



Hip
Technology
Portfolio

Forever Young
Forever Active

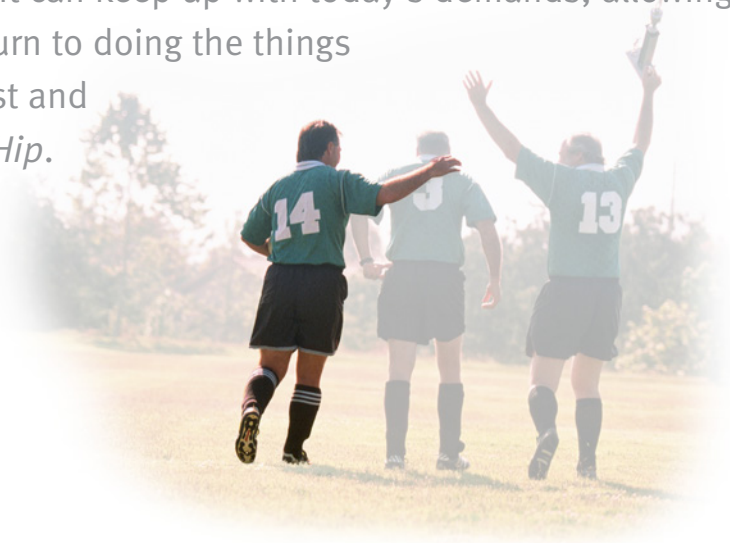
FOREVER HIP™

Once in a lifetime hip
replacement technologies



World Class Technology for Long-Lasting Performance

The *Continuum*[®] Acetabular System provides highly flexible solutions for orthopaedic surgeons who treat a wide range of patients. The system combines the clinically proven biologic fixation¹⁻³ of *Trabecular Metal*[™] technology with *Vivacit-E*[®] Vitamin E Technology, the only hip replacement technology that has demonstrated it can keep up with today's demands, allowing patients to return to doing the things they enjoy most and being *Forever Hip*.





Hip replacement is being performed on younger patients who expect to remain active throughout their lives, and this demographic shift has created a need for more durable, longer-lasting implant bearing performance. As a result of these increasing demands, Zimmer developed *Vivacit-E* Vitamin E Highly Crosslinked Polyethylene and has continued to challenge the material to unprecedented levels of aggressive laboratory testing. When combined with Zimmer's enhanced hip technologies, the advantages provide a high-demand solution for younger, more active patients.



Vivacit-E Vitamin E Technology building on the legacy of *Longevity*[®] HXPE with **15+** years of clinical success

Highly porous *Trabecular Metal* Technology with **17+** years of clinical history

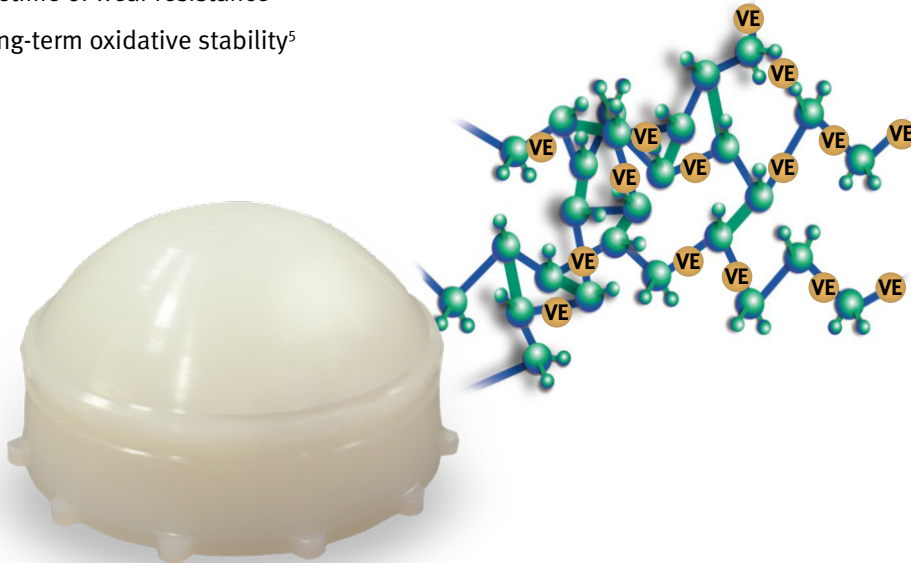
BIOLOX[®] *delta* Ceramic Technology with **10+** years of clinical history



Vivacit-E Vitamin E Technology

Zimmer understands that clinical data suggests a need to develop and evaluate bearing technology for younger, more active patients seeking performance well beyond the first decade of use. Building on the legacy of *Longevity* HXPE's more than 15 years of clinical success, *Vivacit-E* HXPE was developed and continues to be challenged to unprecedented laboratory testing. Results of this aggressive laboratory testing demonstrate the material provides major advantages over other polyethylene materials resulting in:

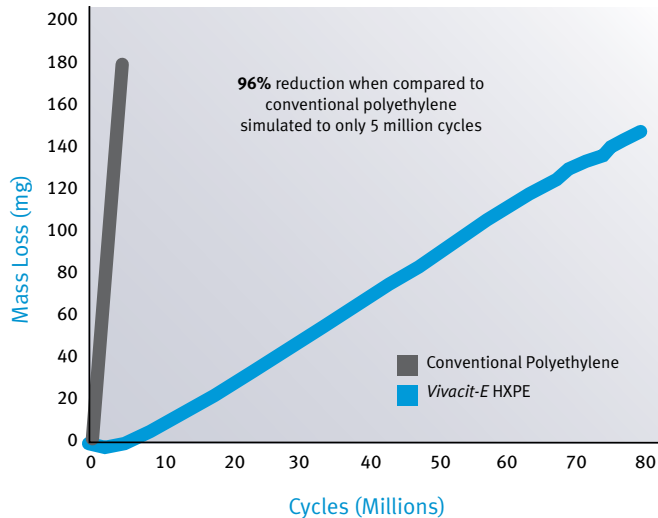
- Lifetime of wear resistance⁴
- Long-term oxidative stability⁵



Lifetime of Wear Resistance⁴

- The only hip replacement technology laboratory tested to mimic the number of walking steps a patient will typically take during their lifetime following total hip replacement surgery (80 million cycles).
- Stable and improved wear performance in long-term 80 million cycle testing.

Aggregate Volumetric Wear Comparison of Zimmer Conventional Polyethylene and Zimmer Vivacit-E HXPE After Simulating Up to 80 Million Cycles

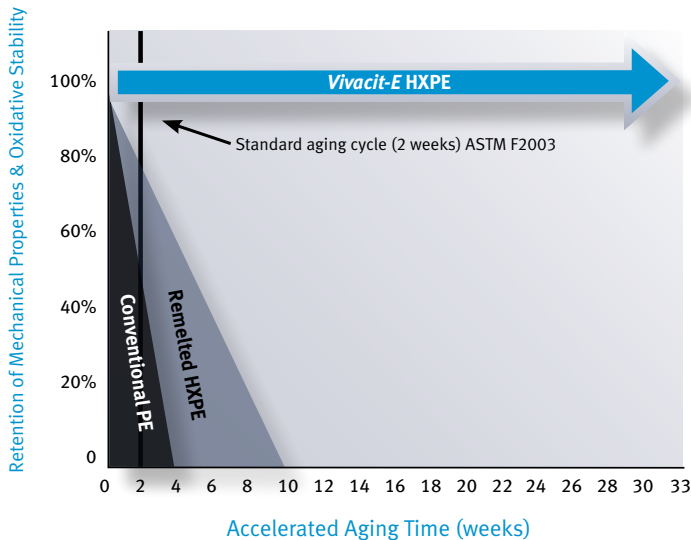




Long-Term Oxidative Stability

- Retention of oxidation prevention and mechanical properties over time (after 33 weeks of accelerated aging, more than 16 times the industry standard of 2 weeks).^{5,6}

Vivacit-E HXPE Retained Mechanical Strength and Showed No Oxidation After 33 Weeks of Accelerated Aging



Trabecular Metal Technology

For the orthopaedic surgeon who desires a clinically proven, advanced fixation material, *Trabecular Metal* Technology provides optimized mechanical and physical properties to address the need for initial stability and long term biologic fixation.





Initial Stability

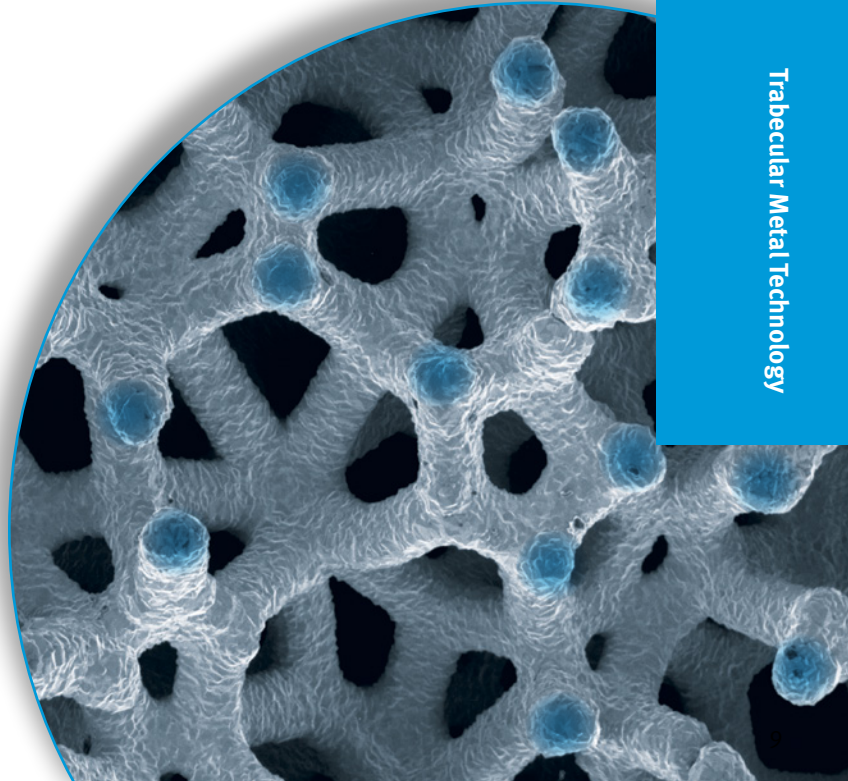
.98 Coefficient of friction*^{1-3,7}

Trabecular Metal Technology offers a high coefficient of friction and scratch fit.

- Helps reduce or eliminate the need for supplemental screws or grafts
- Reduces micromotion, enabling tissue ingrowth

*For non-machined surfaces such as the *Trabecular Metal* Modular Shell and *Continuum* Shell

Trabecular Metal Material
Magnified at 200x



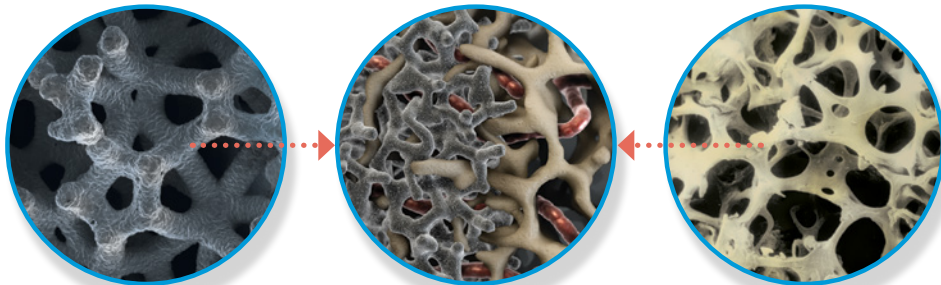
Long Term Fixation¹⁻³ Up to 80% Porosity

Trabecular Metal Technology 3D construct provides a high level of porosity and potential for osteoconductivity.

- Allows for bone and soft tissue ingrowth
- Supports a vascularized structure to maintain healthy bone

Proven Clinical History^{1-3,8} 17+ years

- More than 17 years of clinical history with orthopaedic implants and over 75 peer-reviewed journal publications
- More than 220,000 *Continuum Trabecular Metal* Shells implanted worldwide since 2009



Trabecular Metal Material

Osseoincorporation

Trabecular Bone

Artistic Rendering



BILOX delta Ceramic Technology

With 10+ years of clinical history, *BILOX delta* Ceramic Technology offers very low wear, high fracture resistance, and excellent biocompatibility.⁹ This high-performance material meets the increased demands of younger, more active patients and outperforms earlier versions of ceramic materials and well as metal heads.

Very Low Wear¹⁰⁻¹³

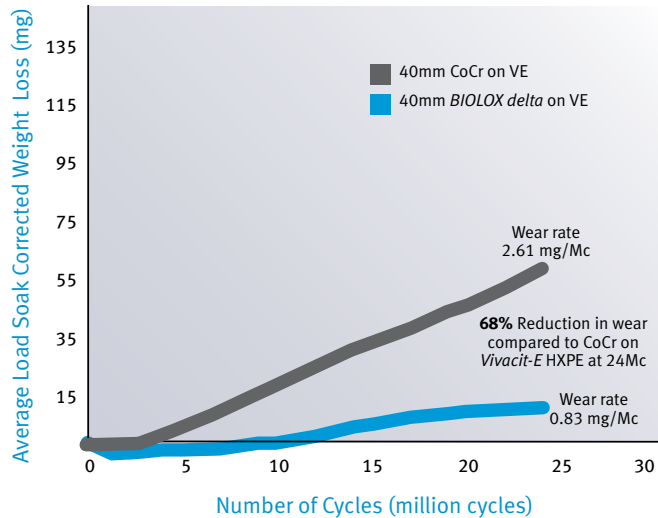
- Increased hardness offers improved resistance to scratching and subsequent wear when compared to CoCr heads articulating against *Vivacit-E* HXPE



- After exposure to clinically relevant third-body debris, wear reduction of 68% can be seen with *BIOLOX delta* ceramic heads when compared to CoCr femoral heads articulating against *Vivacit-E* HXPE for 24 million cycles of wear simulation

Vivacit-E HXPE Wear Performance: CoCr vs. BIOLOX delta Femoral Heads

Long-term wear simulation performed after both types of heads were exposed to clinically relevant mixture of bone cement, bone, and metallic particles





Minimizes Potential for Head/Neck Corrosion^{14,15}

- Addresses corrosion by eliminating cobalt chrome on the head/neck taper junction

High Fracture Resistance^{15,16}

- Optimum composite balance combines hardness with increased bending strength
- Fracture incident rate of approximately 1:200,000 to date (0.0005%), after more than 2.5 million implantations worldwide¹⁷



References

1. Lakstein D, Backstein D, Safir O, Kosashvili Y, Gross A. "Trabecular Metal Cups for Acetabular Defects with 50% or Less Host Bone Contact." *Clin Orthop Relat Res.* 2009; 467(9):2318-2324.
2. Nakashima, Yasuharu, et al. "Clinical and radiographic evaluation of total hip arthroplasties using porous tantalum modular acetabular components: 5-year follow-up of clinical trial." *Modern Rheumatology.* 2013;23(1):112-118.
3. Simon, Jean-Pierre and Bellemans, Johan. "Clinical and radiological evaluation fo modular trabecular metal acetabular cups- Short-term results in 64 hips." *Acta Orthop. Belg.* 2009; 75:623-630.
4. Zimmer Report TTN 1010-001 Wear testing conducted per ISO 14242-1 for 80 million wear cycles
5. Zimmer ZRR_WA_2409_11
6. Peiserich M et al. Retention of Mechanical Properties in a Blended Vitamin E Polyethylene After Extreme Oxidative Challenge. Poster 1060, ORS 2013 Meeting.
7. Zhang Y, et al., Interfacial frictional behavior: cancellous bone, cortical bone, and a novel porous tantalum biomaterial. *J Musculoskeletal Res.* 1999; 3(4): 245-251.
8. Sales data on file at Zimmer (2009-2014)
9. Hamilton, William et al. "THA With Delta Ceramic on Ceramic. Results of a Multicenter Investigational Device Exemption Trial." *Clin Orthop Relat Res.* (2010) 468:358-366.
10. Fisher, et al., Wear of Crosslinked Polyethylene Against Cobalt Chrome and Ceramic Femoral Heads. 11th BILOX Symposium July 2006. Section 6.4: Tribology.
11. Rajpura, A. et al. "The current state of bearing surfaces in total hip replacement." *Bone Joint Journal.* 2014;96-B:147-156.
12. Zimmer TTN 1209-001
13. Conditt M., Noble P., Stein J., The Role of Pitting and Third Body Debris in the Wear of Hip and Knee Prosthesis. 48th ORS Poster No. 1011, 2002.
14. Hallab, N. J. et. al. *Journal of Orthopedic Research.* 2004; 22:250-259.
15. Kurtz, Steven M. et al. "Do Ceramic Femoral Heads Reduce Taper Fretting Corrosion in Hip Arthroplasty? A Retrieval Study." *Clin Orthop Relat Res.* (2013)471:3270-3282.
16. Kuntz M, Validation of a New High Performance Alumina Matrix Composite for use in Total Joint Replacement. Seminars in Arthroplasty 17, 2006: 141-145.
17. Sales and complaint data on file from CeramTec GmbH, August 2014.



Note: *Vivacit-E* HXPE liners were tested for 80 million cycles to simulate use under typical conditions, based on in-vitro wear simulation testing conducted per ISO 14242. Bench testing is not necessarily indicative of clinical performance. The results of in-vitro hip wear simulator tests have not been shown to quantitatively predict clinical wear performance.

How long a hip replacement will last varies from patient to patient and depends on many factors, such as the patient's physical condition, activity level, body weight and the surgical technique. These other factors were not studied as part of the testing.

BIOLOX is a registered trademark of CeramTec GmbH

Contact your Zimmer representative or visit www.ForeverHip.com for more information

