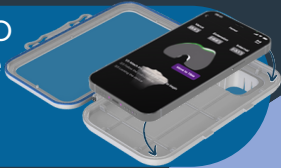


HOW DOES IT WORK?

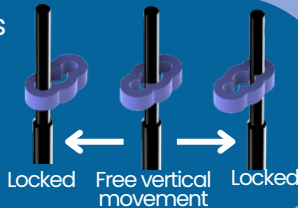
A smartphone with the M.A.R.I.O app is sealed inside the phone case and inserted onto the handle of the M.A.R.I.O device



The device is placed on top of the bone, where the pins vertical position is adjusted to mimic the surface of the bone anatomy.



The positioning of the pins is secured by applying a small force to the protruding tab, thereby engaging the locking mechanism.

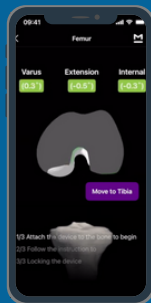


The phone camera faces the bone at 45° and captures the differences in pin heights



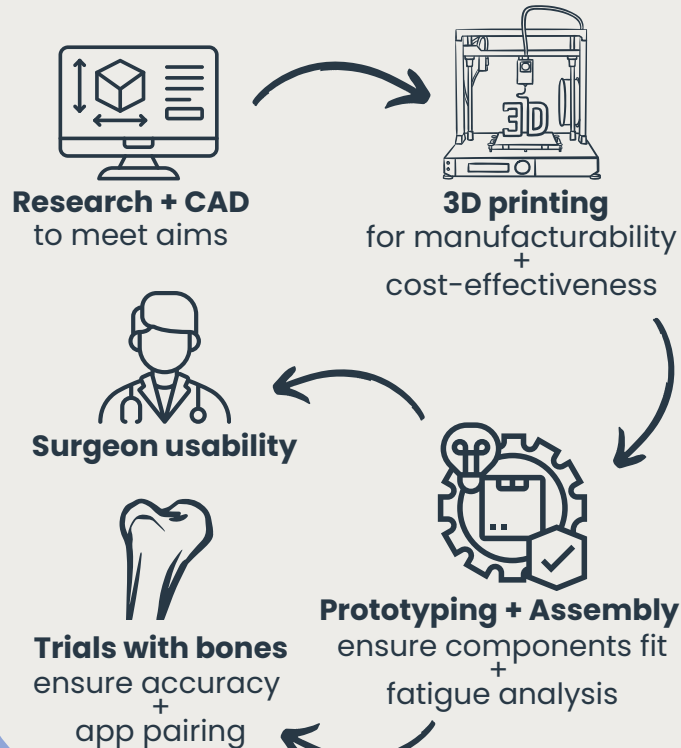
The **M.A.R.I.O** app:

1. Processes the anatomical data using the pin heights and statistical shape modelling.
2. Provides the surgeon with real-time feedback, guiding precise pin placement.



DEVELOPMENT & TESTING

The M.A.R.I.O device was developed through **iterative testing**:



FUTURE IMPACT & OUTCOME

Provides a cost-effective solution to:

- Implant **malalignment**
- Patient **discomfort**
- **Revision** procedures



Future work includes:

- Developing a **singular** pin arrangement for the tibia **and** femur so surgeons do not need to switch plunger systems mid-surgery
- Clinical trials



M.A.R.I.O Device

TEMPLATING BONE SHAPE FOR SURGICAL ACCURACY



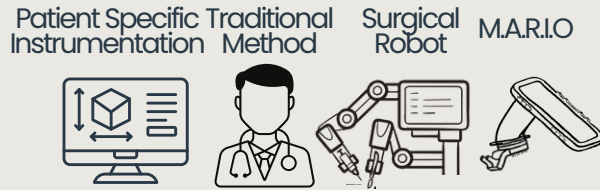
SCAN ME for an immersive experience!



MOTIVATION

Total Knee Arthroplasty (TKA) is a knee replacement procedure where surgical pins are used to **determine** locations of bony resections.

The **Mobile Assisted Reconstruction In Orthopaedics (M.A.R.I.O)** device overcomes current TKA surgery method shortcomings:



	Patient Specific Instrumentation	Traditional Method	Surgical Robot	M.A.R.I.O
Low cost	✓	✓	✗	✓
Low learning curve	✓	✗	✗	✓
High stability	✗	✗	✓	✓
Intraoperative flexibility	✗	✓	✓	✓
Short surgery time	✓	✗	✗	✓
High accuracy	✓	✗	✓	✓
Short preparation time	✗	✓	✓	✓

MAIN AIMS

- 1 Optimise stability of the device
- 2 Reduce manufacturing costs
- 3 Increase accuracy
- 4 User-friendly
- 5 Sterilisable design
- 6 Increased time efficiency for TKA surgery

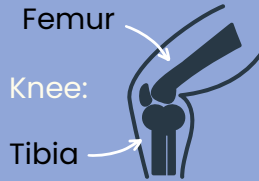


How each Feature addresses the Aims

M.A.R.I.O'S KEY FEATURES

- 6 The M.A.R.I.O device is manufactured using 3D printing, as well as readily available materials.

- 4 **Smartphone integration**
 - Allows portability and avoids use of large equipment.
 - App guides user with clear instructions.



- 3 **Plunger system**
 - Specific arrangement to optimise shape capture for the femur and tibia.
 - Matte black plungers are used to prevent light reflection for accurate camera detection.



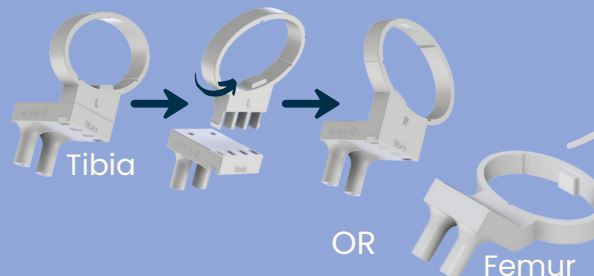
- 5 **Phone Case**

Achieves **sterile** design through:

 - **Tight** silicone seal along **edge** of case.
 - Plastic screen **between** surroundings and phone.

- 2 **Handle**
 - Ergonomic handle design for ambidexterity and mass production.

- 6 **Attachments**
 - Easy and fast attachment for femur and tibia.
 - 4 - 2 in 1 reversible attachment for tibia.



- 1 **Locking Mechanism**
 - Holds pins in position once activated.
 - Ambidextrous and dual-material design.

