Robotic-Assisted Total Knee Arthroplasty

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Mako Robotic-Arm Assisted Surgery

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The role of new technology in the treatment of knee arthritis is to enable accurate execution of the surgical plan for each individual's arthritic presentation. A robotic-assisted approach allows a surgeon to perform a unicompartmental to a tricompartmental knee replacement in a consistent and reproducible manner.[1]

The desire is to address the technical inaccuracies (malalignment, malrotation, and soft tissue imbalance) that lead to early revisions and patient dissatisfaction.

Preoperative planning utilizing a computed tomography-based approach enables the evaluation of the entire limb pathology, and aids the surgeon in"patient-matching" the implant position based on anatomic references 3-dimensionally.

Intraoperative tracking informs the surgeon on pre-resection alignment, and flexion-extension gaps. The surgeon can define a fixed vs correctable deformity, and then adjust the implant position prior to cutting, if required, while defining the desired implant and limb alignment.

Haptically guiding the saw allows the surgeon to perform accurate bony cuts in 3 planes while protecting the soft tissues (**Figure 1**). The workflow enables a measured resection approach or a gap balancing approach. I commonly use a new "robotic hybrid" approach that allows me to place the single-radius knee system on the femur in my desired sagittal, coronal, and rotation position; then match the tibia tray position and perform bony alignment modifications to achieve a well-balanced knee.

Trialing with integrated sensors allows me to evaluate the effects of the alignment and gaps on the soft tissue balance, and kinematic rollback with dynamic testing.[2] The robotic arm can then be utilized to achieve inter-compartmental balance through accurate bony readjustments, while minimizing extensive soft tissue releases (**Figure 2**).

The goal of robotic sensor-assisted surgery is to develop a patient specific preoperative plan, and then assist in accurate, dynamic modifications based on the patient's limb alignment and soft tissue tension. The final implant position can be evaluated through a full range of motion (ROM), and stability defined. This information is then collected, and the effects of implant position and various limb alignment targets on soft tissue balance are evaluated as it relates to functional outcomes and patient satisfaction measurements.

Surgical pearl: Using the Mako Robotic-Arm Assisted Surgery, I performed the first robotic-assisted total knee replacement in June 2016, and have performed over 80 cases to date. Early results are showing improved accuracy, early ROM, and a decreased postoperative utilization of therapy and assistive devices. Multi-centered studies will enable the evaluation of robotic surgical approaches on short- and long-term outcomes.

Author's Disclosure Statement: Dr. Roche reports that he is a consultant to Stryker-Mako.

References

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2. Roche M, Elson L, Anderson C. Dynamic soft tissue balancing in total knee arthroplasty. *Orthop Clin North Am.* 2014;45(2):157-165.

Figure 1. Haptically controlled saw allows accurate bone preparation and alignment for final implantation.

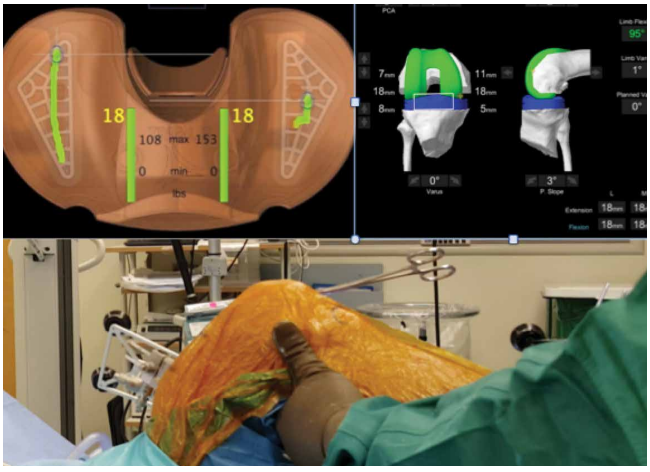

Figure 2. The surgeon confirms that the appropriate alignment, gaps, rotation, and kinetic rollback stability have been achieved.