The Best Thing Next to Bone™

Introducing osseoincorporation to implant dentistry.
Trabecular Metal Technology is a three-dimensional material, not an implant surface or coating. Its structure is similar to cancellous bone.4-6

Figure 1 Trabecular Metal Material’s structure is similar to cancellous bone

Tantalum

Trabecular Metal Material is made of tantalum, element number 73 in the periodic table. Tantalum is a highly biocompatible and corrosion-resistant metal7-21 used in various implantable devices for over 60 years,12-16 including a dental implant in the 1940s.16 Per-Ingvar Brånemark, known as the father of modern dental implantology, conducted osseointegration research in the 1950s utilizing tantalum.17

While the highly biocompatible and passive characteristics of tantalum were documented long ago, its cost and methods of production limited its use12 until the late 1990s. Since then, hundreds of thousands of Zimmer Trabecular Metal Implants have been sold.18
How is Trabecular Metal Material Made?

Trabecular Metal Material is fabricated in Zimmer’s TMT facility in Parsippany, New Jersey. The Trabecular Metal material process demands strict specifications for pore size, shape and interconnectivity to ensure a cancellous bone-like structure is obtained. Utilizing a thermal deposition process, elemental tantalum is deposited onto a substrate, creating a nanotextured surface topography to build Trabecular Metal Material, one atom at a time. This proprietary process utilizes the physical and biological properties of tantalum to create a unique material that has a structure similar to cancellous bone.4-6

![Figure 3](image)

**Figure 3** Numerous Zimmer Implants contain Trabecular Metal Material

Material Properties

Trabecular Metal Material has a low modulus of elasticity (2.5-3.9 GPa) closer in value to cancellous bone than titanium (106-115 GPa).4,5 In compression testing, Trabecular Metal Material exhibits high ductility without mechanical failure.19

![Figure 4](image)

**Figure 4** Trabecular Metal Material’s modulus of elasticity (2.5-3.9 GPa) is closer to both cancellous bone (6.8 GPa) and cortical bone (13-17 GPa) than titanium (106-115 GPa), cobalt chromium (210 GPa) or stainless steel (230 GPa).4,5

![Figure 5](image)

**Figure 5** Ductility without mechanical failure19

![Figure 6](image)

**Figure 6** Trabecular Metal Material forms a frictional interface with bone20-23

The Trabecular Metal Material has been demonstrated to contribute to the primary stability of the implant based on in vitro insertion torque testing.20-23

*NOTE: In the dental implant configuration, the overall compression strength and elasticity will be a function of multiple materials.*
**Topography**

A glimpse inside *Trabecular Metal* Material reveals its uniform three-dimensional cellular architecture with up to 80% porosity.\(^2\)\(^-\)\(^4\),\(^6\),\(^24\),\(^25\) The entire surface area of *Trabecular Metal* Material exhibits a nanotextured topography.\(^26\),\(^27\)

**Osseoincorporation**

Conventional textured or coated implant surfaces achieve bone-to-implant contact, or ongrowth.\(^17\) However, *Trabecular Metal* Material’s consistent, open and interconnected network of pores is designed for both ongrowth AND ingrowth, or osseoincorporation.\(^2\),\(^4\),\(^24\) Bone has the potential to grow onto the nanosurface of the *Trabecular Metal* Material, into its interconnected pores and around its struts.\(^4\),\(^5\),\(^25\),\(^28\),\(^32\)

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Figure 7 Three-dimensional uniformity with up to 80% porosity.\(^2\)\(^-\)\(^4\),\(^6\),\(^24\),\(^25\)

Figure 8 Nanotextured surface topography of *Trabecular Metal* struts

Figure 9 Zimmer MTX\(^\text{®}\) Microtexture at 2000x magnification

Figure 10 Straumann SLActive\(\text{™}\) at 2000x magnification

Figure 11 Nobel Biocare TiUnite\(^\text{®}\) at 2000x magnification

Traditional Implant Surfaces Have the Potential for Bone Ongrowth,\(^17\)
But Not Bone Ingrowth
Bone Ingrowth in Canine Mandibular Models

In a study of Trabecular Metal Implants placed in canine mandibular models, evidence of ingrowth by maturing bone has been documented as early as two weeks after implantation. Further research is required to determine the rate of ingrowth and its effects on secondary stability in human dental applications.

While other manufacturers have tried to mimic the attributes of Trabecular Metal Technology, sintered bead and other conventional porous coatings and materials differ significantly from Trabecular Metal Material’s high degree of interconnected porosity, low modulus of elasticity and consistency in pore size and shape.

The cancellous-like structure, interconnected porosity and bone ingrowth potential are a unique combination of attributes that contribute to the osteoconductive properties of Trabecular Metal Technology.1-6,24,25


20. Data on file with Zimmer Dental Inc.

23. Data on file with Zimmer Dental Inc.
33. Data on file with Zimmer Dental Inc.
34. Data on file with Zimmer Dental Inc.
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