Metalworking

How Kennametal's Innovative Tools Smooth Machining of Medical Implants

James Langford | May 21, 2024

Every human body is different, something you can see for yourself whenever you turn on the TV or stream videos on social media.

Which means the odds of running into someone who looks exactly like you are extremely slim, though you may well meet people who have cars, telephones and even tools that are difficult to distinguish from your own.

It also explains why fashioning medical implants to support and sometimes replace injured body parts—as well as tools to work on them—poses starkly different challenges than manufacturing tools and machining parts for mechanical devices.

Not only are implants typically crafted from difficult-to-machine materials such as ***titanium*** and ***cobalt chromium***, they're often ordered in smaller quantities with sharply different dimensions.

Even something as seemingly straightforward as a bone screw must be made in an array of sizes dictated by the regions of the body where it may be used, with small ones helping fuse vertebrae in the spine, for example, and much longer ones supporting hip bones.

"There's a wide variety of bone plates and bone screws that are often relatively lower volume because it's not like an automobile where you're making the same car and just changing the paint color," says Chris Merlin, a senior global product manager with Kennametal. "If you're a precision machine shop, you have to expect that you might have some shorter lead times and a wide variety."

Kennametal's portfolio of equipment for medical machining is designed to help shop operators meet those demands, with versatile tools that offer long life and consistent performance, even with the materials used in implants and surgical instruments.

Photo courtesy of Kennametal

“These metals are all difficult to machine: they’re more challenging to break chips in, get long tool life with and achieve great surface finishes on—and those are things that you need in medical components,” says Scott DeVinney, Kennametal’s global product manager for marketing.

Smooth finishes are vital because they help prevent surface contamination of implants, corrosion and the spread of disease-causing pathogens inside a patient’s body.

Maintaining Dimensional Accuracy

Simultaneously, “you’re going to want long tool life because if you’re machining bone screws, for example, you may be using the same turning tool on hundreds or even thousands of them, even if the screws are different lengths,” DeVinney says.

The company’s new small parts machining insert line, introduced this spring, is designed to provide that.

Featuring four new carbide grades, one new cermet grade and seven new geometries, it delivers superior chip evacuation and surface finish in low feed, high depth-of-cut applications, Kennametal says.

That’s important since controlling chips can be difficult when shaping small components in Swiss-type turning operations. Because machinists are often unable to achieve high speeds in such tasks, they must “be able to break the chip in other ways,” DeVinney says.

The polished geometries of the new inserts produce smooth chip flow, the company says, while a curved cutting edge distributes the tool pressure to avoid concentration in a single area.

Together, those qualities deliver optimal surface finishes and consistent accuracy, he says.

“Anyone can achieve, for example, a quarter-inch diameter plus or minus two-tenths, but the question is whether you can hold that plus or minus two-tenths over the next 1,000 pieces,” DeVinney explains. “The insert doesn’t lose its sharpness. It doesn’t lose that dimensional accuracy over time.”

The line complements Kennametal’s KCS10B turning inserts, which have for several years been go-to cutting tools for larger medical components such as acetabular components, used in connecting thigh bones to the pelvis during hip replacements.

The KCS10B “has been the big brother of turning,” he says.

Finishing Sculptured Surfaces

Kennametal also offers drilling and milling tools for medical applications. The company’s KenDrill™ Micro, introduced last year, is built to handle short- and deep-hole applications below 3mm in diameter, with lengths from two times diameter (2xD) to 50 times diameter (50xD).

That breadth of range helps ensure machine shops can be ready to meet a variety of demands for medical-implant customers, which is important given the potentially quick turnarounds required, Merlin says.

Another challenge is finishing of sculptured surfaces, a common requirement in orthopedic implants, for which Kennametal offers its eight-flute HARVI IV end mills and multi-axis finishing tools, sometimes referred to as “barrel tools.”

Additionally, the company’s proprietary KCSM15A end milling grade includes an innovative physical vapor deposition, or PVD, coating that can deliver extended tool life, increased output and higher metal removal rates when working with titanium and stainless steel.

“The people we sell to are measured on their on-time delivery, so they need a reliable supplier,” Merlin says.

With leading technology, much of which was developed in the company’s aerospace division, Kennametal is ideally positioned to meet that demand, he adds. Its range of tool sizes, well-stocked inventory and wealth of documentation help medical implant customers meet strict regulatory requirements, such as biocompatibility validation.

“Every day,” Merlin adds, “we’re machining parts in our lab to understand how we can get even better.”

What are the biggest challenges your shop faces in machining medical implants? Tell us in the comments below.