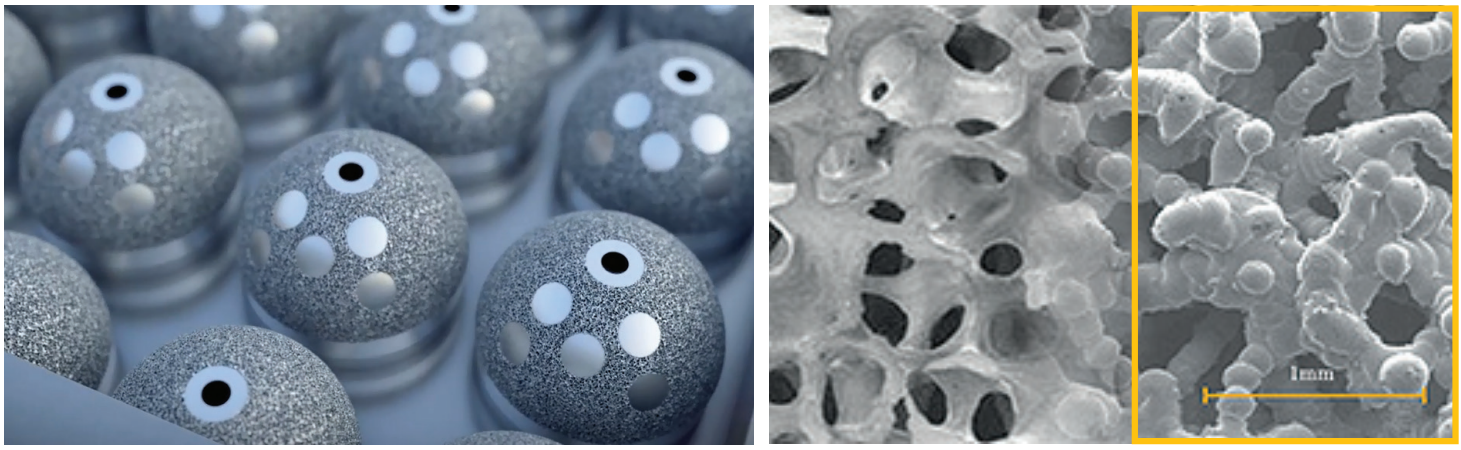
stryker

Triathlon® Tritanium®
Cone Augments

Design rationale

Triathlon Tritanium Cone Augments

Triathlon Tritanium Cone Augments are produced using Stryker's AMagine™ Additive Manufacturing technology. Highly precise geometries are sintered together using a focused laser beam to grow the unique implant structure layer by layer.



What is additive manufacturing?

Additive Manufacturing (AM) is a state of the art manufacturing technique that uses a computer model of an implant and grows the part layer by layer in a three-dimensional environment, fusing one layer of fine titanium powder to the layer preceding it.

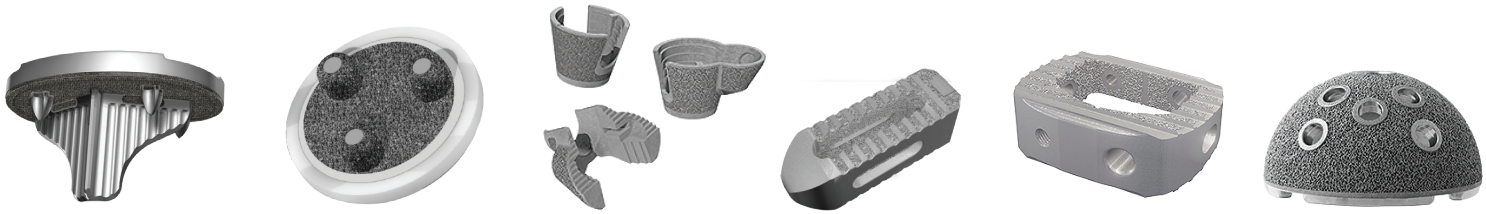
Average pore size[1]
458 microns

Average porosity[1]
64%

Average porous thickness[1]
1212 microns

Mean surface roughness[1]
90nm

Commercial launches with Tritanium



2014	2014	2015	2016	2017	2018
Triathlon Tritanium Baseplate	Triathlon Tritanium Patella	Triathlon Tritanium Cones	Tritanium PL Cage	Tritanium C Cage	Trident II Tritanium Acetabular Shell

Bone loss management with **cones**

"The intraoperative goal of revision TKA is to **reconstruct bony defects** to **restore the anatomical joint line**..."[2]

Factors that may contribute to bone loss include:

- Infection[3]
- Instability[4]
- Stress shielding[4]
- Implant failure[3]
- Osteolysis[4]
- Implant removal[3]

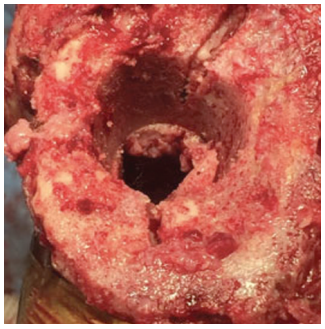
In revision TKA, bone defects may be quite large, despite being asymptomatic.[3]

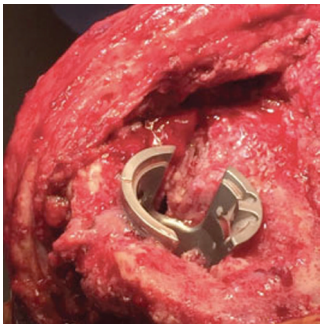
In revision TKA, porous cones may be an excellent option to manage bone defects and offer excellent short term outcomes[3,5-8]. For AORI Type 2 or 3 defects, cones may be a better alternative to allograft augmentation with less complications:[4,9]

Study	N*	Bone defect management	Avg f/u (yrs)	Survivorship (%)	Complications
Howard, et al[10]	24	Porous Cones	2.7	100	None
Schmitz, et al[11]	44		3	94	Loosening (5.7%)
Clatworthy, et al[12]	52	Structural allograft	10	72	Infection (7.7%)
Steens, et al[13]	34	Impaction Graft	4	76	Loosening caused by failure of the graft

*N = number of revision knees available for follow-up

"... The long-term goal of revision TKA is a well-fixed, stable joint that improves the patient's quality of life."[2]



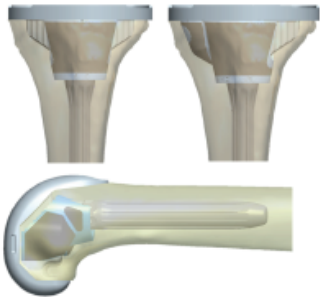


With Triathlon Tritanium Cone Augments, metaphyseal defects are managed using a reamer-based prep method, which may minimize fracture risk and reduce excess bone reaming.[5]

Fixation first

"Solid fixation of implants is **essential for mobilization and longevity**."[14]

It is important to identify **zones** available for fixation and fixation methods best suited to the case.[14]



Triathlon's **SOMA-designed cone shapes** were designed to minimize unnecessary bone removal and reduce intraoperative contouring of bone.[15] The combination of **solid and porous structures** allows for reduced cone cross sections.[16]

Metaphyseal fixation in revision TKA is paramount for survivorship. Cones may restore metaphyseal integrity with the potential for **long-term durable fixation**.[17]

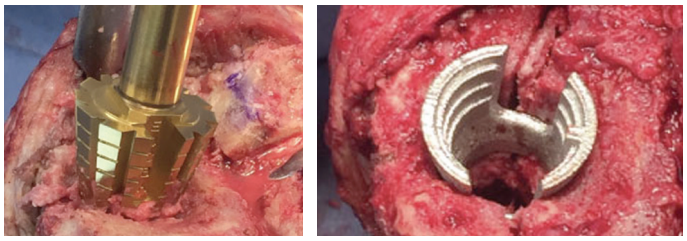
Once biologic fixation is achieved, the loads are dispersed away from the joint line, protecting the interface from stresses that cause mechanical loosening.[9]

Micromotion of the tibial components may lead to lysis, believed to be the main reason for aseptic loosening.[18] The solid titanium inner surface of Triathlon Cone Augments is **optimized for cement adhesion**.[19]

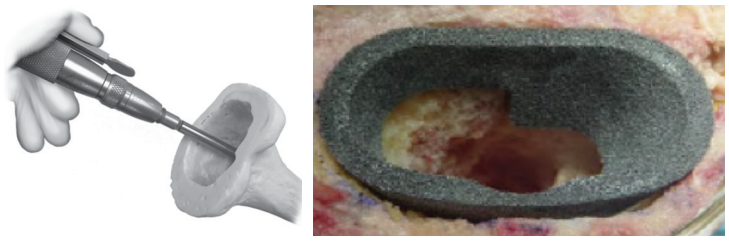
A stable construct

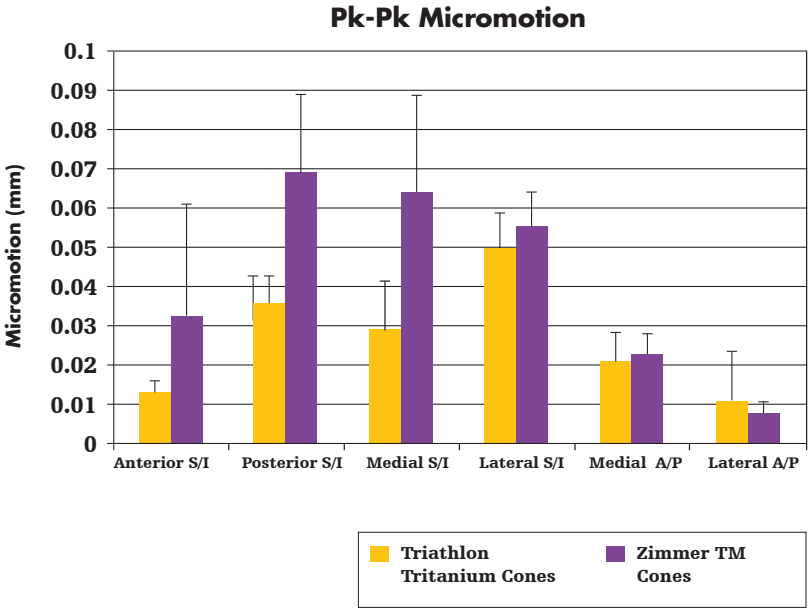
"A successful revision total knee arthroplasty (TKA) requires a **stable foundation**."[9]

Porous Titanium Cone: 1 step prep[5]



Porous Tantalum Cone: Repeated burring[20]

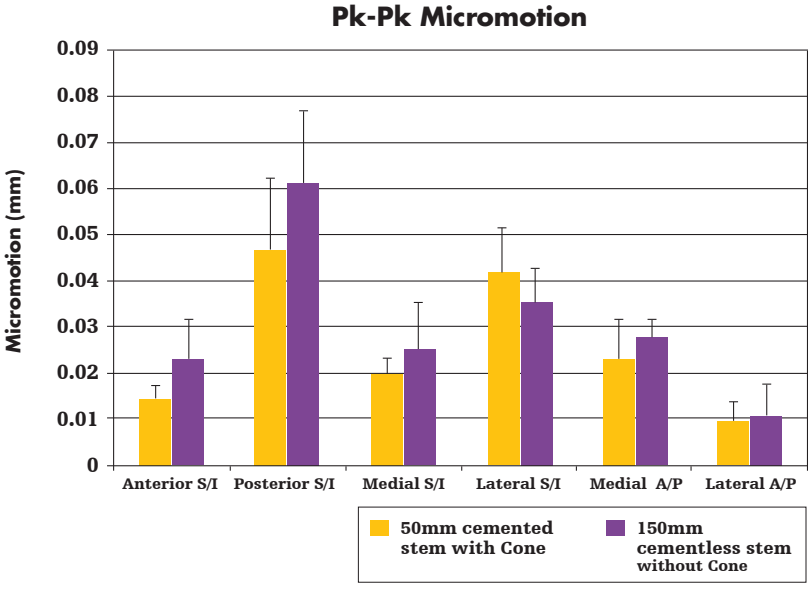




Triathlon Tritanium Cone Augments are designed to provide structural support to the implant and they **have been shown to minimize micromotion** compared to TM cones.[20]

Biomechanical studies support cement fixation in rTKA, especially in cases of uncontained defects or poor bone quality.[21]

Normalizations on the solid, inner surface of the Cones create a cement interface to reduce cement shear and **unitize** the components.[19]



Triathlon Tritanium Cone Augments may assist in improving rotational stability and alignment for short cemented stems.[22]

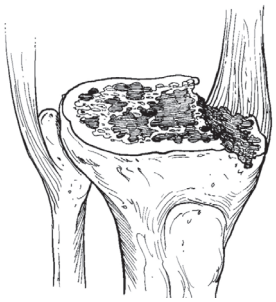
In one study, a cemented baseplate with a Triathlon Tritanium Symmetric Cone achieved equal **axial** and **rotational stability** compared to long press-fit stems in cases of moderate tibial defects.[22]

Meet the **cones family**

The Anderson Orthopaedic Research Institute (AORI) classification was developed to categorize metaphyseal bone loss.[23]

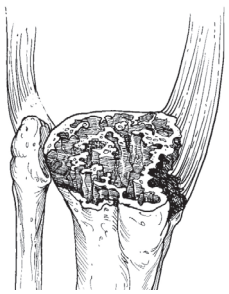
However, no two defects are alike, and management of defects can be a technical challenge.[24] For this reason, Triathlon Tritanium Cone Augments are designed to **fit the bone**, not the defect.

T_{2A}



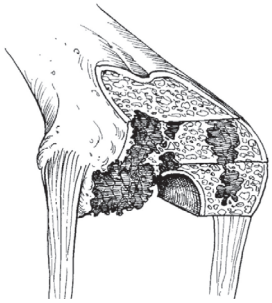
Symmetric Tibial Cones are designed to manage bone loss in **centralized** AORI type II **defects** and support the remaining bone stock

T_{2B}



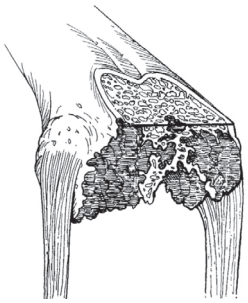
Asymmetric Tibial Cones are designed to manage type II and **uncontained defects of the tibia**. Size-specific lobes are optimized for a variety of bone shapes and sizes.

F_{2A}



Central Femoral Cones are designed to manage centralized AORI **type IIa defects** of the femur and support the remaining bone stock.

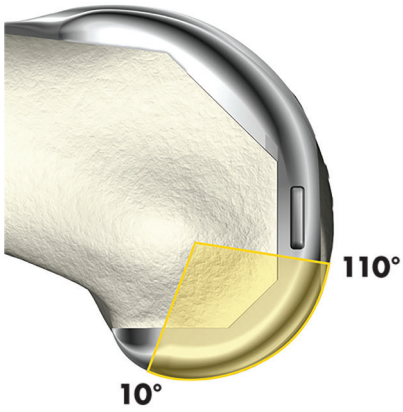
F_{2B}



Bi-lobed Femoral Cones are designed to manage **type IIb defects of the femur**. Lobes are designed according to corresponding femoral component dimensions.

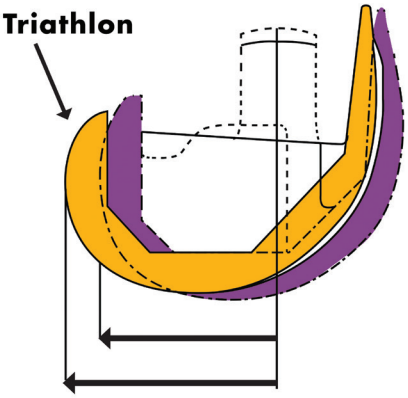
AORI defects as illustrated by Pecora, et al.[25]

Revision **redefined**



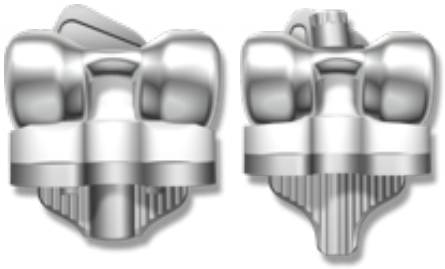
Patient-reported results of revision TKA are often inferior to that of a primary[26], but Triathlon TS demonstrated restored function and reduced pain with results similar to those in primary TKA at two-year follow-up.[27]

Triathlon TS has a **single radius** design for stability throughout the active range of motion.[28-31]



Posterior Condylar Offset (PCO) is directly attributable to flexion stability and has been shown to be an independent predictor of positive outcomes.[32]

Triathlon Revision femurs feature a **built-in femoral offset** to help correct flexion–extension mismatches and reduce the need for femoral offset adapters.[33]



The Triathlon portfolio allows for intraoperative flexibility of various constraint options.[34] If stability cannot be obtained in a revision, progressive levels of constraint should be considered in the revision construct.[35]

Instability often requires some mechanical constraint, and a constrained design that provides Varus/Valgus constraint should be used if there is functional loss of the collateral ligaments or an inability to balance gaps.[35]

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