stryker

Mako Total Knee 2.0

SmartRobotics™

Overview deck

Mako Total Knee 2.0

Evolution of Mako SmartRobotics™

stryker

2006 — MAKOSurgical Corporation

2009 — Restoris MCK Partial Knee System

2010 — First Mako Total Hip procedure

2012 — Restoris Hip System

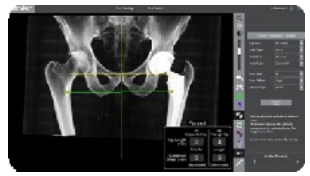
2013 — stryker MAKO SURGICAL CORP.® Stryker acquires Mako

2015 — Third generation Mako System

2016 — First Mako Total Knee case

2018 — Mako Partial Knee 3.0

2020 — Mako Total Hip 4.0



2022 — Mako Total Hip 4.1 / Mako Total Knee 2.0

Leading a robotics market

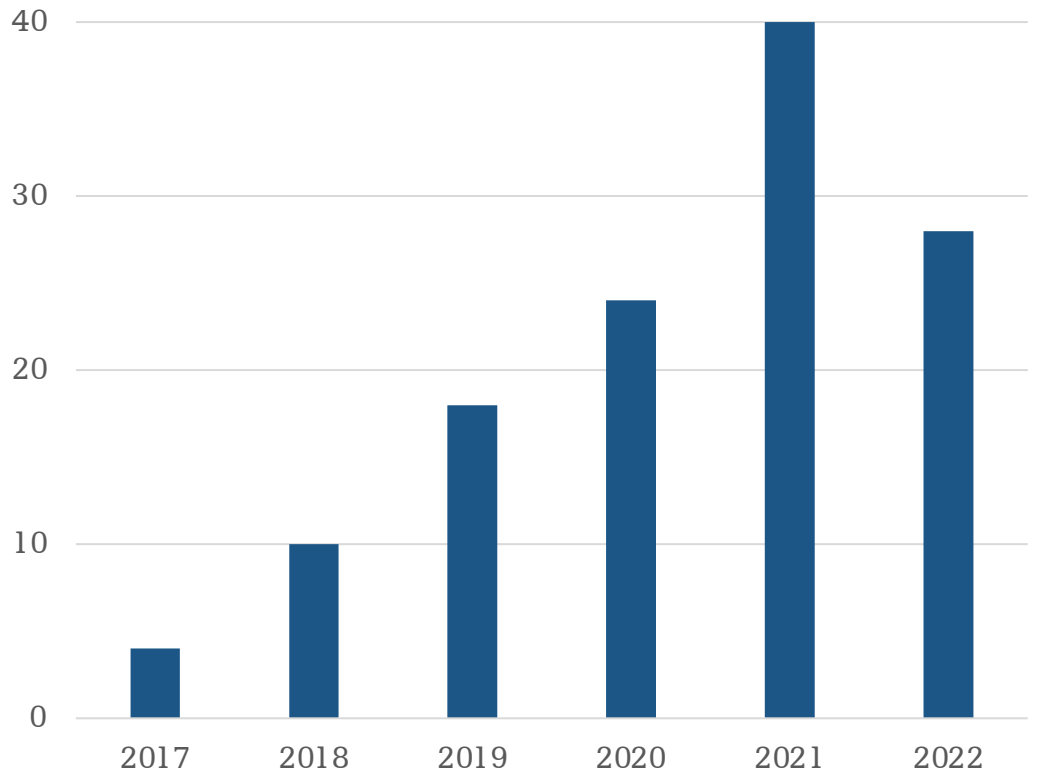
6 years — Mako Total Knee surgery experience

500k+ Mako Total Knee procedures — have been performed*

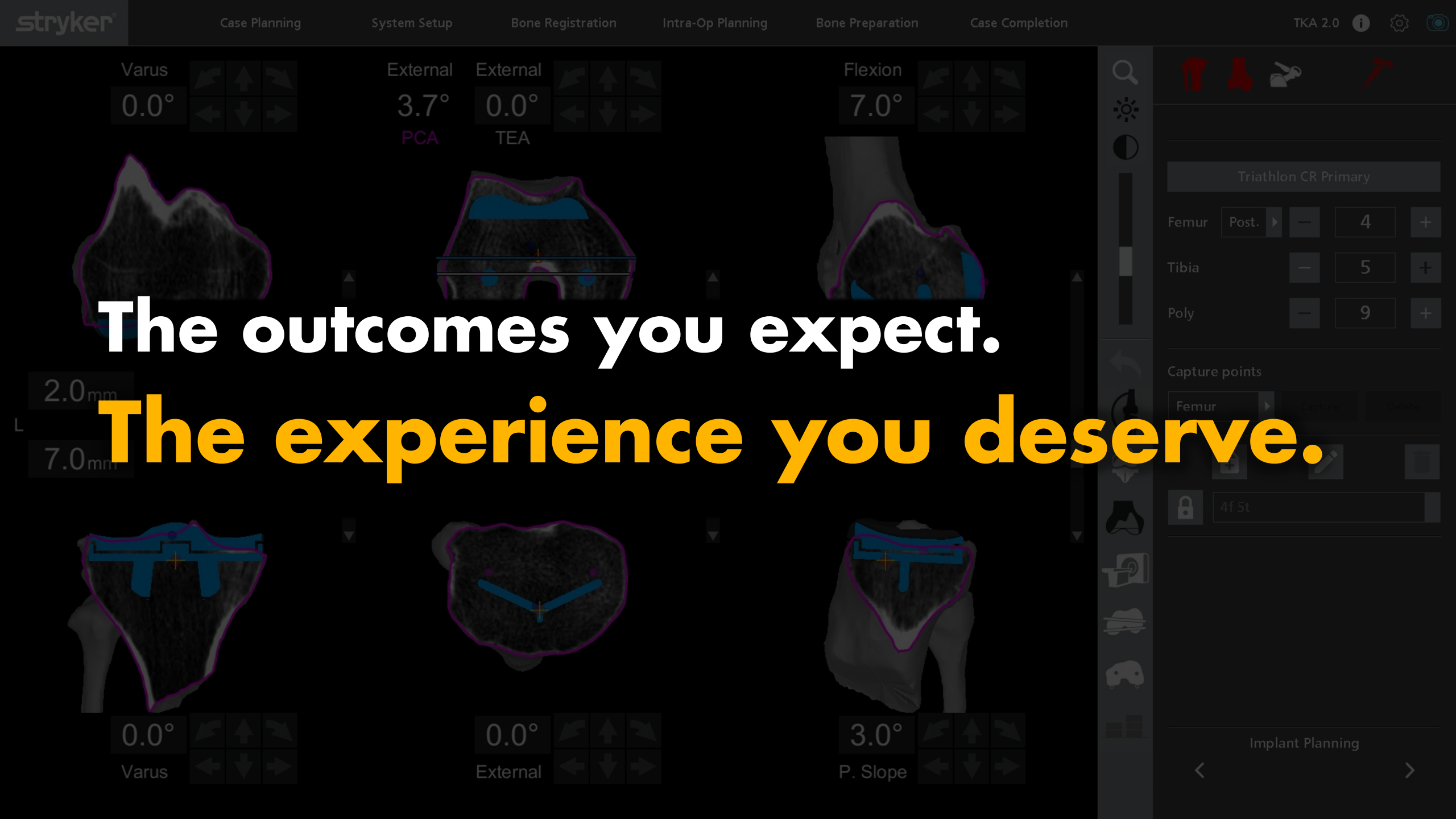
58% Robotic knee — cementless mix*

54% Triathlon knees — implanted robotically*

120+ **Mako Total Knee** peer-reviewed published manuscripts



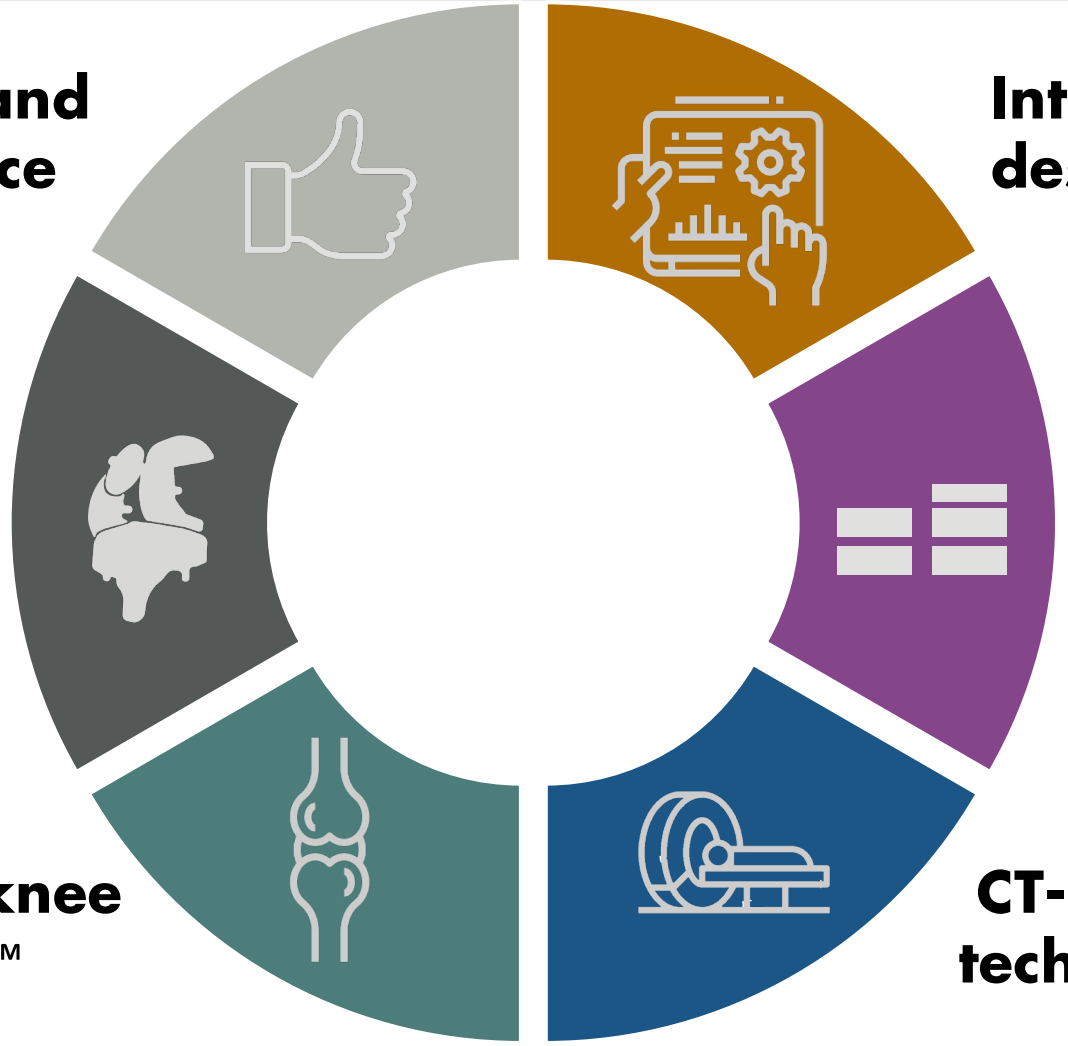
*Stryker's 2022 sales data



The outcomes you expect.

The experience you deserve.

Mako Total Knee 2.0



Control and confidence

Intuitive design

Triathlon Cementless

New Digital Tensioner

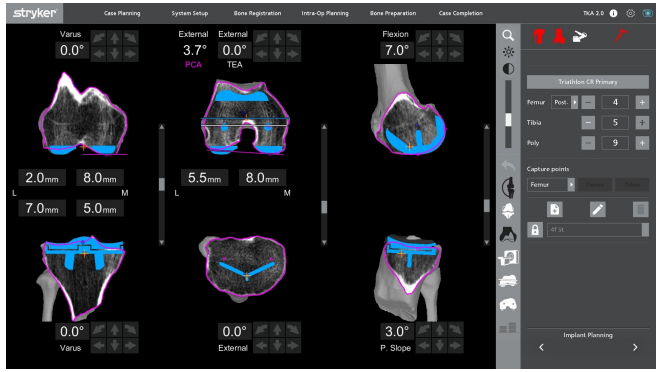
Functional knee positioning™

CT-based technology

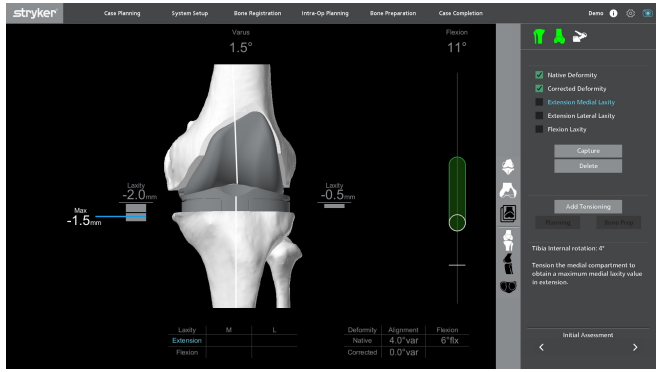
Three core features

Mako Total Knee 2.0

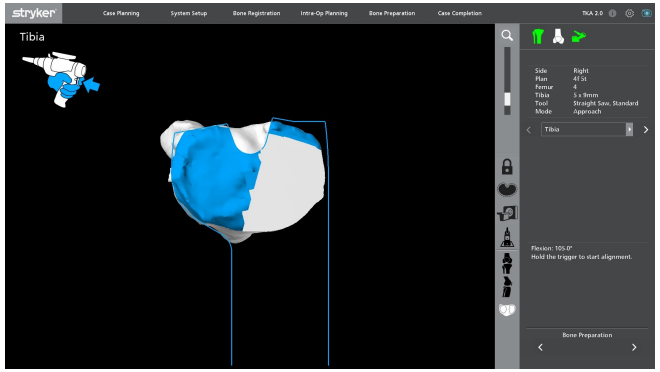
3D CT-based planning



Dynamic joint balancing

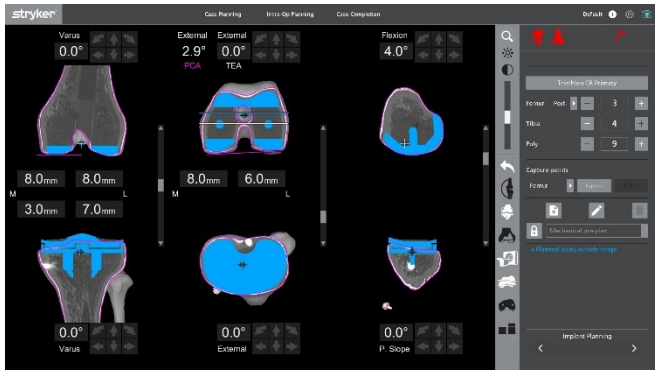


AccuStop™ haptic technology



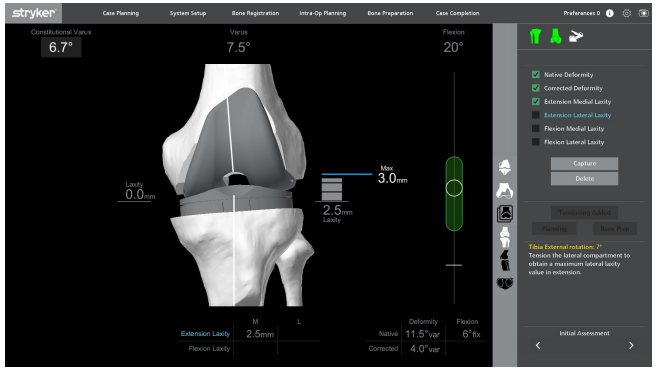
Mako Total Knee 2.0

Functional Knee Positioning™



3D CT-based preoperative plan

+



Intraoperative assessment

+

Intraoperative planning

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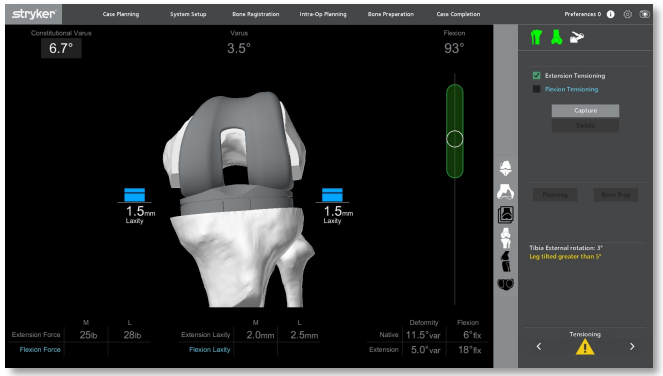

Tensioning
(Midresection only)

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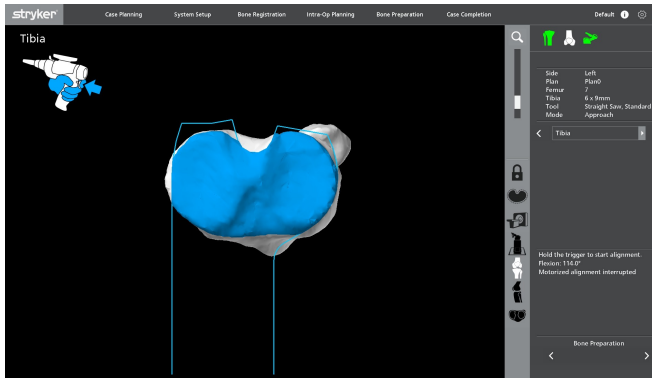

AccuStop™ haptic technology

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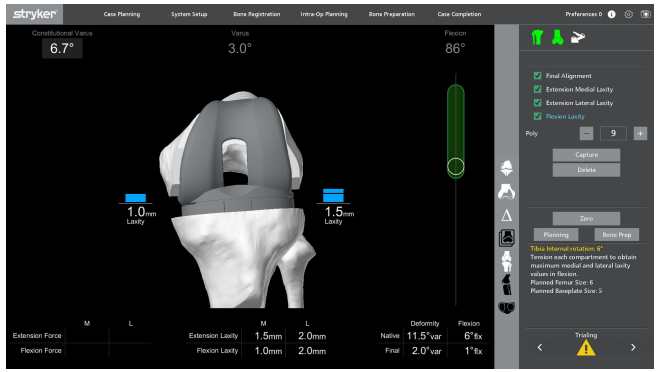


Trialing

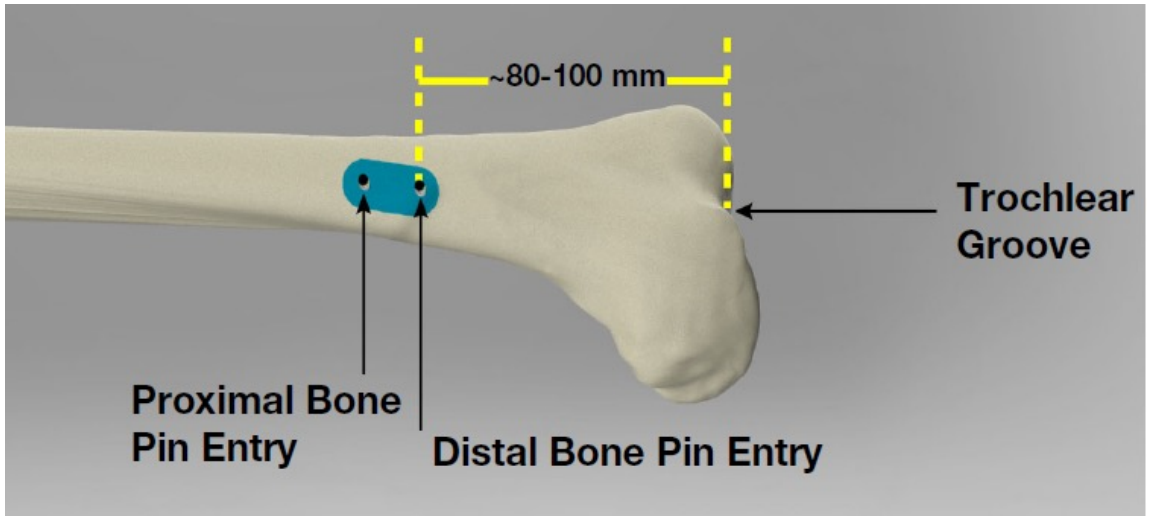
Prioritizing surgical efficiencies

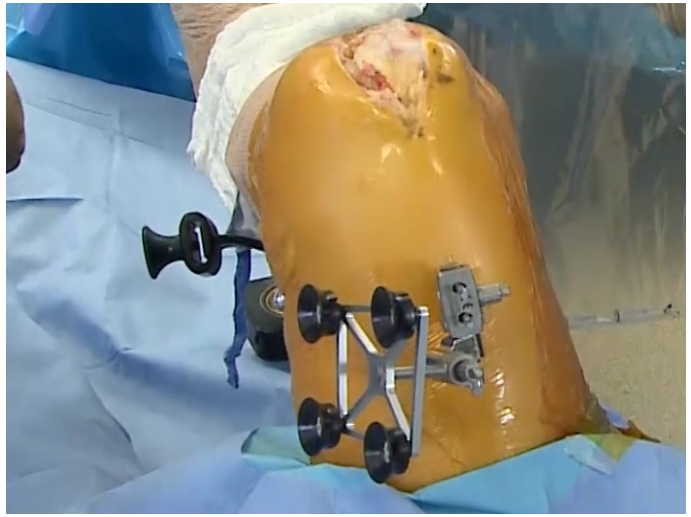
- Mako Park
- Cementless
- Intuitive balancing
- Surgeon preferences
- Digital Tensioner
- Preoperative implant sizes
- Cut advancements

Setup

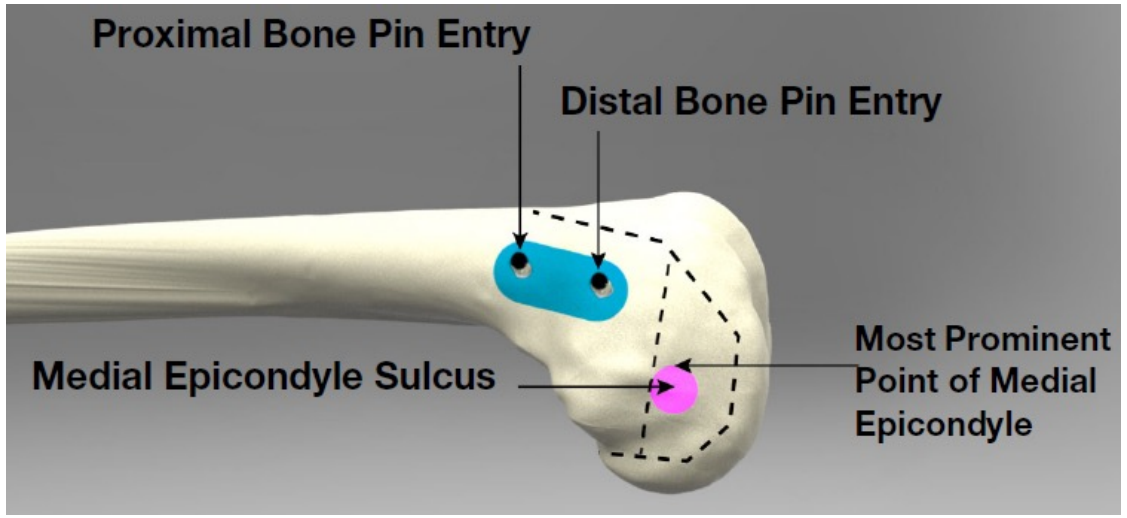
Femur pin and array placement

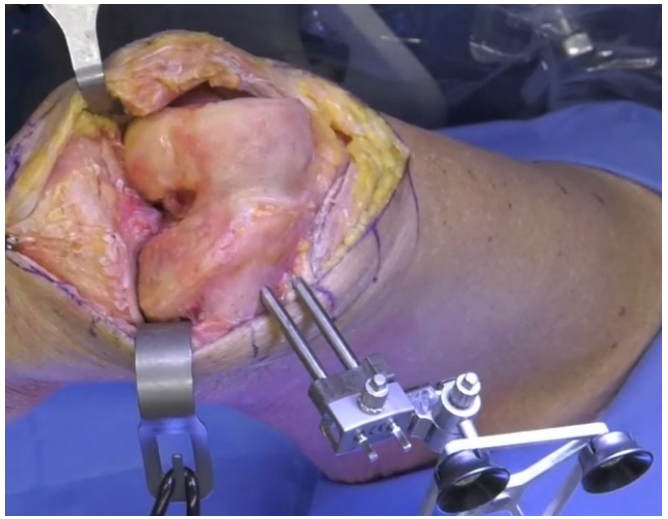
Extra-incision





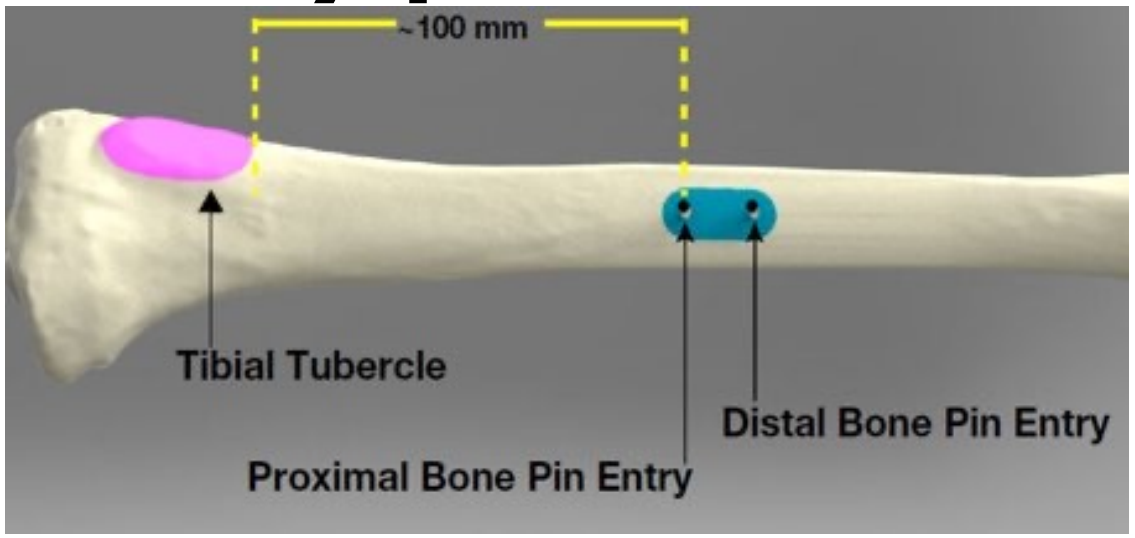
Intra-incision



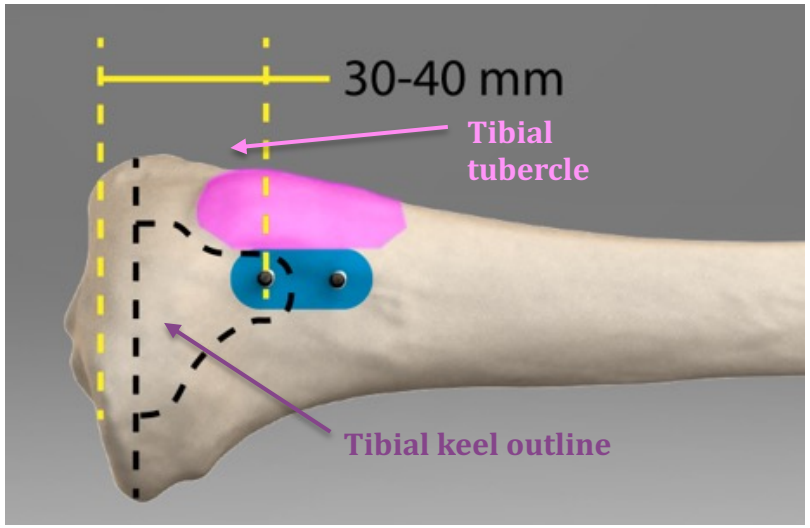


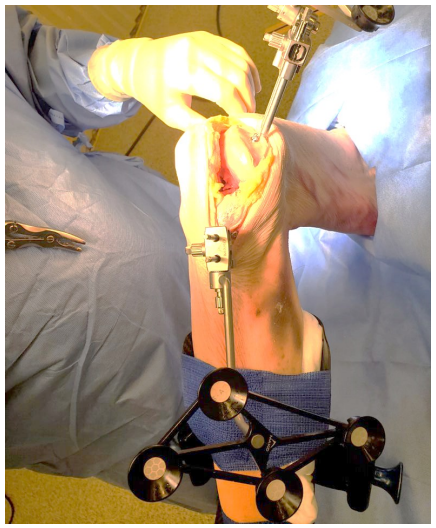
Tibia pin and array placement

Extra-incision



Intra-incision

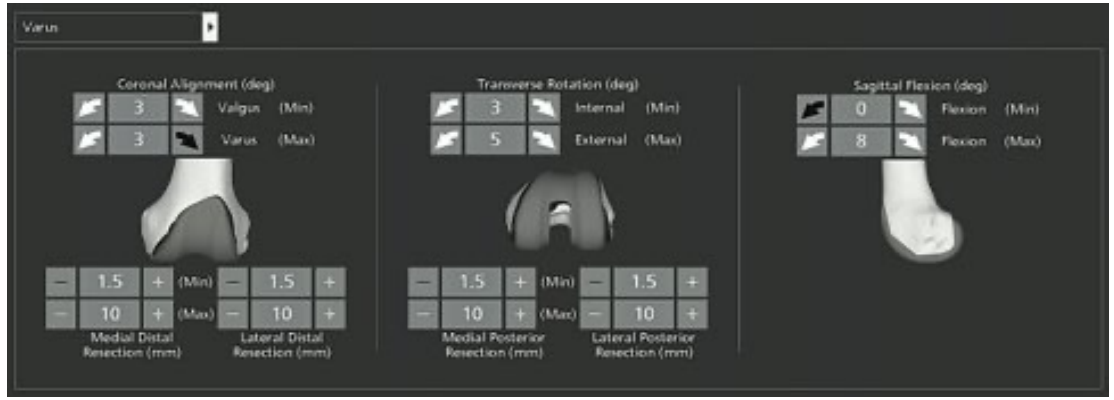


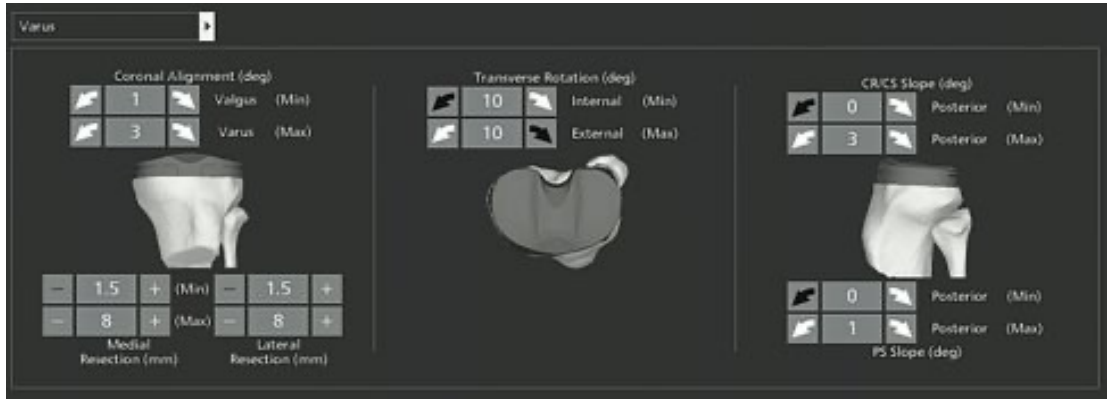


Planning preferences

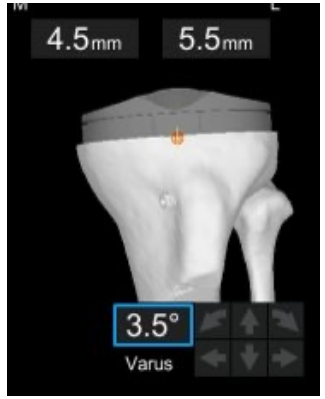
- The surgeon can set their own personalized implant parameters in the surgeon preferences to customize the workflow. Resection depths and rotational limits are two examples.
- If a value goes outside these bounds, a notification appears on the planning screen as a blue box around that value.

Resection and rotation limits

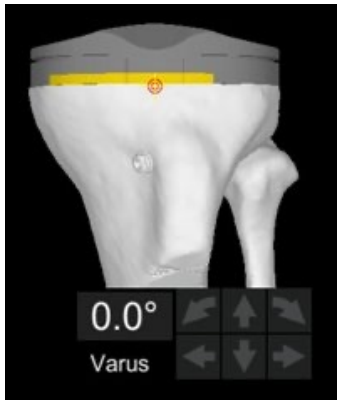




Notifications



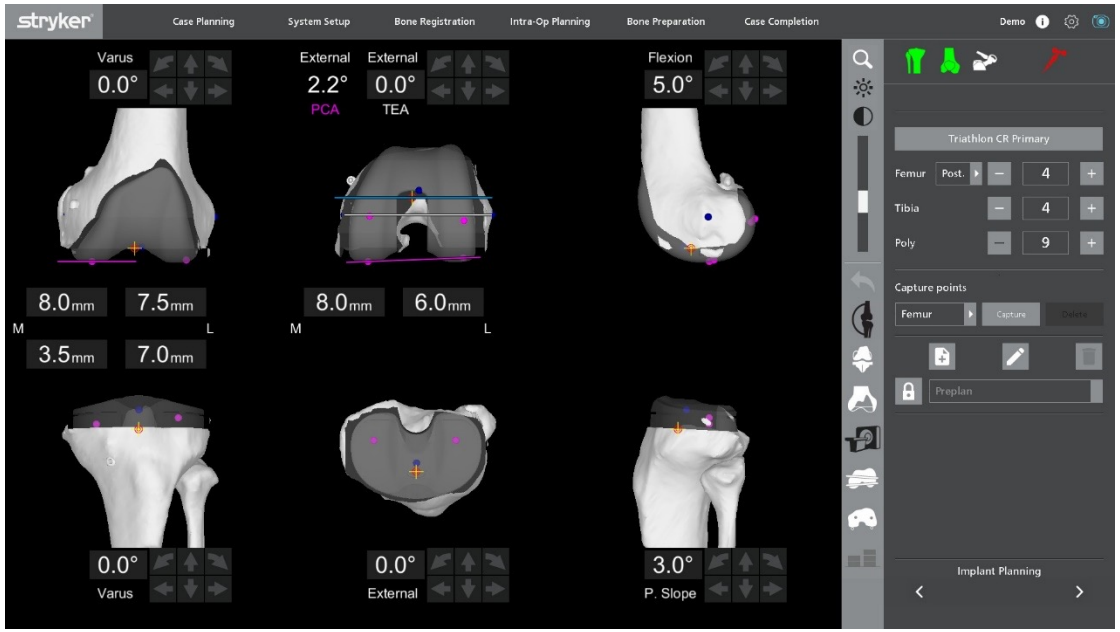
Warnings

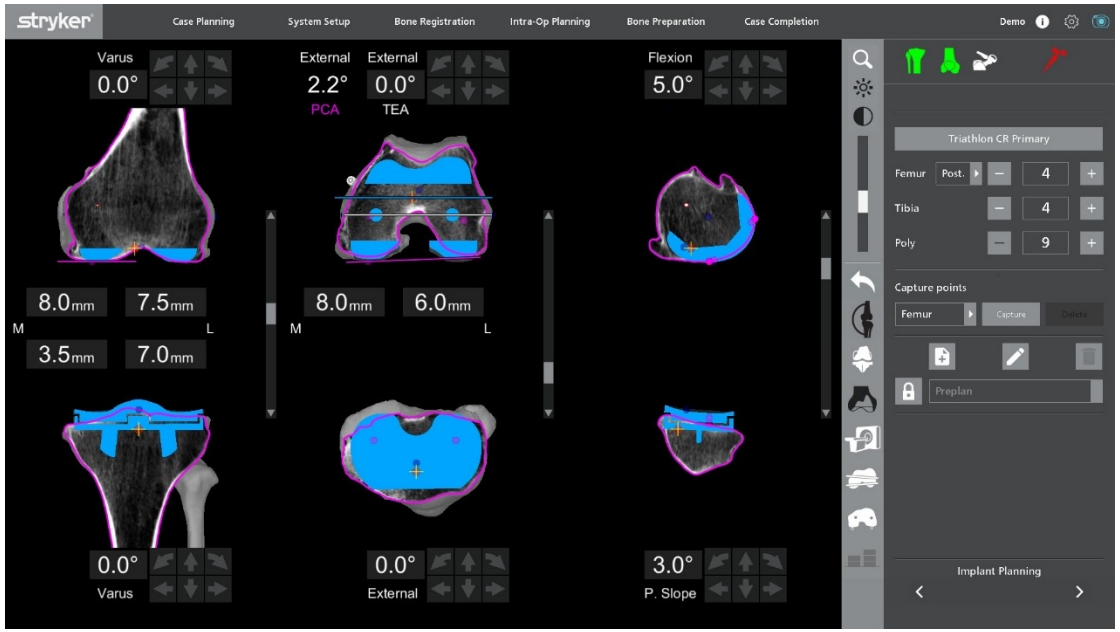


CT-based planning

3D CT-based planning

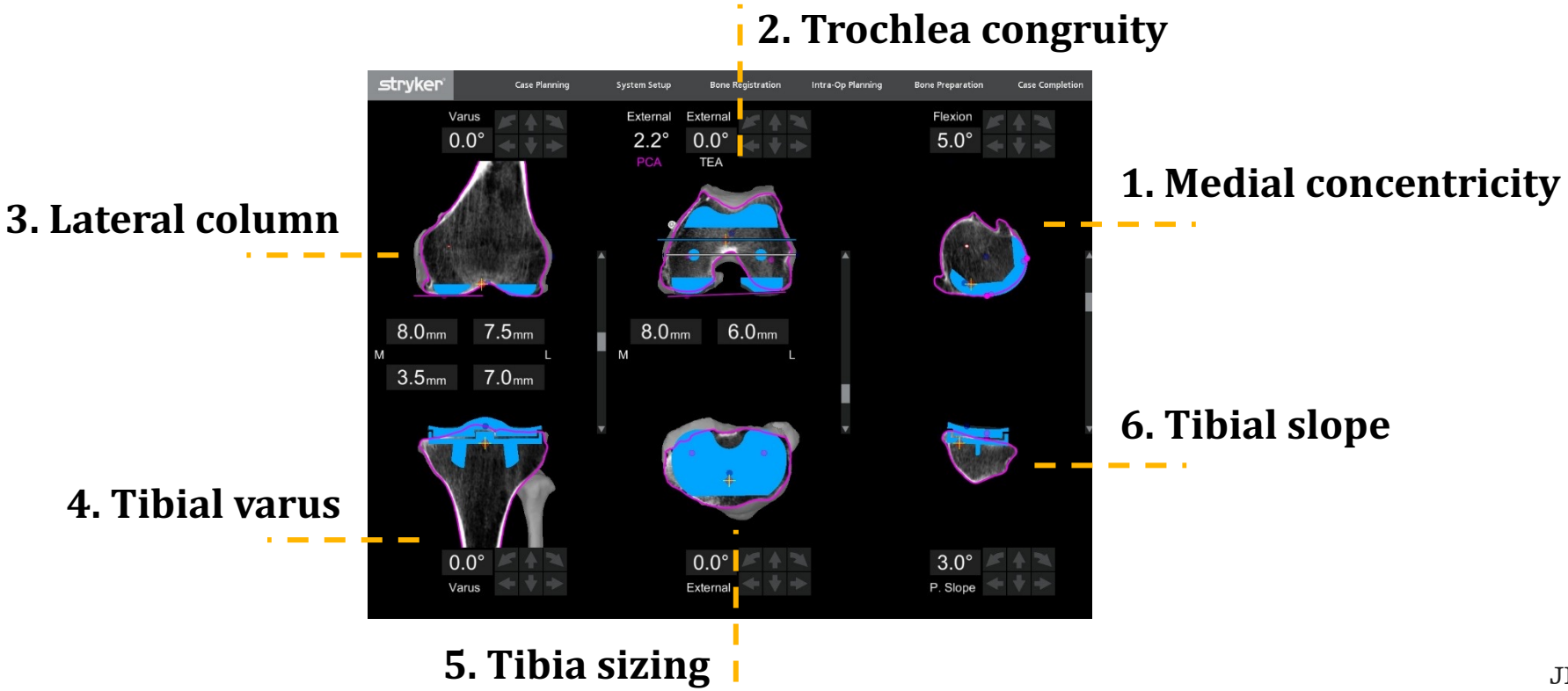
- Mako's 3D CT-based planning allows you to **see more** of your patient's **unique anatomy** and virtually **plan Triathlon in the coronal, transverse and sagittal** planes for each patient.[1]
- **Functional knee positioning™** is achieved by use of the **3D CT-based** preoperative plan based on the patient's bony anatomy and acknowledging **proxies for knee function**.





Functional planning guidelines

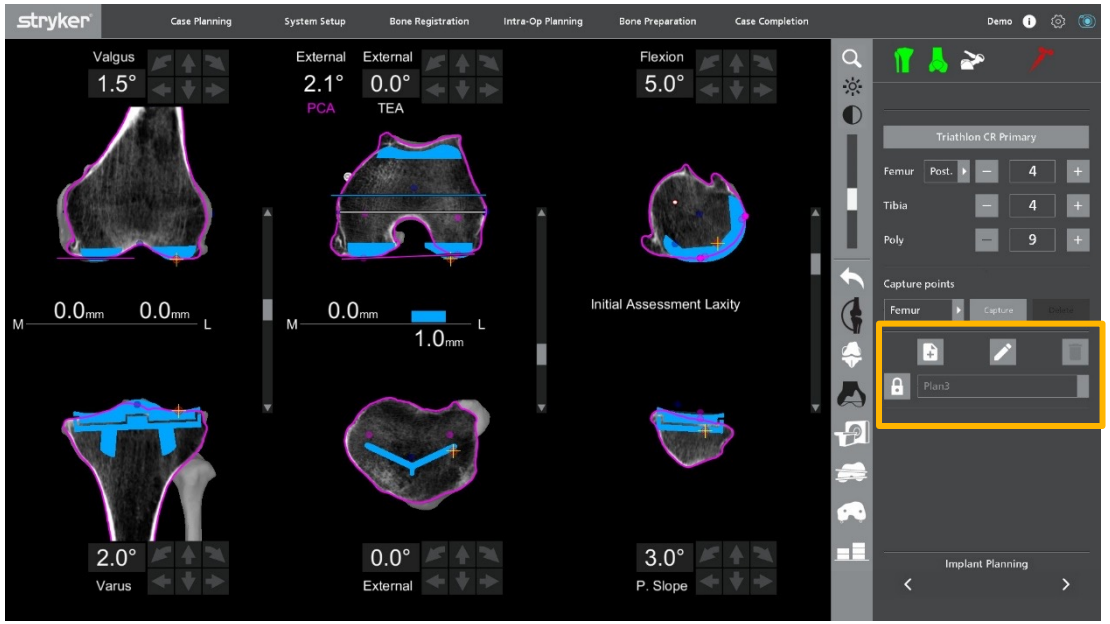
- The functional planning guidelines enable the surgeon to prioritize the attributes of the knee that have the most impact on function, before and after assessing the soft tissue laxities.
- Follow the counterclockwise sequence on the implant planning screen to complete the functional planning guidelines assessment.



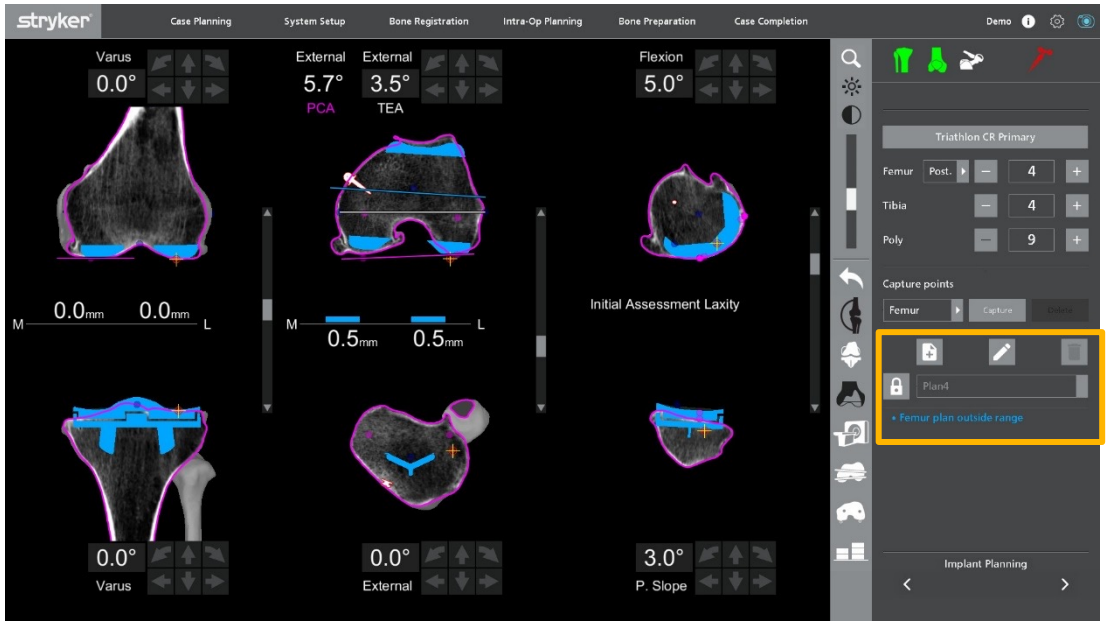
Multiple saved plans

- The surgeon can save multiple plans within a patient's session file and has the ability to balance each individually before choosing the final plan.
- Allows surgeons to evaluate different decision-making hierarchies efficiently and simply.

Plan 1



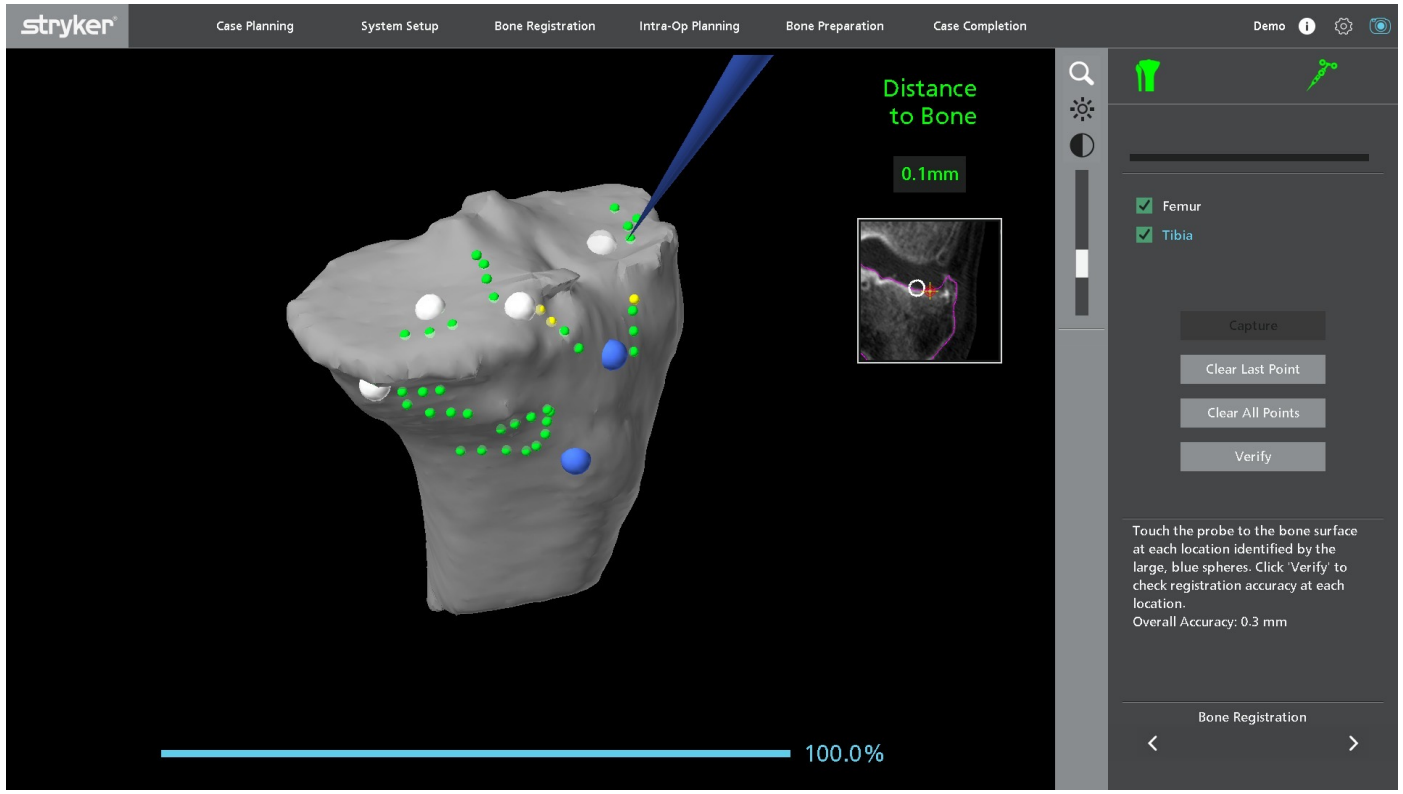
Plan 2



Bone registration

Bone registration

- Surgeon completes bone registration on the femur and tibia by collecting points on the surface of the patient's bones. This step confirms that the CT-based model is aligned to the patient's anatomy within 0.5mm.

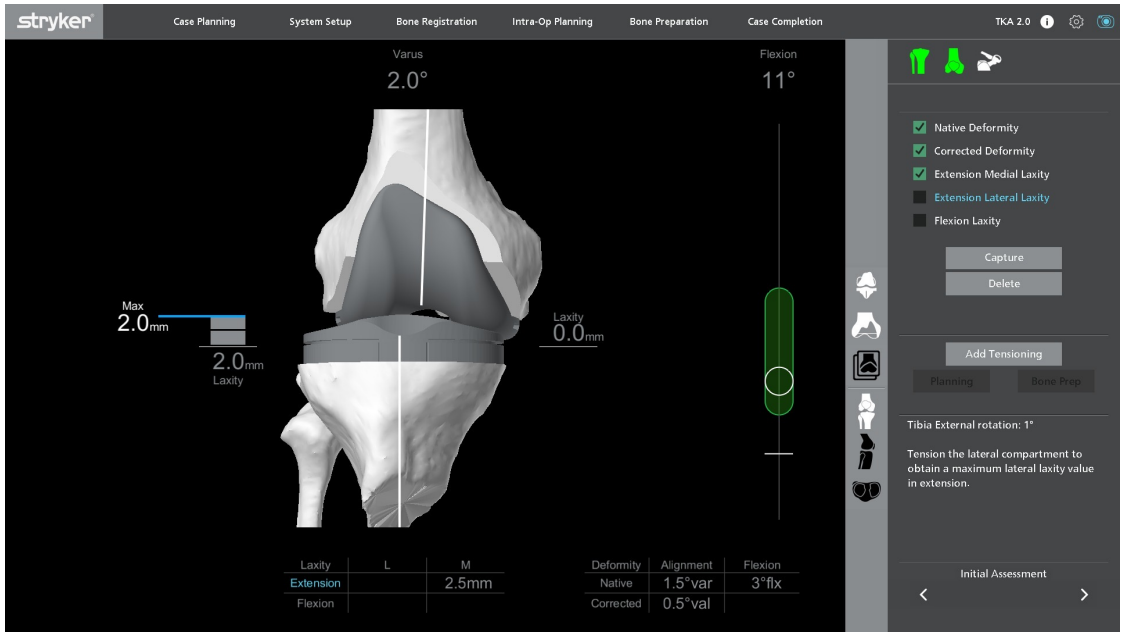


Deformity and laxity assessment

Initial Assessment

- The surgeon can capture the **native deformity and the corrected deformity** to assess the limb, and then capture the **extension and flexion laxity data.**

- The medial and lateral compartments in extension and flexion can be assessed together or separately; this is customizable in surgeon preferences.

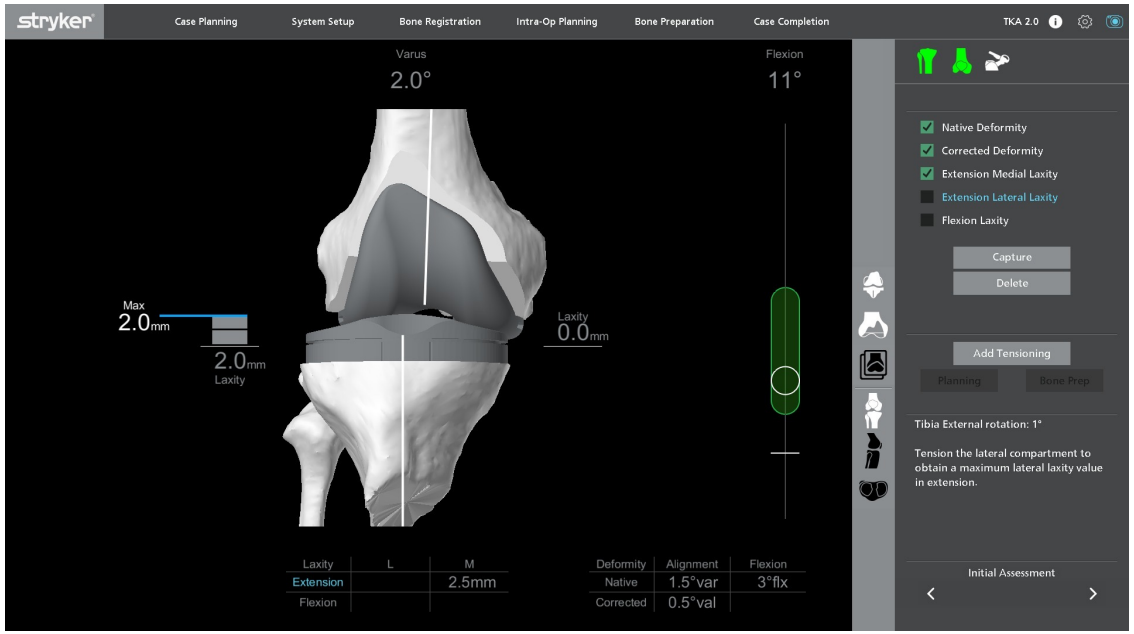


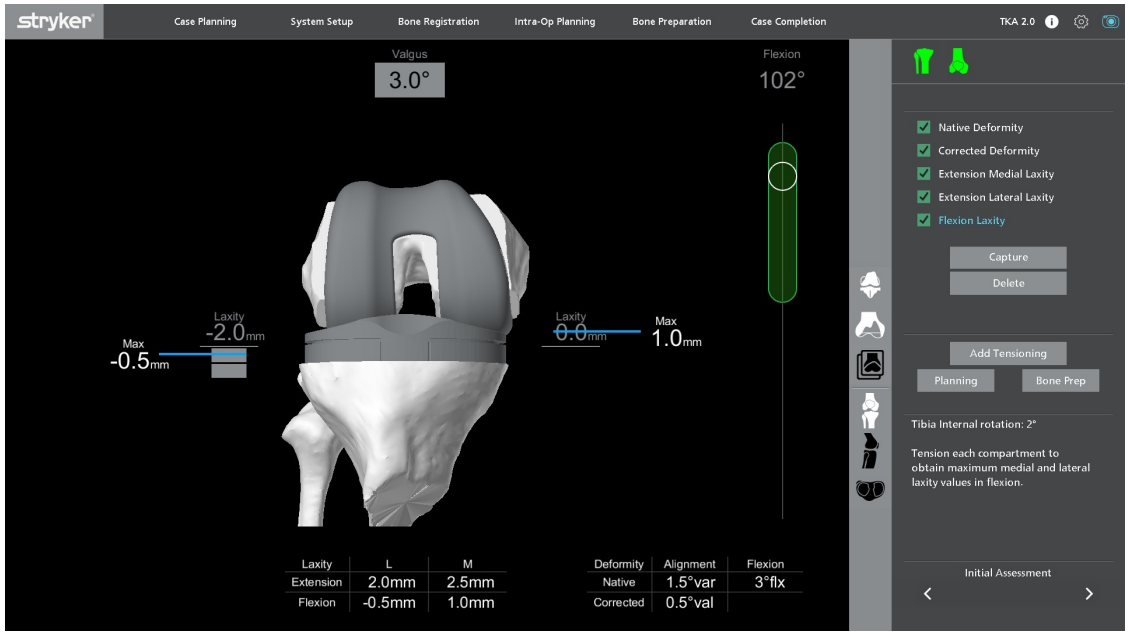
Mako Total Knee 2.0 features a new Digital Tensioner to assess ligament laxity

- No additional instrumentation or hardware.
- Medial and lateral compartment laxity in both flexion and extension can be captured independently and measured every 0.5mm.
- Audible and visual guidance during ligament assessment.
- The maximum amount of laxity that is achieved for each compartment will be automatically stored.

Why the Digital Tensioner?

- Ligament tension can be subjective.[2]
- The digital tensioner has been shown to have excellent intra-user repeatability[3] (ICC ≥0.96) and inter-user reproducibility[3] (ICC ≥0.90)[3] minimizing subjectivity and potentially leading to a more predictable surgery.



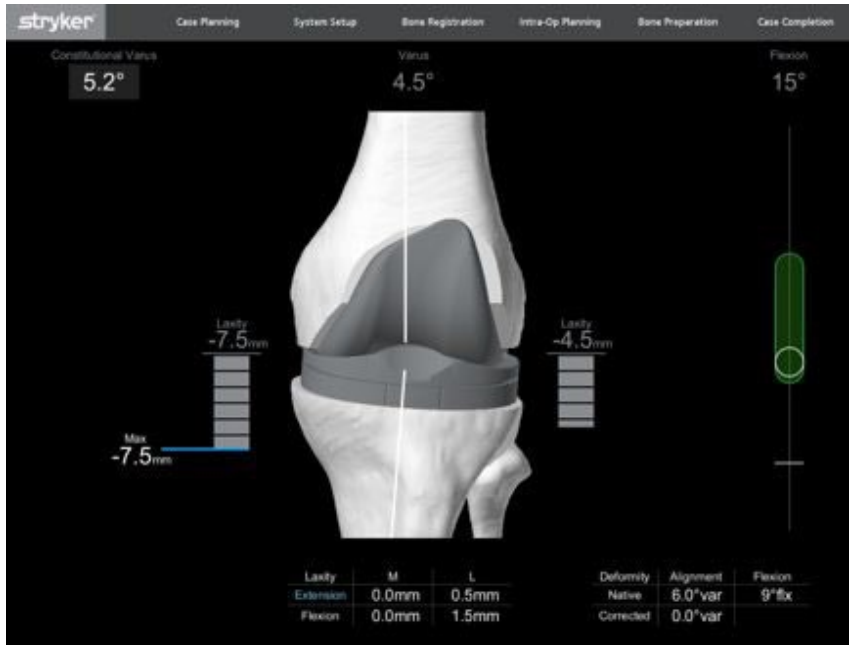


Digital Tensioner – how it works...

1. As the surgeon applies tension to the ligaments and opens each compartment, an audible and visual cue will be provided every 0.5 millimeters.

2. As the surgeon opens a compartment, they may reference the audible cues. Once the surgeon finds the end stop of the ligament, by referencing the plateau of the stress/strain curve, the audible and visual feedback will start to slow and eventually stop. That signifies to capture this point.

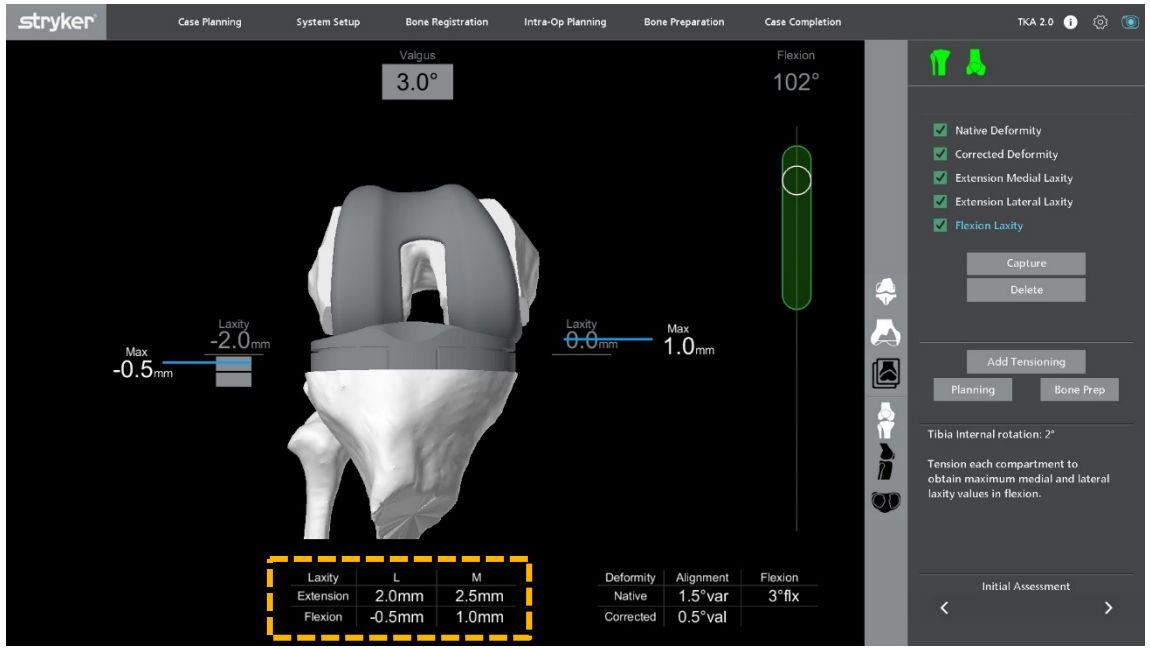
3. The system will temporarily store the maximum laxity value assessed, after which the value can be captured into the laxity table by the Mako Product Specialist. Once captured, the surgeon can move onto the next compartment.

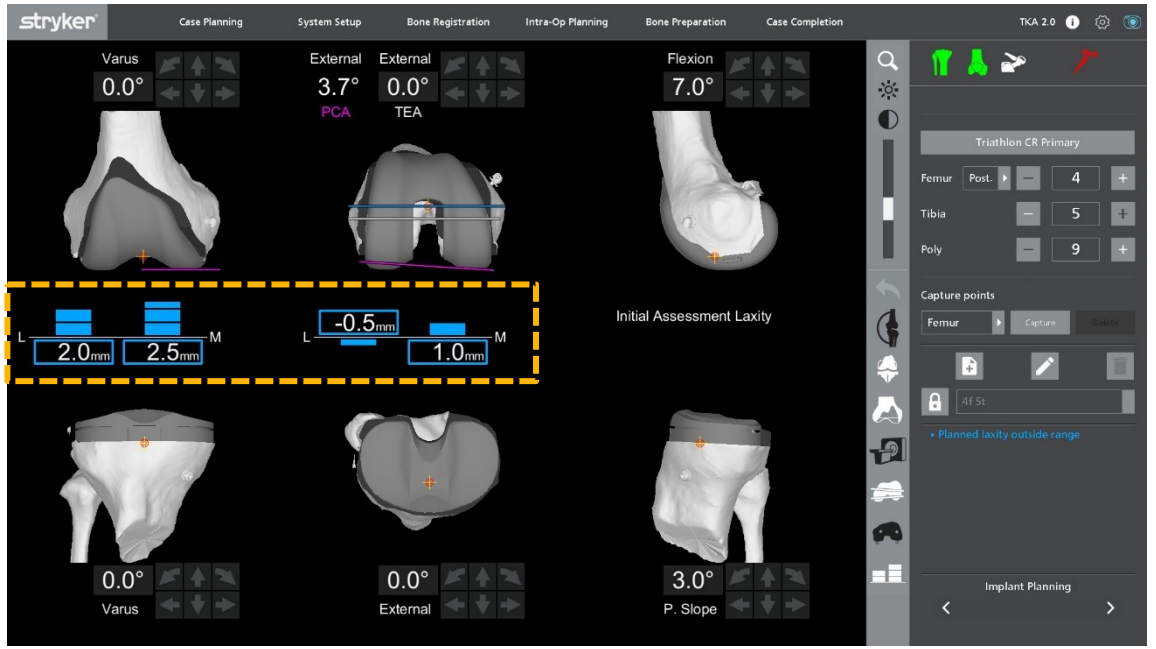


Intraoperative implant adjustments

Intraoperative planning

- The laxity information is transferred to the implant planning page to allow the surgeon to balance the knee.
- The balancing page provides all the necessary information on one page, including the ability to balance the knee in CT view.
- The surgeon can balance the knee in conjunction with the functional planning guidelines to help achieve functional knee positioning™.





Intraoperative planning – targets

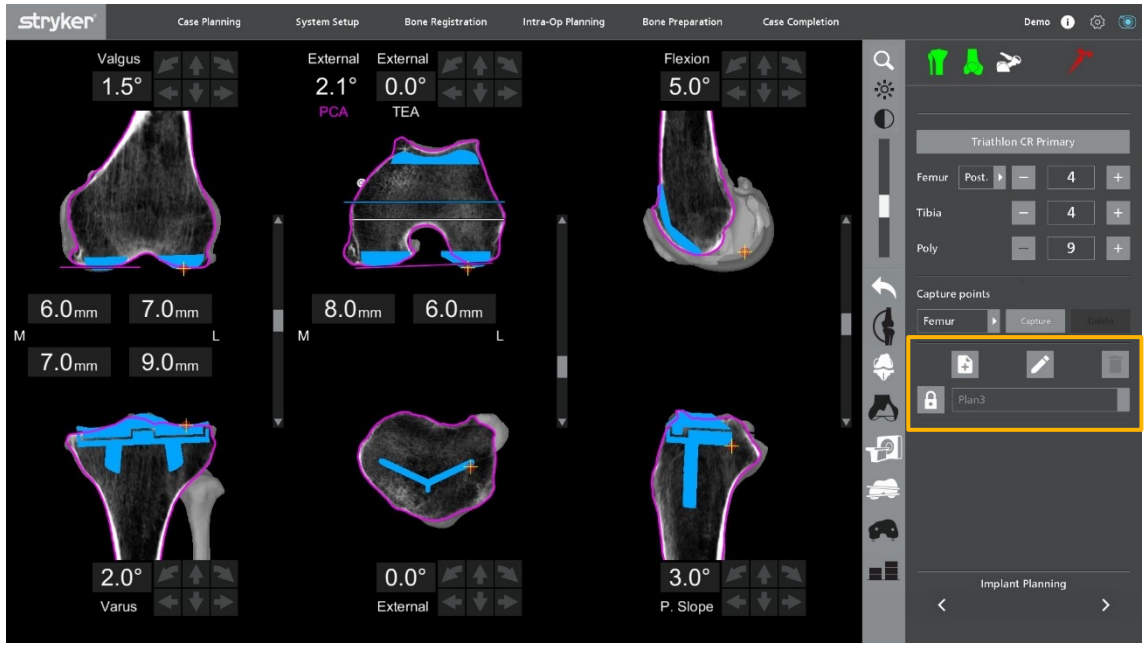
When balancing, consider the following target ranges:*

- Extension medial: 0-0.5mm
- Extension lateral: 0-0.5mm
- Flexion medial: 0-0.5mm
- Flexion lateral: 0-1mm

*This is a recommendation. The deformity, flexion contracture and hyper extension of each individual knee should be considered.

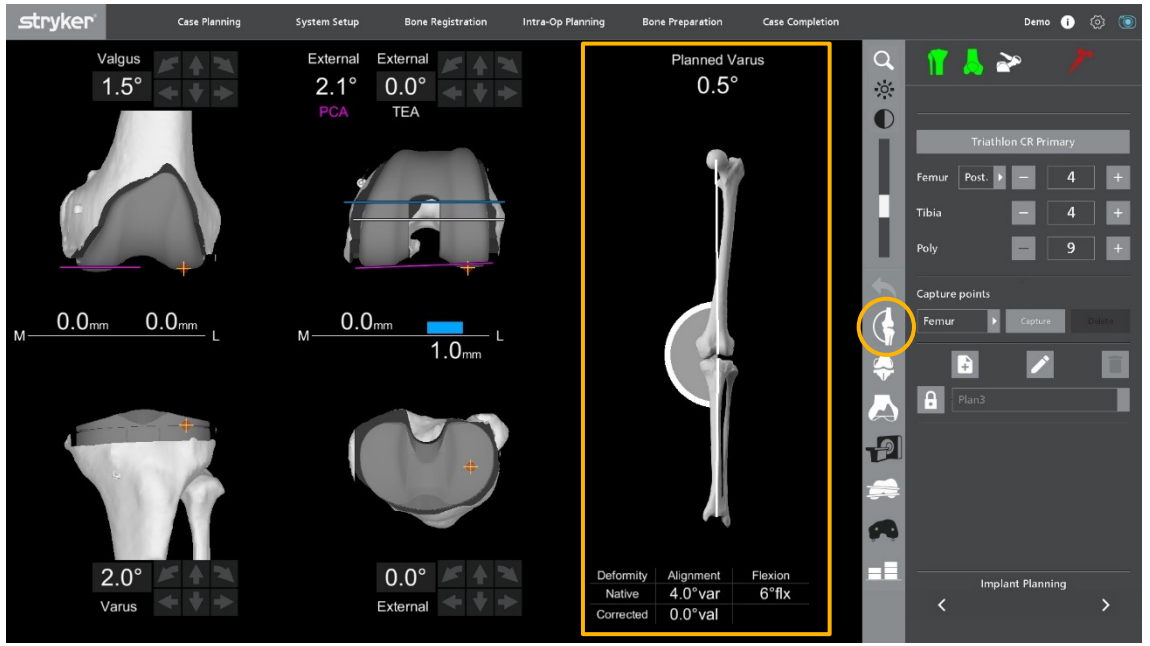
Intraoperative planning features

Multiple plans



- Utilizing the multiple plan feature, the surgeon can balance the plan in different ways.

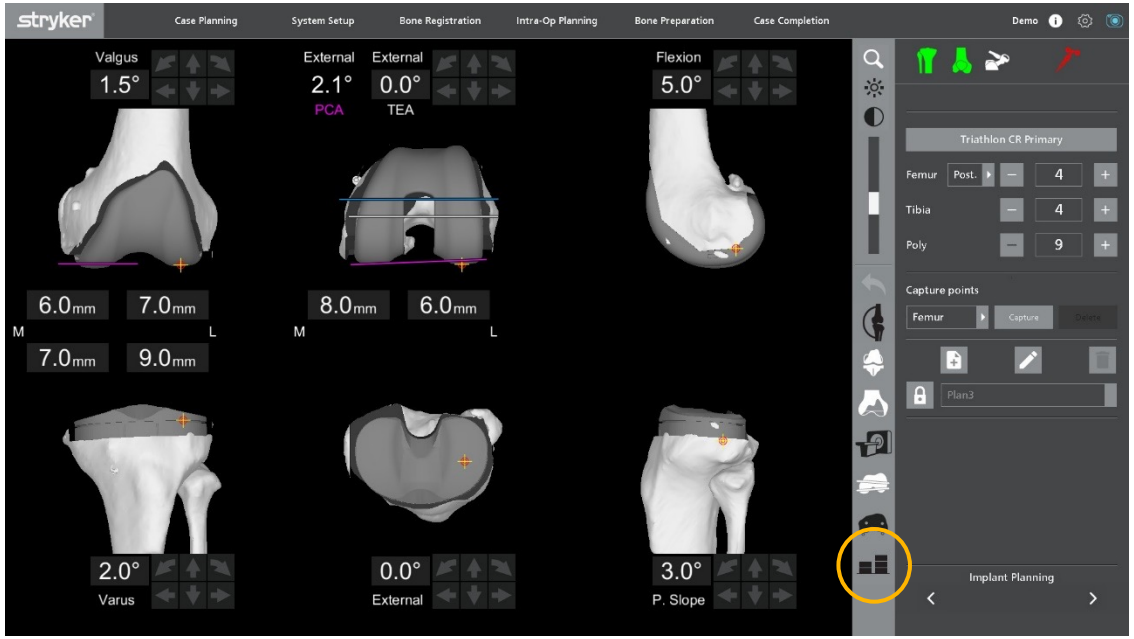
Full limb view



- The surgeon can reference the overall limb alignment, native and corrected deformity values in full limb view.

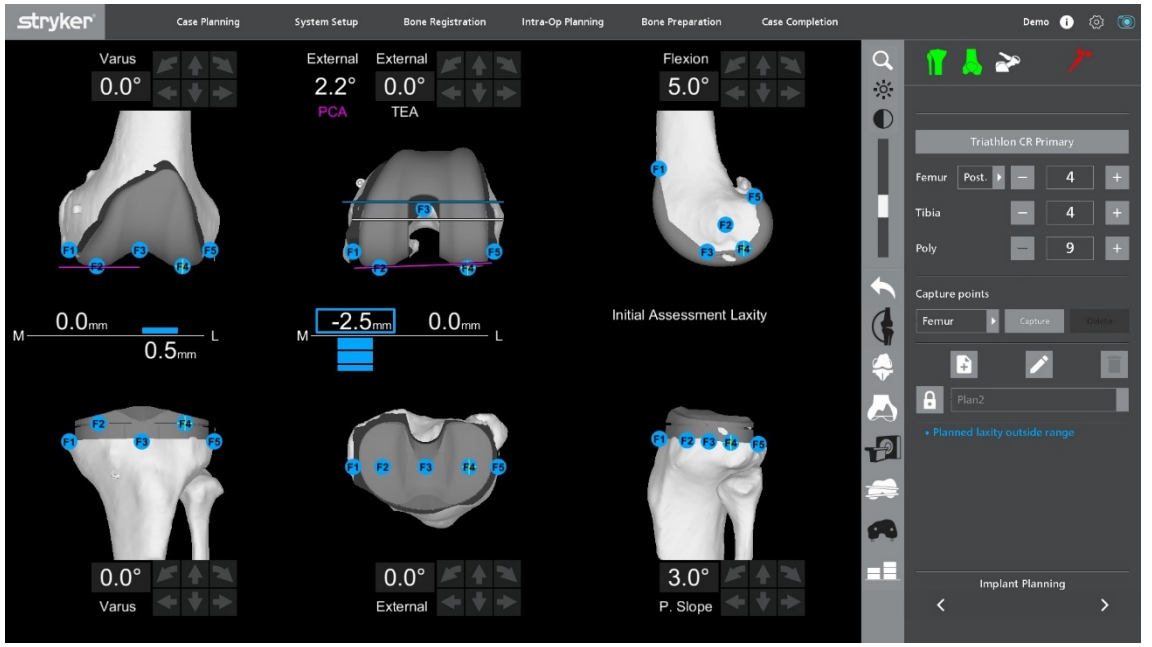
Intraoperative planning features

Resection values



- Toggle between laxity values and display the resection values by clicking the button on the right.

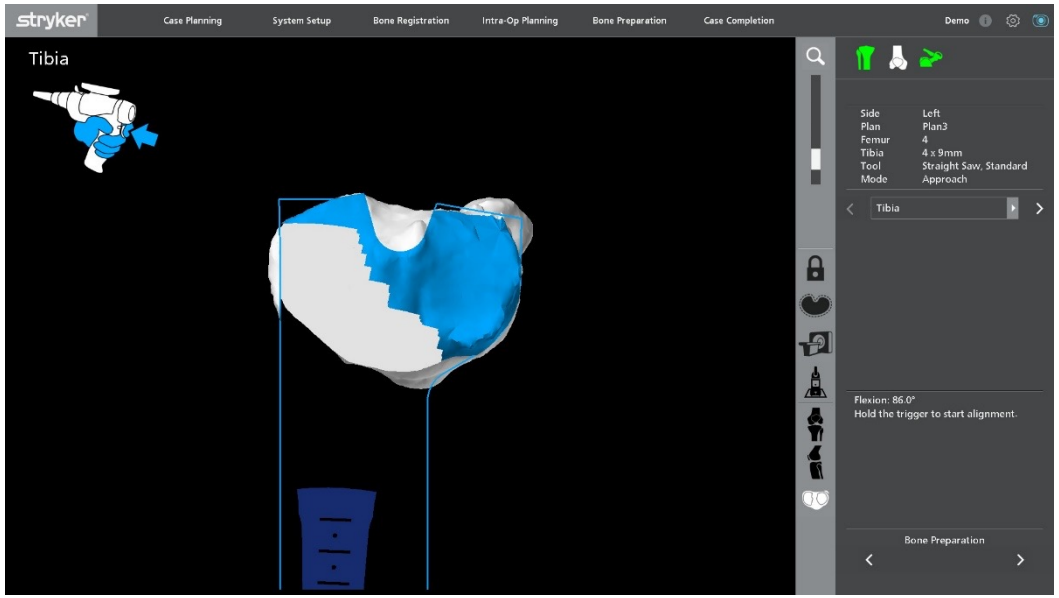
Anchor points



- Preset anchor points are provided to help maximize and streamline implant adjustments.

AccuStop™ haptics

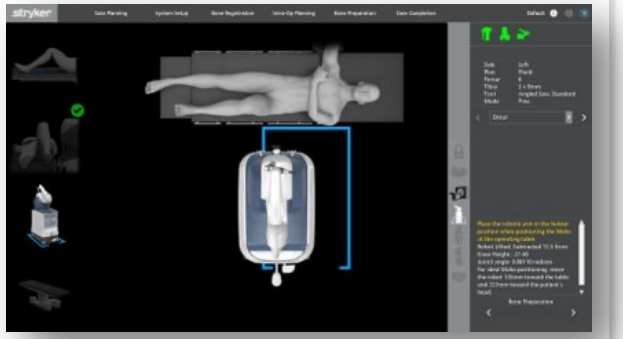
AccuStop™ haptic technology



- Constrains the saw within a virtual boundary that is established by the surgeon's patient-specific plan
- Is no longer limited by cutting blocks and manual techniques
- Allows the surgeon to accurately execute the final plan[4] while protecting soft tissues[5] when compared to manual cutting blocks

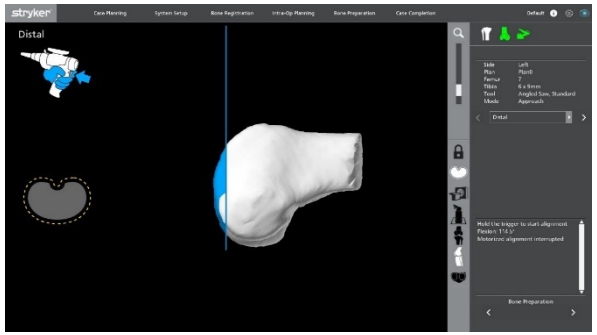
Mako Total Knee 2.0 – bone prep features

Mako Park



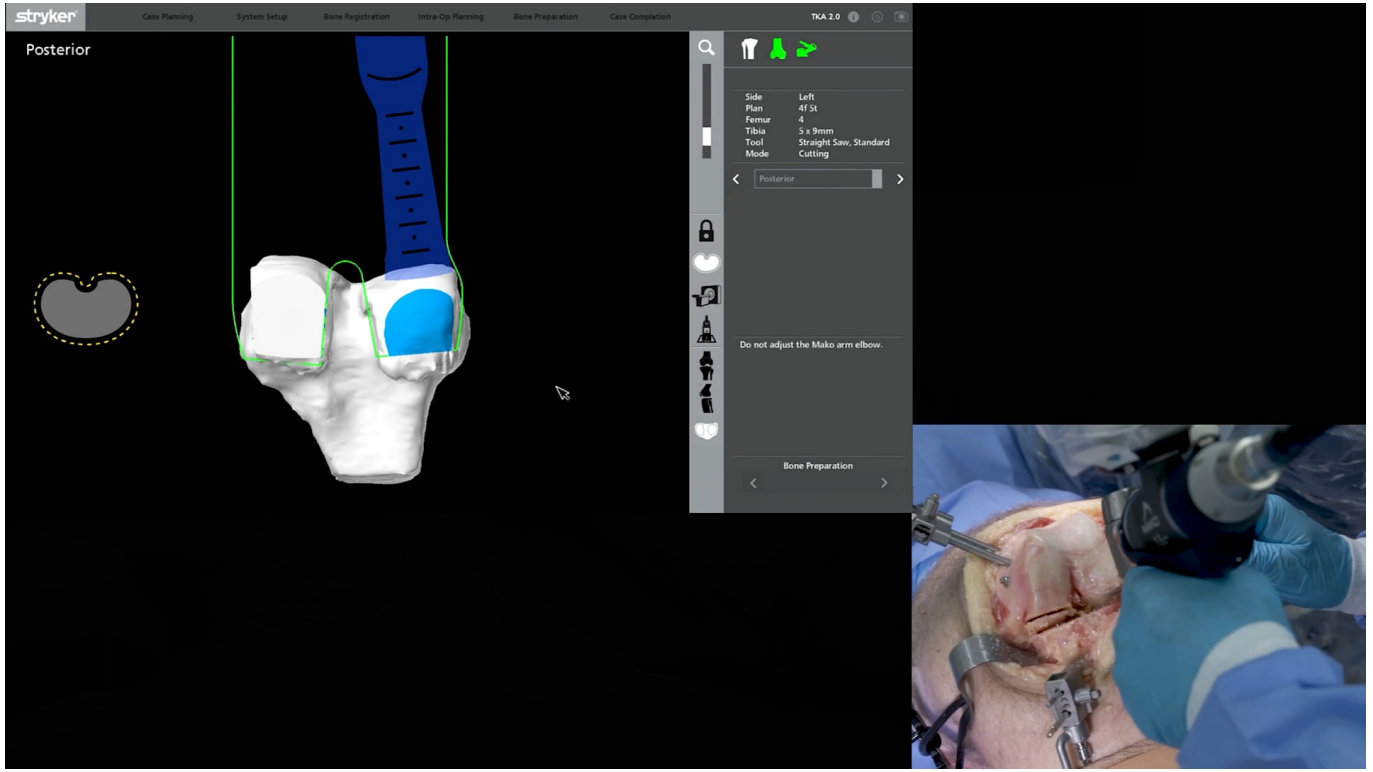
Advancing cuts

Extended boundaries



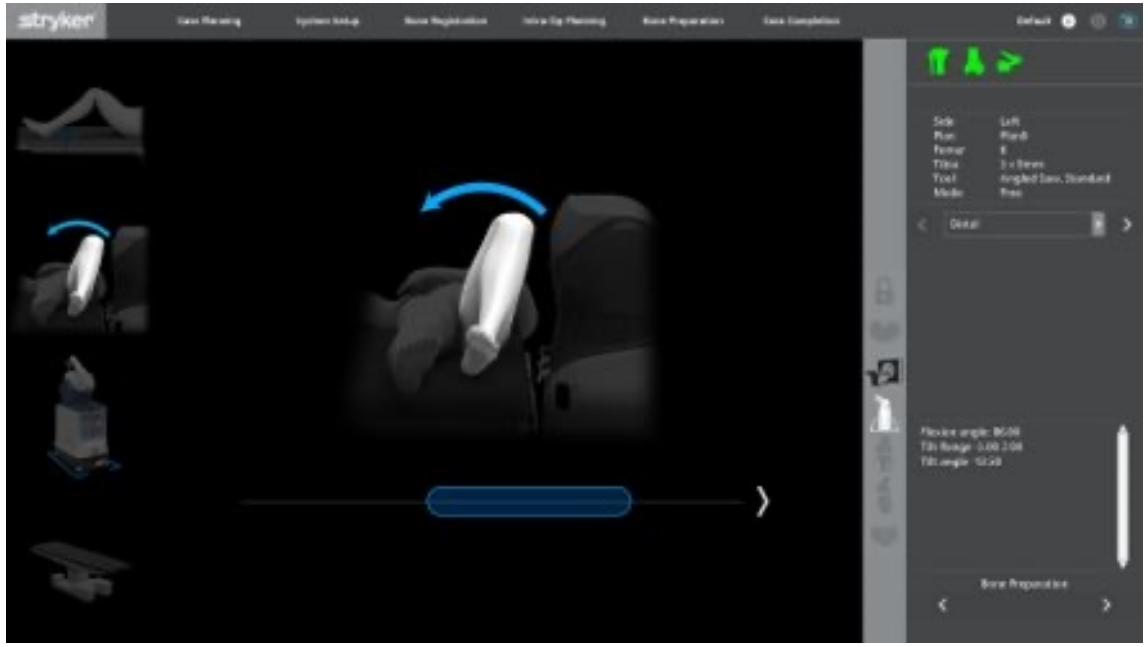
AccuStop™ haptic technology

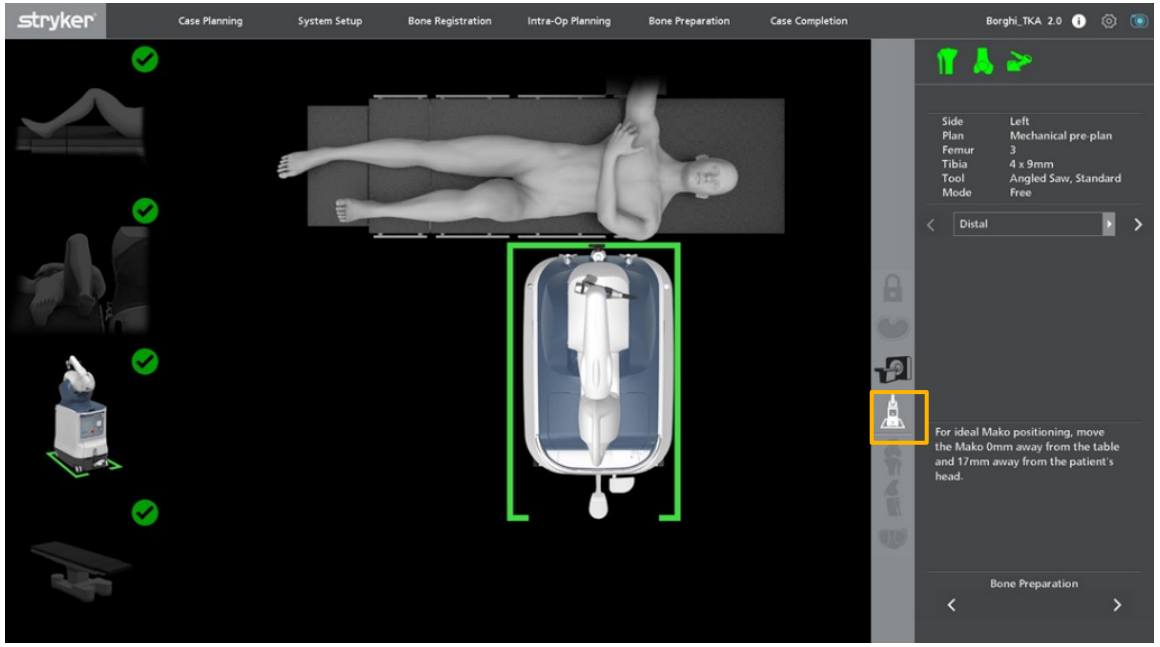
- The surgeon can advance through their cut sequence by double clicking the MICS trigger or pressing the foot pedal.
- Default extended boundaries can be pre-set in preferences and the narrow saw blade can be used for all cuts.



Mako Park

- Mako Park ensures that the Mako System is positioned into the most optimal spot for cutting. This will allow the surgeon to access each cut with ease and complete bone prep efficiently.

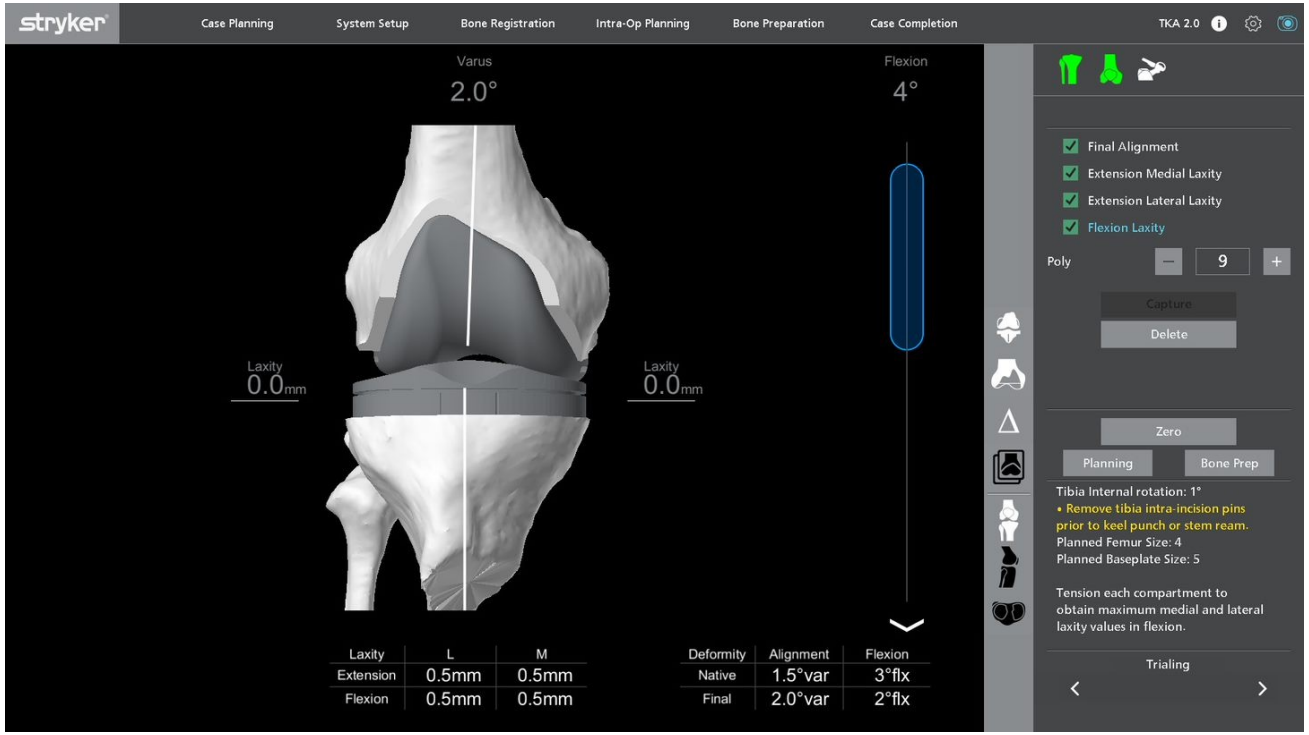


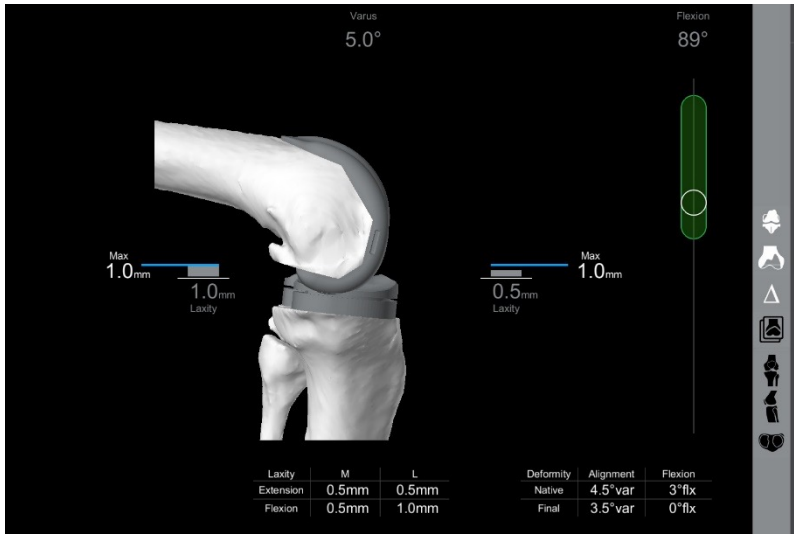


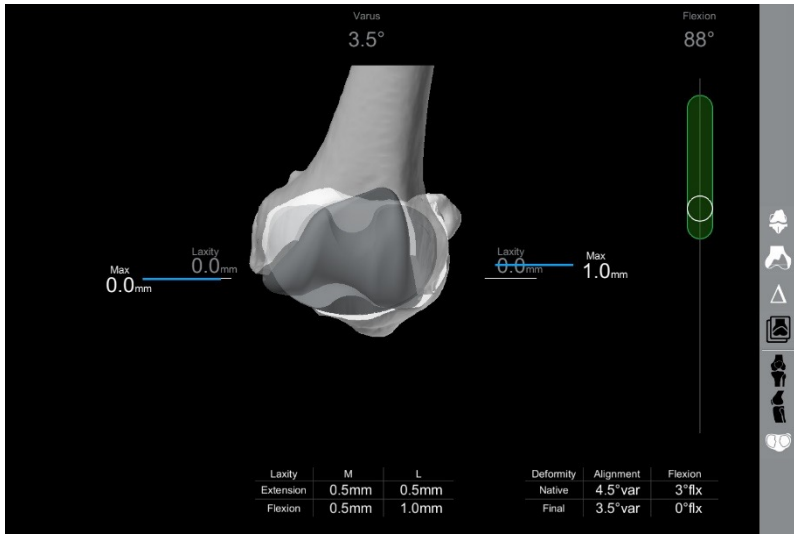
Trialing

Trialing

- The new trialing page allows the surgeon to capture the patient's final alignment as well as the final extension and flexion laxities, utilizing the digital tensioner.
- The surgeon can utilize the sagittal and transverse preset views to ensure the medial and lateral translations and shuck test.







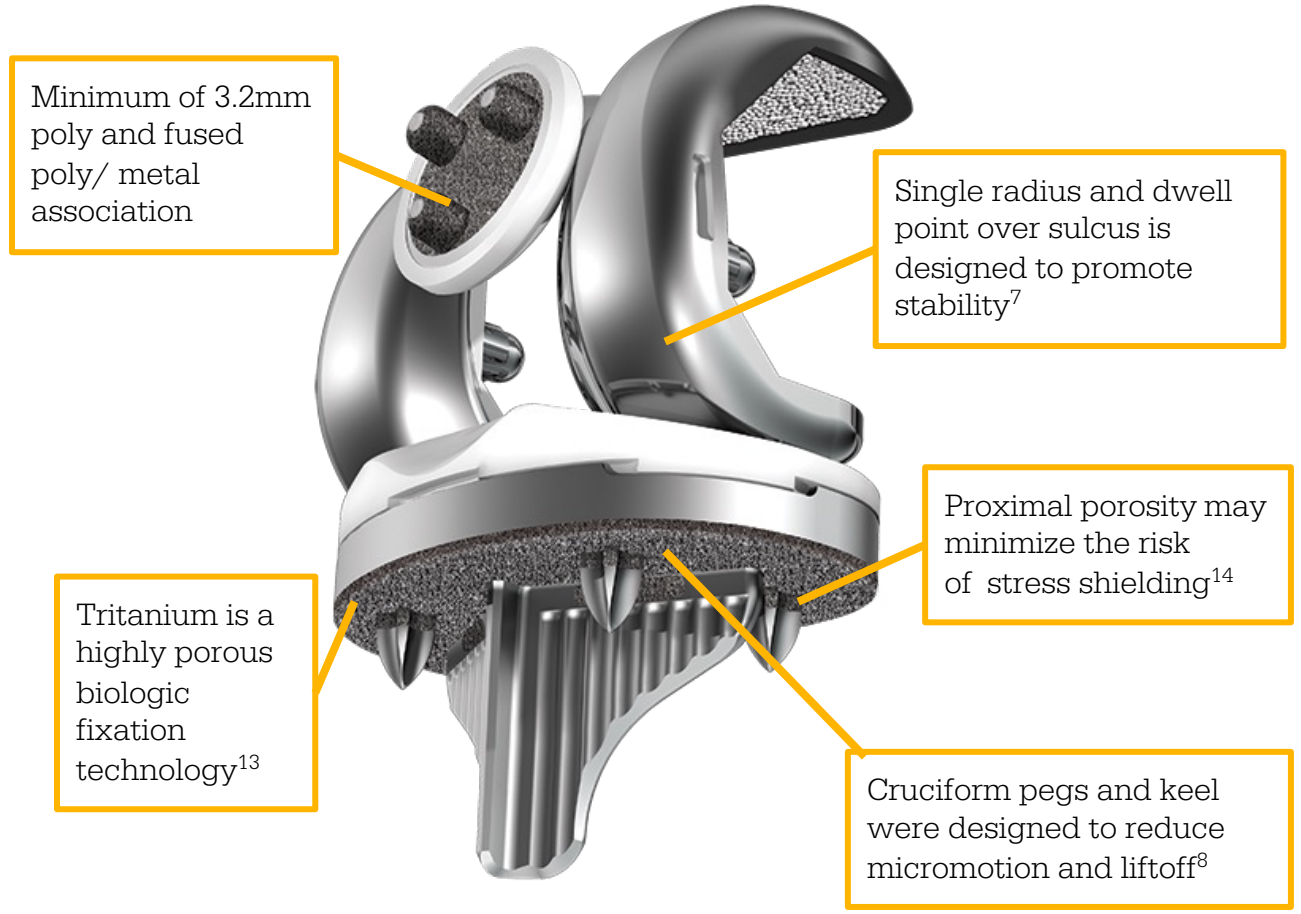
Triathlon Cementless Knees

Improved efficiency and outcomes[8-11]

- **Over 1 million Triathlon Cementless knees** have been implanted since cleared in 2013 and **make up over half of the Mako Total Knees implanted** in the U.S[6]

- The American Joint Registry has shown:
  - **Triathlon Tritanium baseplates achieved 98.9% survivorship** at 5 years across 37,105 cases[9]
  - **Triathlon Tritanium metal-backed patellas achieved 99.0% survivorship at 4 years** across 28,257 cases[10]

- Several studies have shown using Triathlon Cementless can **save up to 22 minutes of OR time** by eliminating the need to mix and apply bone cement[11,12]

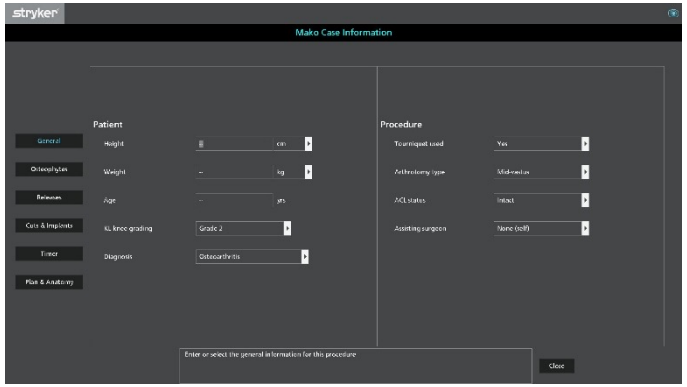


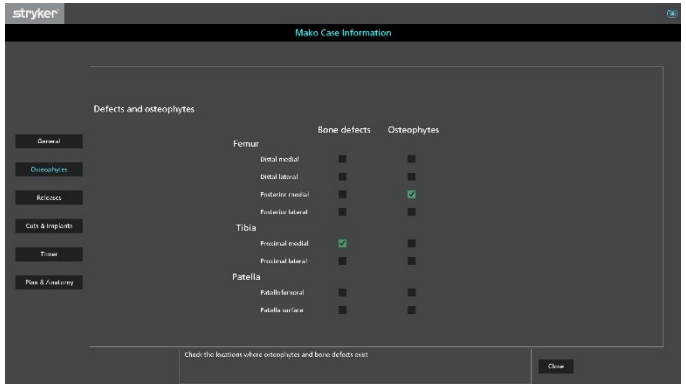
Mako Case Information

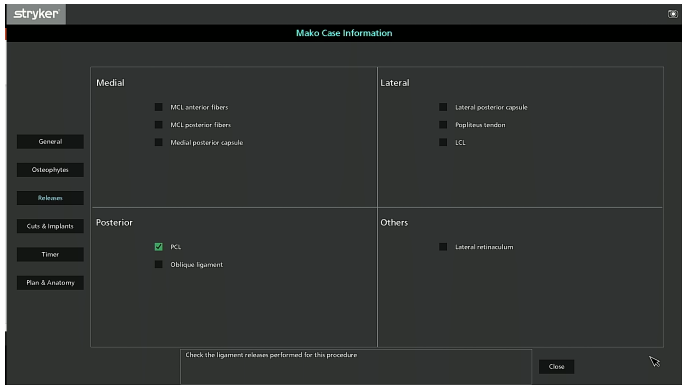
Mako Case Information
Plan and Anatomy

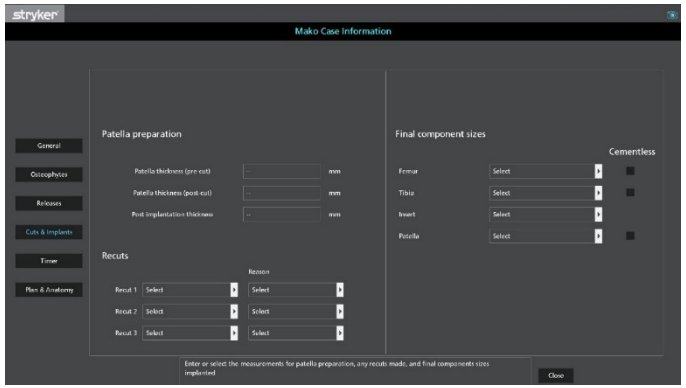
There are six tabs:

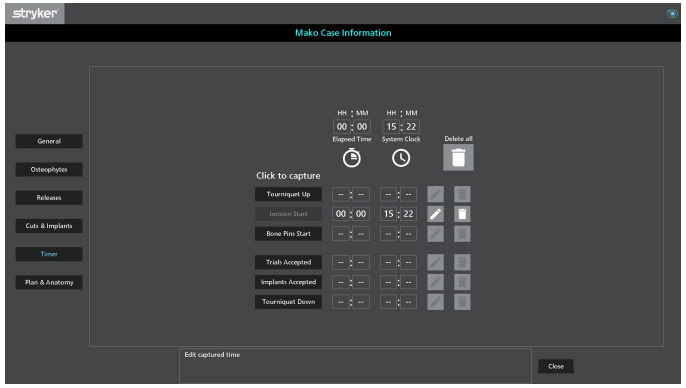
1. General
2. Osteophytes
3. Releases
4. Cuts and implants
5. Timer
6. Plan and Anatomy

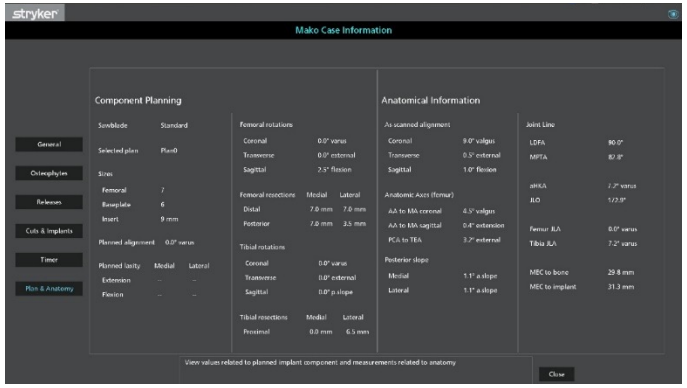






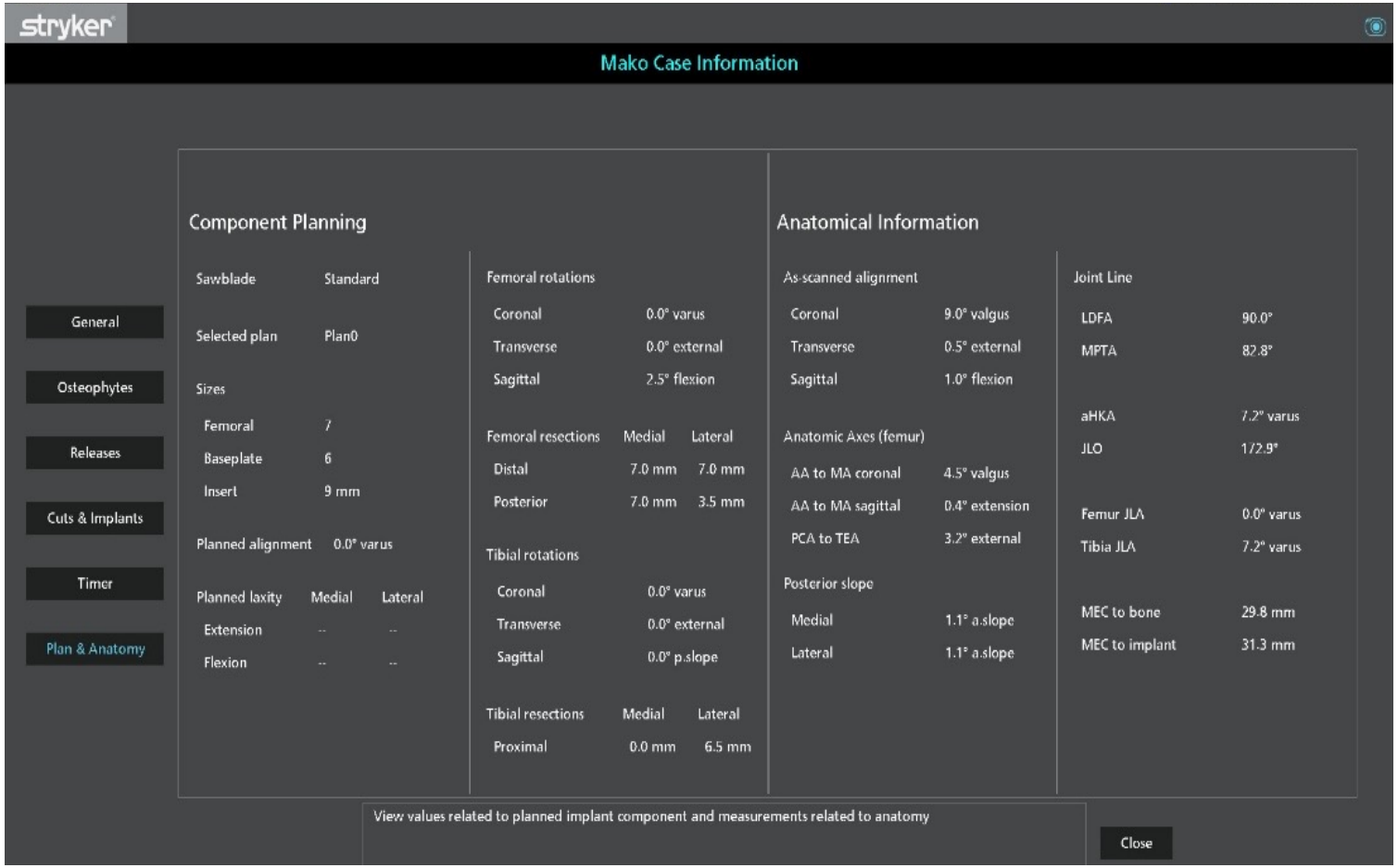






Mako Case Information
Plan and Anatomy

Allows the surgeon to view case-related info pertaining to the selected implant plan and the patient's anatomical dimensions.



Clinical evidence

Mako Total Knee 2.0

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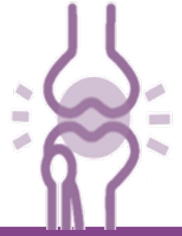
The outcomes you expect...

Greater precision to plan

Studies have shown 3D CT planning and haptic boundaries allow surgeons to deliver a more accurate and precise procedure to plan,[1] with less soft tissue damage compared to manual. [5,15]



Less pain, fewer meds

Patients experienced less pain,[16] and required less pain relief[17] compared to manual total knee replacement.

Improved early recovery

Patients hit postoperative goals earlier and were discharged home sooner.[16] Physical function scores continued to be favorable three-years post-surgery.[18]

Improved mid-term survivorship

In the Australian Registry, Four-year survivorship of the Triathlon CR implanted with Mako had a relative improvement of 19% over manual TKA.[19]

Mako Total Knee 2.0

stryker

...the experience you deserve.

Confidence and control

In a cadaveric study, 95% of users surveyed reported overall increased confidence intra-operatively compared to manual total knee.[20]

Intuitive design

In a cadaveric study, 84% of users surveyed reported intuitive use of the system.[20]

New Digital Tensioner

A cadaveric study has shown excellent repeatability and reproducibility when using the Digital Tensioner.[3]

Accurate 3D CT registration

A cadaveric study has shown that registration landmarks are more accurately identified using a 3D CT scan compared to intra-op digitization. [21]

Mako Total Knee 2.0

Confidence and control

- After a cadaveric lab, three established, high-volume surgeons were asked to compare their experience of the new Mako Total Knee 2.0 software to manual total knee arthroplasty.[20]
- The surgeons reported new Mako Total Knee 2.0 software provided overall increased confidence, as well as improved confidence when performing initial assessment and implant adjustment compared to MTKA.[20]

Confidence

95% report overall increased intra-operative confidence[20]

Control

100% more confident in intra-operative implant adjustment[20]

Mako Total Knee 2.0

Intuitive design

- After a cadaveric lab, established, high-volume surgeons were asked to compare their experience of the new Mako Total Knee 2.0 software to manual total knee arthroplasty.[20]
- Surgeons found overall use of RATKA was intuitive and were satisfied with overall use of the application.[20]

Intuitive Design

84% report intuitive use of the system[2]

Overall satisfaction

90% report overall satisfaction with the new software[2]

Mako Total Knee 2.0

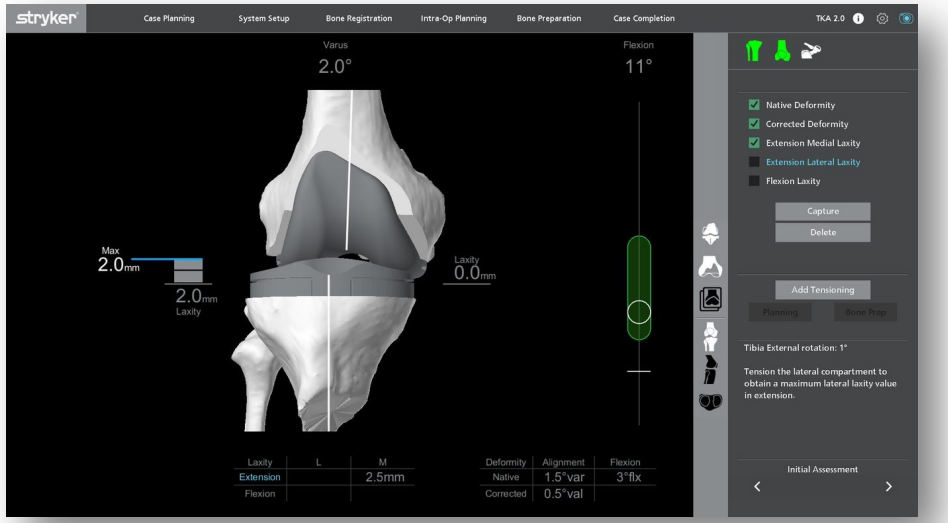
Digital Tensioner - repeatability

- A cadaveric study has shown that when using the digital tensiometer average variation **between use by the same surgeon** was 0.31mm.[3]
- Intraclass correlation coefficient (ICC) analysis showed excellent repeatability (ICC ≥ 0.96)3
- Repeatability was within 1mm 96% of the time and within 1.5mm every time.[3]

Repeatability

Mean: 0.31mm

100% < 1.5mm[3]



Mako Total Knee 2.0

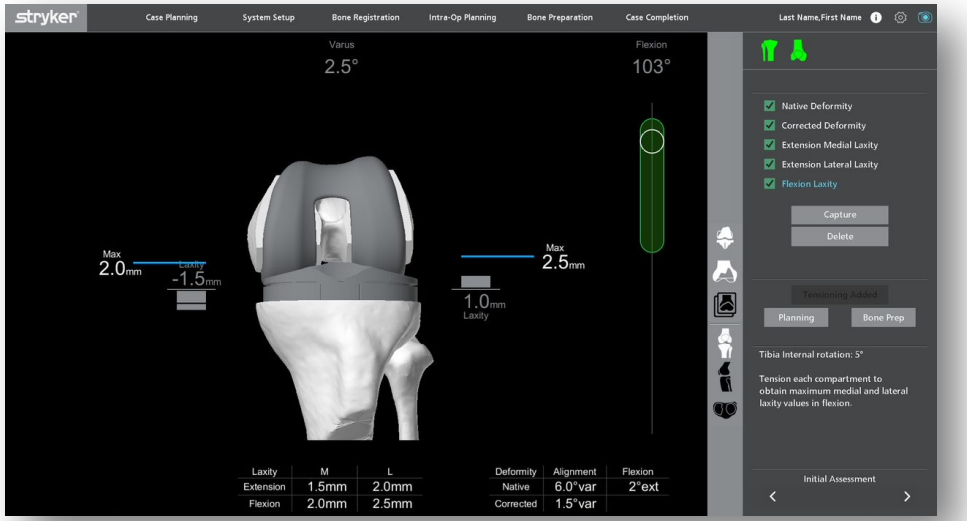
Digital Tensioner - reproducibility

- A cadaveric study has shown that when using the digital tensiometer average variation **between use by different surgeons** was 0.6mm.[3]
- Intraclass correlation coefficient (ICC) analysis showed excellent reproducibility (ICC ≥ 0.90).[3]
- Reproducibility was within 1mm 99% of the time and within 1.5mm every time.[3]

Reproducibility

Mean: 0.6mm

100% < 1.5mm[3]



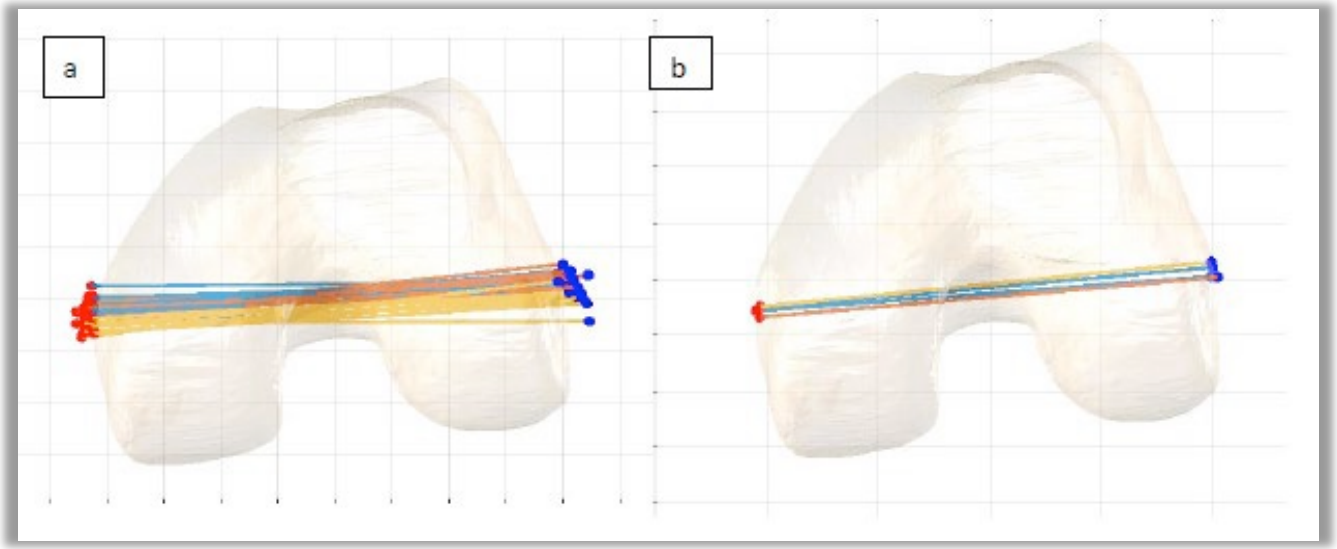
Mako Total Knee 2.0

Accurate 3D CT registration

- A cadaveric study has shown that manually selecting rotational landmarks intraoperatively resulted in increased error compared to digitally selecting preoperatively using a 3D CT scan.[21]
- Greater reliability of landmark identification was observed in the anterior/posterior direction when using the CT scan, indicating that using CT based images may better identify the axis often used to set femoral component rotation, as compared to intraoperative manual identification.[21]

Accuracy

28% relative reduction in error in the rotational plane[21]



TEA angle variation for (a) intraoperative landmark digitisation and (b) pre-operative 3D CT landmark digitisation.

Thank you

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