The Triathlon Total Stabilizer Revision System

Overview:
Over the past five decades, engineers have been striving to improve the fit, function and longevity of knee replacement implantations and the surgical approaches to total knee replacement. The Triathlon Knee System’s evolutionary design incorporates the engineering science behind the millions of Stryker knee implantations worldwide. Stryker engineers designed the Triathlon Knee System to provide excellent performance across all three critical areas of functionality – Triathlon provides patients the potential for more natural motion, better fit and implant longevity. Now, the science behind these critical areas of functionality has been applied to the arena of revision surgery with the launch of the Triathlon Total Stabilizer Revision System.

The Triathlon TS Knee is an evolutionary design developed to offer mobility with stability through 135˚ of flexion. It is the 1st revision system designed to provide stability without compromising performance. With the potential to increase intra-operative flexibility and to improve OR efficiency, and offer seamless integration with the primary system, the Triathlon TS may improve patient outcomes and streamline revision surgeries.

Potential Benefits to Surgeons and Patients: Implant Design
By focusing on more natural motion, better fit and implant longevity, the Triathlon TS has the potential to improve patient outcomes.

While the traditional goal of a revision procedure is to simply restore stability, TS was designed to offer stability without compromising performance. As an additional benefit, due to the single radius design of the implant, patients may have the ability to return to full functionality earlier.1 Additionally, the Triathlon TS system is the first revision system to have an anthropometrically-based design, unique implant geometry, and femoral sizing options provide surgeons the flexibility to respond to anatomical and surgical realities.

Single Radius
Studies of kinematics and biomechanics have identified a constant radius in natural knee motion centered about the transepicondylar axis.

The Triathlon TS Knee system designed with a patented single radius, centering the radius of curvature about the transepicondylar axis provides ligament isometry, not only in full extension and 90˚ of flexion, but through the entire range of motion. The single radius is designed to potentially minimize the quadriceps forces required for extension, thereby maximizing muscle efficiency.

Deep Flexion Radius and Flared Posterior Condyles
The Triathlon TS Knee System is the first of its kind with shorter and flared posterior condyles to facilitate the relaxation of soft-tissues to enable deep flexion. The condylar geometry is designed to accommodate flexion and enhanced contact area through 135˚ of flexion. Flaring the posterior condyles allows for increased angles of tibial rotation as the knee approaches deep flexion while maintaining excellent contact area.

Anatomic Patellofemoral Track
The Triathlon TS Knee patellofemoral track shares the same design as preceding Stryker Total Knee Systems, bringing over a decade of worldwide clinical performance and the industry’s lowest revision rate (0.3%)4 to this knee system. The patellofemoral track has been revised to include a deepened trochlear groove. This feature relaxes the extensor mechanism and is designed to enable deeper flexion and to reduce the contact stresses exerted across the patella in deeper angles of flexion.

The Triathlon Knee System addresses smaller anatomies, often found in female patients, heavily concentrated in the region shown, while still accommodating larger patient sizing requirements.
The Triathlon TS is available with Stryker’s patented X3 bearing technology. With Stryker X3, surgeons and hospital may now provide their patients with Triathlon TS tibial inserts that have excellent mechanical and fatigue properties, extremely low wear, and high resistance to oxidation.

For many patients, the prospect of a potentially longer lasting knee is particularly appealing. In general, knee revision surgery can cause patients significant emotional distress and lead to an increase in morbidity. Follow up revision surgeries compound the problem.

For the hospital, X3 demonstrates a lower wear rate compared to conventional polyethylene based on laboratory testing and was developed to address hardware failure and other complications that the American Academy of Orthopaedic Surgeons Committee on Professional Liability finds most often prompt malpractice claims.

The proprietary instrumentation design also offers intra-operative flexibility. The following features allow for surgical preferences and help surgeons adapt to multiple surgical realities:

The Triathlon TS Knee Instrumentation is configured in three trays per procedure. Information gathered from LCCK, DePuy and Duracon Surgical Protocols.

Conclusion:
A key design goal of the Triathlon TS Knee System was to provide excellent stability in deep flexion. The unique design of the Triathlon Knee System replicates proper tracking of the epicondyles, creating natural soft-tissue tension that may promote stability and allow for deep flexion. Enhanced patellofemoral mechanics may reproduce natural knee motion through range of motion.

The Triathlon TS Knee design criteria are realized through component features including a patented anatomic radius, deep flexion radius and flared posterior condyles, and a revised anatomic patellofemoral track.

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References:
2. X3 UHMWPE maintains mechanical properties for Tensile Yield Strength and Ultimate Tensile Strength of N2/Vac gamma sterilized UHMWPE as measured by ASTM D638. Tensile Yield Strength was 23.2 ± 0.4 MPa and 23.5 ± 0.3 MPa for N2/Vac UHMWPE and X3 UHMWPE, respectively. Ultimate Tensile Strength was 54.8 ± 2.5 MPa and 56.7 ± 2.1 MPa for N2/Vac UHMWPE and X3 UHMWPE, respectively.
3. X3 UHMWPE resists the effects of oxidation. No statistical difference was found for Tensile Yield Strength, Ultimate Tensile Strength, Elongation, Crystallinity and Density as measured per ASTM D638, D3417 and D1503 before and after ASTM F2003 accelerated aging (5 ATM of oxygen at 70°C for 14 days). Tensile Yield Strength was 23.5 ± 0.5 MPa and 23.6 ± 0.2 MPa, Ultimate Tensile Strength was 56.7 ± 2.1 MPa and 56.3 ± 2.3 MPa, Elongation was 267 ± 7% and 266 ± 9%, Crystallinity was 61.7 ± 0.6% and 61.0 ± 0.5% and Density was 939.2 ± 0.1 kg/m3 and 939.2 ± 0.2 kg/m3 before and after accelerated oxidative aging, respectively.
8. Zimmer LCCK, JNJ DePuy TC3 and Stryker Duracoa revision systems require 10 - 12 trays per procedure. Information gathered from LCCK, DePuy and Duracoa Surgical Protocols.

The Triathlon TS Revision System is designed to offer the Triathlon performance in a streamlined revision procedure. Apart from the procedural components, hospitals using the Triathlon TS may develop a long term partnership with Stryker Orthopaedics. Stryker offers its partners various levels of support including Hospital Programs, Patient Education Materials, Practice Marketing Services, Reimbursement Services, and more.

Potential Benefits to Hospital and Surgical Staff
The Triathlon TS was designed with the surgeon in mind. The main goals were to be able to offer extensive intra-operative flexibility, and seamless integration with the primary system, which may improve OR efficiency.

The Triathlon TS Knee System Instrumentation design team focused on identifying ways to increase the accuracy and simplicity of the surgical procedure, two variables that may affect OR efficiency. Some of the TS solutions are:

- An IM Reamer referencing based system – potential for more accurate results.
- Color coding of trials for ease of use and clear identification.
- Quick attach and release mechanisms to facilitate easy assembly.
- Quick offset determination.
- Simplified implant assembly.

Instrumentation Case Configuration
The proprietary instrumentation design also offers intra-operative flexibility. The following features allow for surgical preferences and help surgeons adapt to multiple surgical realities:

- A common platform that is designed to allow for seamless intra-operative transitions.
- Limited incision capabilities.

Cases and the instrumentation layout within have been designed based on operative usage pattern metrics. Triathlon TS Knee Instrumentation is configured in modules that correspond to the surgical procedure, helping to optimize surgical flow while accommodating surgeon preference. Instruments used with less frequency are available in optional trays, reducing the number of required instruments and simplifying hospital operation. The system requires 45% less trays compared to competitive systems.

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