Mako® Total Knee

Triathlon Total Knee System with Tritanium cementless technology

Mako Robotic-Arm Assisted Surgery
**Mako Total Knee application**

The Mako Total Knee application allows for **functional implant positioning**, which is patient-specific implant placement as a result of the three unique features of the Mako Total Knee procedure: enhanced planning, dynamic joint balancing, and robotic-arm assisted bone preparation. A single study showed Mako Total Knee having significantly lower mean pain ($p < 0.05$) and mean total patient satisfaction scores ($p < 0.05$), indicating greater patient satisfaction and clinical outcome for the Mako cohort compared to manual TKA.  

**Enhanced planning**

CT data is segmented to create a 3D model of the patient’s bony anatomy. The Mako Total Knee application allows you to manipulate the Triathlon implant on the patient’s virtual 3D anatomy taking into account the 6 degrees of freedom, implant alignment in all three planes, and consider key anatomic landmarks such as the transepicondylar axis, posterior condylar axis and the mechanical axis during planning. In a single center, prospective study of consecutive cases, patient specific planning has been shown to be able to consistently determine femoral and tibial component sizing within one size of the pre-operative plan. This has the potential to enhance efficiencies in the operating room by minimizing the number of trays opened, and potentially decreasing revisions due to instability with more accurate sizing and placement of the components to achieve a well aligned and balanced TKA.  

**Dynamic joint balancing**

After assessing the patient’s ligament tension, gap analysis, and limb alignment, you can make intraoperative adjustments to the pre-operative plan in both flexion and extension before bone preparation. In a case series of complex TKA cases, Mako Total Knee has been shown to assist surgeons in achieving desired alignment and rotation, even in patients with severe varus/valgus and flexion deformities.  

**Robotic-arm assisted bone preparation**

The Mako Total Knee creates a haptic boundary which assists the surgeon in executing both the tibial and femoral bone resections to plan. The haptic boundary has the potential to protect essential anatomical structures of the knee during bone preparation including the PCL and the popliteal artery. In a cadaveric study, on average, Mako Total Knee final bone cuts and component positions were 5 and 3 times more precise to plan than the manual TKA control, respectively.
**Triathlon Total Knee System**

The coupling of the Triathlon primary knee portfolio with the Mako Total Knee application brings you the design and technology that’s built on clinical evidence. A wealth of clinical data around the world has largely supported the enhanced survivorship, stability, and satisfaction of the Triathlon design over the past decade.

<table>
<thead>
<tr>
<th>Triathlon 10-year survivorship</th>
<th>Source</th>
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<tbody>
<tr>
<td>99.0%</td>
<td>Mistry et al. 2016¹</td>
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<tr>
<td>96.7% (including infection)</td>
<td>2016 National Joint Registry (UK/Wales)⁶</td>
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<tr>
<td>96.6% (including infection)</td>
<td>2016 Australian Orthopaedic Association Joint Registry⁵</td>
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<tr>
<th>Triathlon Tritanium 2-year survivorship</th>
<th>Source</th>
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<tbody>
<tr>
<td>99.5% (including infection)</td>
<td>Harwin et al. 2016¹¹</td>
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<tr>
<td>100%</td>
<td>Buzhardt et al. 2017²²</td>
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**Triathlon design**

The Triathlon single radius is designed to restore the knee’s single center of rotation during active flexion, where most motion occurs.¹⁵,¹⁶ This allows for constant ligament tension and stability in flexion.⁷, ⁹-¹¹

In a gait investigation study, patients with the Triathlon knee experienced gait patterns that closely mimicked those of healthy knees.¹⁰ Numerous studies, including a level I study, showed enhanced functional and satisfaction outcomes with the Triathlon knee.⁹-¹⁴

**Tritanium technology**

Tritanium is a highly porous structure designed for biologic fixation.²³

Initial stability is important for long term fixation in cementless TKA.²⁴ Our additive manufacturing technology enables unique geometries for enhanced initial stability to allow biologic fixation at the bone-implant interface and stronger association at the metal-polyethylene interface for the Tritanium metal-backed patella.²⁶

**Less constraint, more stability**

Triathlon is designed to accommodate ±20° of rotational freedom. The less constrained the design, the less potential for stresses generated at the articulating surface to be transferred to the bone-implant interface.²⁹

**Do more**

Tritanium cementless TKA offers the potential for shorter operative time and enhanced procedural efficiency.²⁷,²⁸ Demographics show patients are younger, more active, and heavier.¹⁷ These patient subsets have shown higher potential for aseptic loosening.¹⁸ Choosing biologic fixation for your TKAs may assist with these challenging patient demographics.
References:


5. Australian Orthopaedic Association National Joint Replacement Registry. 2016. KT8 Cumulative Percent Revision of Primary Total Knee Replacement with Cement Fixation. Figure KT29 Cumulative Incidence Revision Diagnosis of Primary Total Knee Replacement by Polyethylene Type (Primary Diagnosis OA).


Orthopaedics

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