# Table of Contents

## Cementless TKA
- Why Cementless TKA? .................................................. 4
- Cementless TKA - Clinical History .............................. 4
- Published RSA Results Comparing Fixation Methods .. 5

## Biologic Fixation
- Tritanium ...................................................................... 6
- What is 3D Printing? .................................................... 6
- Peri-Apatite (PA) Technology ....................................... 7

## Knee Design
- Importance of Knee Design ......................................... 8
- SOMA Designed .......................................................... 8
- Initial Stability .............................................................. 9
- Metal-Backed Patella ..................................................... 10

## Procedural
- Procedural Highlights ................................................ 11
Cementless TKA

Why Cementless TKA?

Cementless TKA is growing in popularity and is a fast-growing trend. Recent studies support that cementless TKA achieve excellent results, including a 2012 study showing 96% survivorship at up to 18 years without aseptic loosening.

The kinematics of Triathlon coupled with the latest in highly porous biologic fixation technology offers a knee system like no other. For surgeons interested in cementless TKA, Triathlon Tritanium implants now allow surgeons to expand its use in more patients. Read more about Triathlon’s cementless product offerings, including Stryker’s enabling technologies like 3D printing technology and SOMA bone morphology analytics design.

Cementless TKA - Clinical History

Multiple successful outcomes have been reported for total knee arthroplasty (TKA) with cementless technology. In one study on cementless (HA-coated) knees in young, active patients, none of the implants in patients under 45 years old had failed at the latest follow-up, as far out as 11 years.

Clinical Studies demonstrating over 10 years of follow-up

<table>
<thead>
<tr>
<th>Study</th>
<th>Implant</th>
<th>Survivorship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melton et al (2012)²</td>
<td>Active Total Knee Replacement</td>
<td>96% at up to 18 years</td>
</tr>
<tr>
<td>Epinette et al (2007)⁶</td>
<td>HA Omnifit Knee Prosthesis-Series 3000</td>
<td>98% at 11 years</td>
</tr>
<tr>
<td>Watanabe et al (2004)⁷</td>
<td>Osteonics Series 3000</td>
<td>100% at 10 years and 96.7% at 13 years</td>
</tr>
</tbody>
</table>
Published RSA Results Comparing Fixation Methods

Stable primary fixation of the implant is a prerequisite for biologic fixation. An RSA study comparing fixation method with the same prosthesis showed no statistical difference between fixation methods in displacement at the prosthetic edge, subsidence, and lift off.
Biologic Fixation

Tritanium

Tritanium implants are the latest evolutions in the Triathlon cementless knee portfolio. Tritanium is highly porous metal biologic fixation technology. Stryker’s 3D printing technology allows for titanium powder to be applied in numerous layers and provide a complex porous structure in appropriate areas of the implant. The proximal surface area for Tritanium on the tibial baseplate has been extended to part of the pegs and keels to allow the minor inconsistencies of bone resection and morphology to remain in close contact with the underside of the implant.

Triathlon Tritanium baseplate and metal-backed patella components are manufactured using this technology. Triathlon Tritanium is also indicated for cemented applications, providing surgeons intraoperative flexibility to decide on the fixation method with the actual component once bone quality is assessed.

<table>
<thead>
<tr>
<th>Material Properties</th>
<th>Tritanium Baseplate</th>
<th>Tritanium Metal-Backed Patella</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Pore diameter (um)</td>
<td>527</td>
<td>497</td>
</tr>
<tr>
<td>Coefficient of friction</td>
<td>1.02</td>
<td>.80</td>
</tr>
<tr>
<td>Mean porosity</td>
<td>68%</td>
<td>65%</td>
</tr>
</tbody>
</table>

What is 3D Printing?

Additive Manufacturing, or 3D printing, is a manufacturing technique that takes a computer model of a component and grows parts layer by layer. The type of process used for Tritanium is a focused laser beam used to melt layers of metal powders, giving Stryker the ability to create unique porous structures. This 3D printing process makes it possible to selectively position porous structures in desired zone.
Peri-Apatite (PA) Technology

Peri-Apatite was developed to coat hydroxyapatite onto porous coated fixation surfaces. Triathlon’s cementless femoral components are manufactured with this technology. As opposed to plasma-sprayed HA coatings, Peri-Apatite HA coating wraps itself around the circumference of the porous surface, which is designed to increase the HA surface available for fixation.9

The most recent study published on the Triathlon (PA-coated) cementless system showed that all implants demonstrated evidence of stable biologic fixation at a mean of 3 years.3

Triathlon PA Clinical Study Results

Excellent Fixation Achieved With Cementless Posteriorly Stabilized Total Knee Arthroplasty

Steven F. Harwin, MD, FACS,* Mark A. Kester, PhD, †
Arthur L. Malkani, MD, ‡ and Michael T. Marley, PhD.§

Implant
Triathlon Peri-Apatite (PA) Cementless
- PA PS Femur
- PA Screw-Fix Tibia
- PA Metal-Backed Patella

Results
- 110 TKAs with no implant related revisions at mean of 3 years.
- All implants demonstrated radiographic evidence of stable biologic fixation with no evidence of loosening, osteolysis, stress shielding, or progressive radiolucent lines.
Knee Design

**Triathlon & The Single Radius**

Stable primary fixation of the implant is a prerequisite for biologic fixation. The less constrained the design, the less potential for stresses generated at the articulating surface to be transferred to the bone-implant interface.

Triathlon CR and PS systems are designed to minimize dynamic stress transfer to the tibial fixation interface by providing minimal resistance to internal and external motion in hyperextension and throughout flexion, and by locating the bearing sulcus directly over the tibial keel to help reduce sagittal rocking during ambulation.

Additionally, Triathlon’s locking mechanism is designed to help minimize micromotion.

**SOMA Designed**

SOMA is the world’s largest database of bone morphology – size, shape, density, stiffness, and inner and outer cortical diameters – drawn from diverse populations. SOMA, the Stryker Orthopedic Modeling and Analytics system, was used to optimize the depth and placement of the Tritanium pegs.

The location and length of the pegs is tailored for each size, and was determined using SOMA analysis of over 350 bones. The addition of the pegs is intended to provide more purchase into outermost, dense cancellous bone. This is designed to address patients with compromised bone quality.
Initial Stability

Given the importance of stable primary fixation, underside features of the Tritanium baseplate were designed to reduce micromotion and lift off. 3D printing technology provided Stryker engineers the ability to think of a design, 3D print it, and then test it. Many designs were tested, but none provided greater stability than the Triathlon keel design.
Metal-Backed Patella

The Triathlon Tritanium metal-backed patella offers a highly porous biologic fixation surface in a monoblock design. The patellofemoral track and polyethylene material in the Triathlon Tritanium Metal-Backed Patella has been studied clinically in the Triathlon PA metal-backed patella design, and one study using that design demonstrated no patella failures.3

While the bone-facing architecture has been created to encourage biologic fixation, a different interface architecture was designed to enhance the association between the metal backing and the polyethylene. Direct compression molding allows the polyethylene to penetrate the porous metal surface to minimize dissociation.12

A solid barrier layer between these two unique porous surfaces can provide added strength, allowing for a smaller metal backing and greater polyethylene thickness in areas that have historically led to revision.30 The peg diameter has also been increased to allow for greater pressfit with the native patella.

---

**Triathlon Tritanium**

- Polyethylene Material Thickness
- Interlock Layer
- Peg Diameter

**Triathlon Peri-Apatite (PA)**
Procedural

Procedural Highlights

The Triathlon Tritanium baseplate can be implanted with minimal additional preparation compared to a cemented Triathlon implant. The only additional step is to prepare the tibia for the pegs, which are designed to aid in initial stability.31

The four peg prep holes on the Tibial Peg Drill Template correspond to the pegs on the implant.

A new Patella Inserter and Patella Captures will help evenly distribute the forces over the entire implant and allow the device to be seated evenly and completely onto the prepared bone surface of the native patella.
A surgeon must always rely on his or her own professional clinical judgment when deciding whether to use a particular product when treating a particular patient. Stryker does not dispense medical advice and recommends that surgeons be trained in the use of any particular product before using it in surgery.

The information presented is intended to demonstrate the breadth of Stryker product offerings. A surgeon must always refer to the package insert, product label and/or instructions for use before using any Stryker product. The products depicted are CE marked according to the Medical Device Directive 93/42/EEC. Products may not be available in all markets because product availability is subject to the regulatory and/or medical practices in individual markets. Please contact your Stryker representative if you have questions about the availability of Stryker products in your area.

Stryker Corporation or its divisions or other corporate affiliated entities own, use or have applied for the following trademarks or service marks: Stryker, Stryker Orthopaedics, Triathlon and X3. All other trademarks are trademarks of their respective owners or holders.

References

11. Stryker Test Report RD-09-088
12. Stryker Test Report RD-12-044
18. Stryker Test Report RD-12-117
20. Stryker Test Report RD-12-113
24. Stryker Test Report RD-12-118
27. Stryker Test Report RD-13-129
28. Stryker Test Protocol 92911