







## Imageless is enough

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Sezione di Chirurgia Protesica ad Indirizzo Robotico Unità di Traumatologia dello Sport U.O.C. Ortopedia e Traumatologia









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### **DISCLOSURES**







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- 95% TKA with ROSA
- Started in 2024 UKA with CORI









#### FROM ACTIVE ROBOTICS

#### TO COLLABORATIVE

System	Application	Planning	Cutting type	Cutting control
TSolution	ТКА	Image based	Burr	Autonomous
Mako	UKA, TKA, PFJ	Image based	Saw	Haptic
CORI	υκα, τκα	Image less	Both	Boundary control
OMNI	ТКА	Image less	Saw	Cutting guide
ROSA	ТКА	Both	saw	Cutting guide
VELYS	ТКА	Both	Saw	Haptic
SKYWALKER	ТКА	Image based	Saw	Cutting guide
CUVIS	ТКА	Image based	Burr	Autonomous
ROBIN	ТКА	Image based	Saw	Cutting guide

- Easy navigation system
- Few tips tricks for inputs
- Ligament evaluation: <u>0°</u>, 30°, 45°, 60°, <u>90°</u>, 120°
- Ligament evaluation can be done at different degrees of flexion to assess ligament compliance, which measures how much space is available for the prosthesis after bone cuts





Easy and quick:

- Robotic arm pinned to the patient
- Collaborative mode
- <u>No boundariers</u>

Other robots:

Haptic control (Mako)

Reaming control system (Navio/Cori)



After bone mapping, the knee is evaluated to assess:

- ROM

- coronal and sagittal plane
   deformity
- ligament compliance (with laxity information)





Balancing begins with:

- Extension space
- Evaluate amount of space given by
- Cuts
- Ligaments





#### Balance

Flexion/Extension

#### (Provisional)Flexion

- 1. Adjusting size of the femoral component
- 2. Anteriorization/posterior position of the femoral component
- 3. Rotation of the femoral component
- 4. Tibial resection adjustment
- 5. Bearing thickness
- 6. Slope and Flexion











proximal tibial cut
followed by an
assessment of ligament
compliance using the
Fuzion tensioner
Replanning

Key step: after the tibial cut, the spaces change significantly, requiring a reassessment of the ligaments



- complete the femoral cuts

reassess the knee,
 evaluating changes in the
 kinematic curve and coronal
 and sagittal alignment

### **ACCURATE WORKING**

Knee Surgery, Sports Traumatology, Arthroscopy (2023) 31:1153–1161 https://doi.org/10.1007/s00167-021-06800-8

KNEE

High accuracy of a new robotically assisted technique for total knee arthroplasty: an in vivo study

Stefano Marco Paolo Rossi<sup>1</sup> · Rudy Sangaletti<sup>1,3</sup> · Loris Perticarini<sup>1</sup> · Flavio Terragnoli<sup>2</sup> · Francesco Benazzo<sup>1,3</sup>



Evaluation of ROSA accuracy – 75 knees in 75 patients operated using this robotic system with Posterior Stabilized Persona

Comparison between: planned, validated and measured angles and cuts for the distal and posterior femur, for the proximal tibia and for the final coronal alignment on long standing x-rays

A statistically significant difference was found only between the average planned and the average validated angle for femoral flexion, tibial coronal axis, medial and lateral cuts; the average difference was in any case **below 1 mm or under 1 degree** with SD < 1

#### **ACCURATE WORKING**

The results of this study demonstrated that using this surgical robot in total knee arthroplasty it is possible to perform accurate bone cuts and to achieve the planned angles and resections

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#### **INCREASE IN OUTCOMES**



At minimum 12-month follow-up, the imageless ROSA knee system showed higher overall ROM and improvement from preoperative condition with increased PROMs compared to the NTKA group (iAssist Knee)

> Archives of Orthopaedic and Trauma Surgery https://doi.org/10.1007/s00402-022-04560-9

2023

KNEE ARTHROPLASTY

A new robotically assisted technique can improve outcomes of total knee arthroplasty comparing to an imageless navigation system

Fabio Mancino<sup>1,2,3</sup> · Stefano Marco Paolo Rossi<sup>1</sup> · Rudy Sangaletti<sup>1</sup> · Ludovico Lucenti<sup>1</sup> · Flavio Terragnoli<sup>4</sup> · Francesco Benazzo<sup>1,5</sup>

#### **NEW ALIGNMENTS: PROMISING OUTCOMES**

International Orthopaedics https://doi.org/10.1007/s00264-022-05671-z

ORIGINAL PAPER

2023

Individualized alignment and ligament balancing technique with the ROSA® robotic system for total knee arthroplasty

Stefano Marco Paolo Rossi<sup>1</sup> · Francesco Benazzo<sup>1,2</sup>

The system is showing a favourable gap balancing technique and the possibility to create an individualized alignment. Preliminary results have now been shown in the literature both on the accuracy of the system and on clinical outcomes.

Preliminary results are promising both in terms of accuracy of the system and of clinical outcomes.



### **NEW ALIGNMENTS: PROMISING OUTCOMES**

Get new info and «learn» from the robot: Optimize your results, be more reproducible

International Orthopaedics https://doi.org/10.1007/s00264-018-4180-8

**ORIGINAL PAPER** 

2018 CrossMark

2021

Computed tomography evaluation of total knee arthroplasty implants position after two different surgical methods of implantation

Francesco Benazzo<sup>1</sup> · Stefano Marco Paolo Rossi<sup>1</sup> · Gianmarco Danesino<sup>2</sup> · Catherine Klersy<sup>3</sup> · Simone Perelli<sup>1</sup> · Matteo Ghiara<sup>1</sup>



Archives of Orthopaedic and Trauma Surgery (2021) 141:2295–2302 https://doi.org/10.1007/s00402-021-04115-4

KNEE ARTHROPLASTY

A ligament tensor-guided extramedullary alignment technique for distal femoral cut in total knee replacement: results at a minimum 3 years follow-up

Stefano Marco Paolo Rossi<sup>1</sup> · Alessandro Ivone<sup>2</sup> · Matteo Ghiara<sup>2</sup> · Eugenio Jannelli<sup>2</sup> · Rudy Sangaletti<sup>1,2,3</sup> · Loris Perticarini<sup>1</sup> · Francesco Benazzo<sup>1,2,3</sup>

#### Elaborate your technique

International Orthopaedics https://doi.org/10.1007/s00264-022-05671-z

**ORIGINAL PAPER** 

2023

#### Individualized alignment and ligament balancing technique with the ROSA<sup>®</sup> robotic system for total knee arthroplasty

Stefano Marco Paolo Rossi<sup>1</sup> · Francesco Benazzo<sup>1,2</sup>

# Elaborate your technique

#### Workflow: Extension first technique with ROSA

- 1. Planning of intra-articular corrections with bone resections
- 2. Tibia resection first  $\rightarrow$  validation and data implementing in the planning
- 3. Re-evaluation of the ligament compliance with <u>FuZion</u>
- 4. Distal femoral resection according to the ligaments and after the tibial cut
- 5. <u>FuZion</u> for rotational final alignment
- 6. 4 in 1 femoral cuts, tibia, patella and cementing

### NOT JUST MY EXPERIENCE vs conventional

Schrednitzki et al. (2023) – Rosa:

- Imageless robotic TKA yielded better coronal alignment and bone resection accuracy vs. conventional methods
- Mean deviation: 1.01° (robotic) vs. 2.05° (conventional) (p < 0.001)</li>

> Arch Orthop Trauma Surg. 2023 Jun;143(6):3471-3479. doi: 10.1007/s00402-022-04648-2. Epub 2022 Oct 21.

Imageless robotic-assisted total knee arthroplasty is accurate in vivo: a retrospective study to measure the postoperative bone resection and alignment

Daniel Schrednitzki <sup>1</sup>, Christoph Eckhard Horn <sup>2</sup>, Ute Anne Lampe <sup>2</sup>, Andreas M Halder <sup>2</sup>

Adamska et al. (2023) – Navio/Cori:

- Higher KOOS scores in robotic groups (p = 0.0001)
- More precise femoral component alignment in robotic groups (p = 0.0013)
- Less blood loss in robotic groups (p = 0.042) but longer surgical time (p = 0.003)

Randomized Controlled Trial> Medicina (Kaunas). 2023 Jan 27;59(2):236.doi: 10.3390/medicina59020236.

Robotic-Assisted Total Knee Arthroplasty Utilizing NAVIO, CORI Imageless Systems and Manual TKA Accurately Restore Femoral Rotational Alignment and Yield Satisfactory Clinical Outcomes: A Randomized Controlled Trial

Olga Adamska <sup>1</sup>, Krzysztof Modzelewski <sup>1</sup>, Jakub Szymczak <sup>1</sup>, Jakub Świderek <sup>2</sup>, Bartosz Maciąg <sup>1</sup>, Paweł Czuchaj <sup>1</sup>, Małgorzata Poniatowska <sup>3</sup>, Artur Wnuk <sup>4</sup>

### NOT JUST MY EXPERIENCE vs image-based

Yee et al. (2023) - Navio/Cori vs Mako

- Image-free robotic systems achieved superior tibial slope accuracy (p < 0.001)</li>
- And higher Knee Society Score at 12 months (p = 0.02)

> Int J Med Robot. 2023 Sep 6:e2574. doi: 10.1002/rcs.2574. Online ahead of print.

#### Surgical accuracy of image-free versus image-based robotic-assisted total knee arthroplasty

Dennis King-Hang Yee<sup>1</sup>, Jonathan Patrick Ng<sup>2</sup>, Cyrus Tsun-Kit Lau<sup>2</sup>, Kevin Ki-Wai Ho<sup>23</sup>, Gene Chi-Wai Man<sup>4</sup>, Vikki Wing-Shan Chu<sup>1</sup>, Tsz Lung Choi<sup>1</sup>, Gloria Yan Ting Lam<sup>1</sup>, Michael Tim-Yun Ong<sup>23</sup>, Patrick Shu-Hang Yung<sup>23</sup>

Rajgor et al. (2024) - Rosa vs Mako

- No significant differences in joint biomechanics restoration
- Imageless system eliminates preoperative imaging costs while maintaining precision

> J Robot Surg. 2024 Jan 17;18(1):33. doi: 10.1007/s11701-023-01786-6.

## Mako versus ROSA: comparing surgical accuracy in robotic total knee arthroplasty

Harshadkumar D Rajgor  $^1$ , Alistair Mayne $^2$ , Chathura Munasinghe $^3$ , Joseph Pagkalos $^2$ , Yuvraj Agrawal $^2$ , Edward T Davis $^2$   $^3$ , Akash D Sharma $^2$ 

#### Push the boundaries: major deformities



> Technol Health Care. 2024;32(5):3737-3746. doi: 10.3233/THC-231261.

## The use of a modern robotic system for the treatment of severe knee deformities

Stefano Marco Paolo Rossi <sup>1</sup>, Rudy Sangaletti <sup>1</sup>, Luca Andriollo <sup>2</sup>, Luca Matascioli <sup>2</sup>, Francesco Benazzo <sup>1 3</sup>

#### Push the boundaries: revision arthroplasty





KNEE ARTHROPLASTY

Knee Surgery, Sports Traumatology, Arthroscopy WILEY



#### The use of an imageless robotic system in revision of unicompartmental knee arthroplasty

Luca Andriollo<sup>1,2,3</sup> | Francesco Benazzo<sup>1,4</sup> | Virgina Cinelli<sup>1,2</sup> | Rudy Sangaletti<sup>1</sup> | Calogero Vellutto<sup>1,2</sup> | Stefano Marco Paolo Rossi<sup>1,4,5</sup> •

#### Push the boundaries: revision arthroplasty





The use of an imageless procedure incorporating intraoperative bone morphing and alignment based on a functional knee positioning has proven to be safe and has yielded excellent clinical and radiographic outcomes

#### KNEE ARTHROPLASTY

Knee Surgery, Sports Traumatology, Arthroscopy WILEY

2025

### The use of an imageless robotic system in revision of unicompartmental knee arthroplasty

Luca Andriollo<sup>1,2,3</sup> | Francesco Benazzo<sup>1,4</sup> | Virgina Cinelli<sup>1,2</sup> | Rudy Sangaletti<sup>1</sup> | Calogero Vellutto<sup>1,2</sup> | Stefano Marco Paolo Rossi<sup>1,4,5</sup> () Imageless is enough?

### **AUTOMATED BONE MORPHING**









A move towards NO RIGID BODIES Automatic regristration



Courtesy of Sebastien Parratte

#### LIGAMENT ASSESSMENT: ELIMINATING SUBJECTIVITY





### AUGMENTED REALITY TO ELIMINATE THE SCREEN

#### Screens and Connectivity

From looking and controling the informations on the screens



Courtesy of Sebastien Parratte

#### To looking and controling the informations onto the field





## **Conclusions: Is the image-less Robot the solution?**

- Great tool not the solution!
- Individualized procedure, more accurate and precise
- Another way of thinking
- Tailored indications and execution
- Knowledge of the implant
- Push the boundaries (revision arthroplasty, new alignments,...)
- In evolution, with new integrated technologies

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