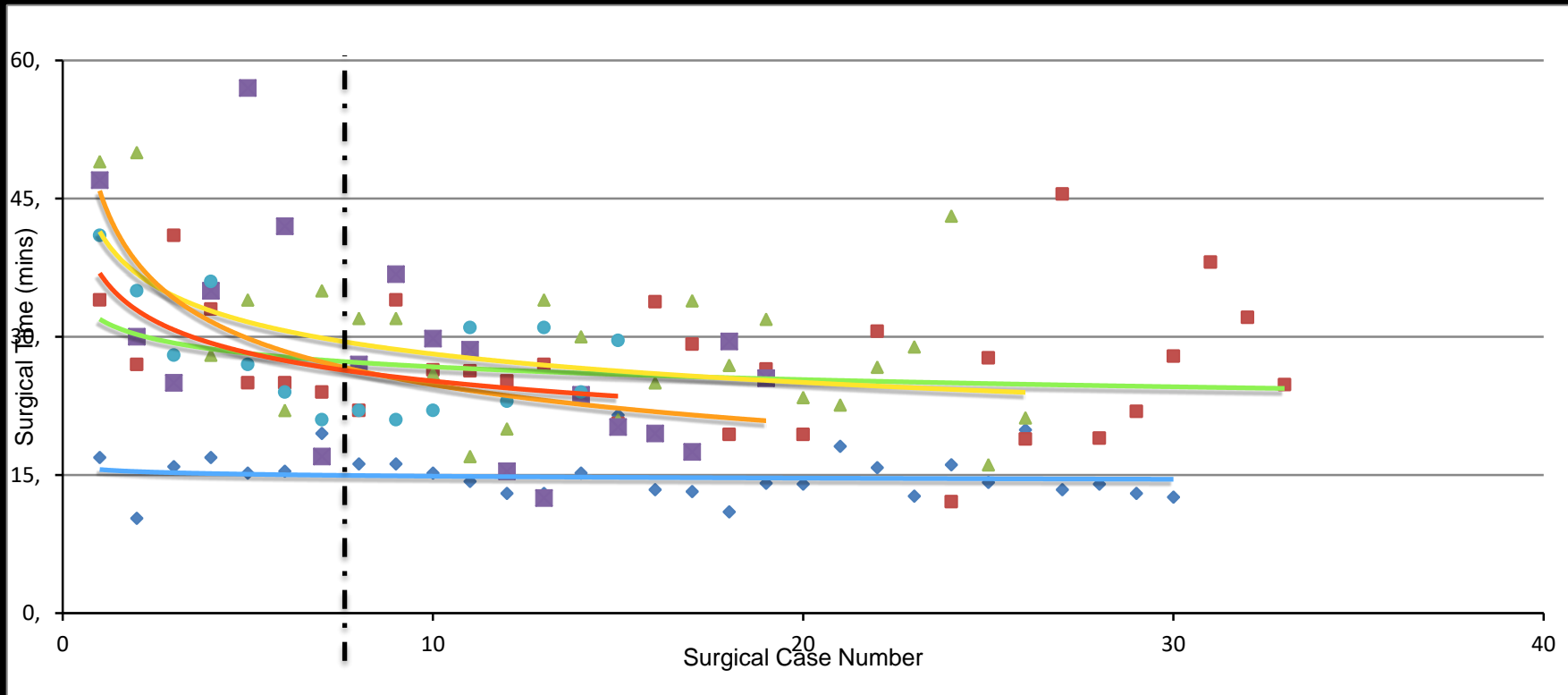
Jess H. Lonner MD, Julie R. Smith PhD, Frederic Picard MD,
Brian Hamlin MD, Philip J. Rowe PhD, Philip E. Riches PhD

References:

1. Dunbar et al. The Journal of Arthroplasty. 2012 Vol. 27 No. 5
2. Cobb et al. J Bone Joint Surg [Br]2006;88-B:188-97.

Does it work ? Learning curve

- *Initial long planning and cutting time,*
- *Rapid move to steady state time (average 8 procedures).*



Does it work ? Clinical study



Prospective study

2 groups
Side
Age - sexe - BMI
Etiology

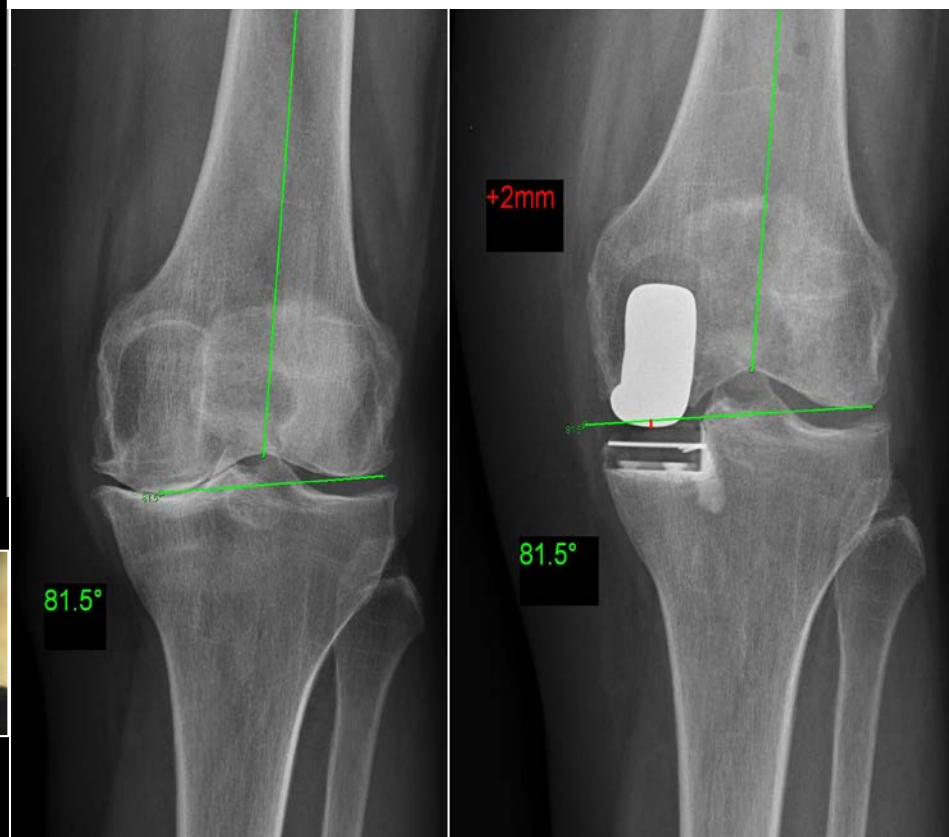
N=40
32 med UKA- 8 Lat
34 w - 6m
70y

Control Group

Robot



**Robotic assisted UKA
is helpful for joint line restitution
(with resurfacing implant)**



WORLD
ARTHROPLASTY CONGRESS

PARIS, FRANCE 17 APRIL 16-18, 2015

www.icjr.net/2015paris



Does it work ? Clinical study

2016

A Review Paper

The Evolution of Image-Free Robotic Assistance in Unicompartmental Knee Arthroplasty

Jess H. Lonner, MD, and Vincent M. Moretti, MD

Am J Orthop (Belle Mead NJ). 2016 May-Jun;45(4):249-54.

« ... » **Component placement**, quantified **soft tissue balance**, and **radiographic alignment** appear to be **improved** and the incidence of outliers reduced with the use of robotic during UKA « ... » optimism that the full benefits of robotic in UKA will be further confirmed with additional time and research « ... »

Challenging situation

Clin Orthop Relat Res
DOI 10.1007/s11999-011-1963-2

SYMPOSIUM: PAPERS PRESENTED AT THE ANNUAL MEETINGS OF THE KNEE SOCIETY

Lateral Unicompartmental Knee Arthroplasty Relieves Pain and Improves Function in Posttraumatic Osteoarthritis

Sebastien Lustig MD, PhD, Sebastien Parratte MD, PhD,
Robert A. Magnussen MD, Jean-Noel Argenson MD,
Philippe Neyret MD





Competitors ?



Knee. 2014 Mar;21(2):428-34. doi: 10.1016/j.knee.2013.11.017. Epub 2013 Dec 4.

Unicompartmental knee arthroplasties: robot vs. patient specific instrumentation.

Jaffry Z¹, Masjedi M², Clarke S¹, Harris S¹, Karia M¹, Andrews B¹, Cobb J¹.

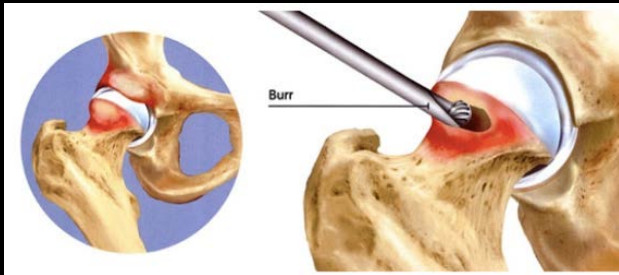
Clin Orthop Relat Res. 2016 Jan;474(1):60-8. doi: 10.1007/s11999-015-4259-0.

The John Insall Award: No Functional Benefit After Unicompartmental Knee Arthroplasty Performed With Patient-specific Instrumentation: A Randomized Trial.

Ollivier M¹, Parratte S¹, Lunebourg A¹, Viehweger E², Argenson JN³.

Other Indications ?

Femoro Acetabular Impingement



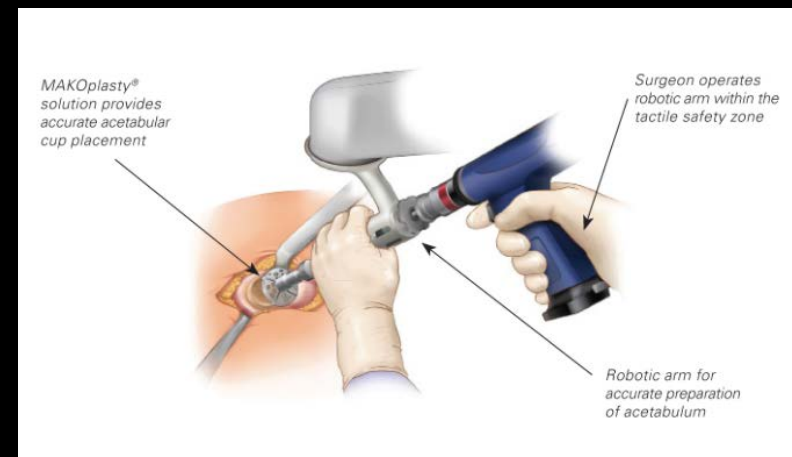
Patello Femoral Arthroplasty



Total Knee Arthroplasty

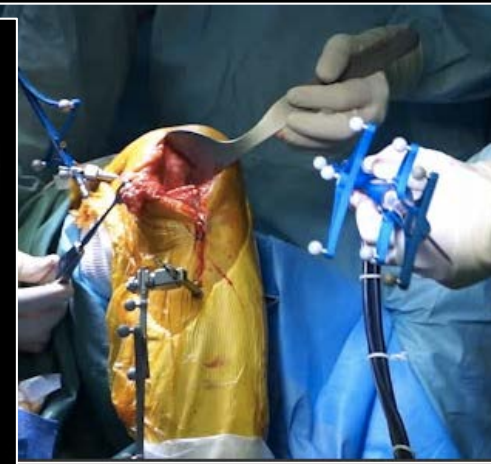


Total Hip Arthroplasty



Conclusions

- Promising technology
- Robotic assistance is helpful regarding accuracy of implant positioning and joint line restitution
- Clinical relevance needs to be confirmed with longer FU and further study.





Thank You

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