Mechanical Engineering Behind Surgical Breakthroughs

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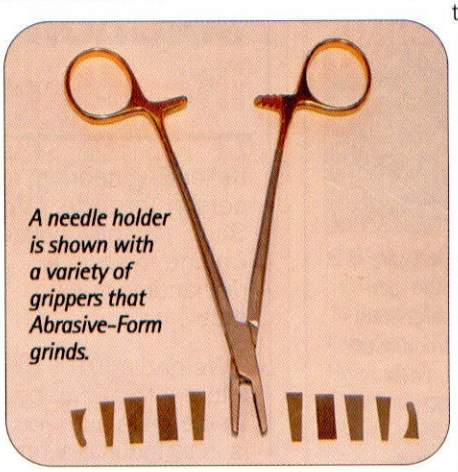
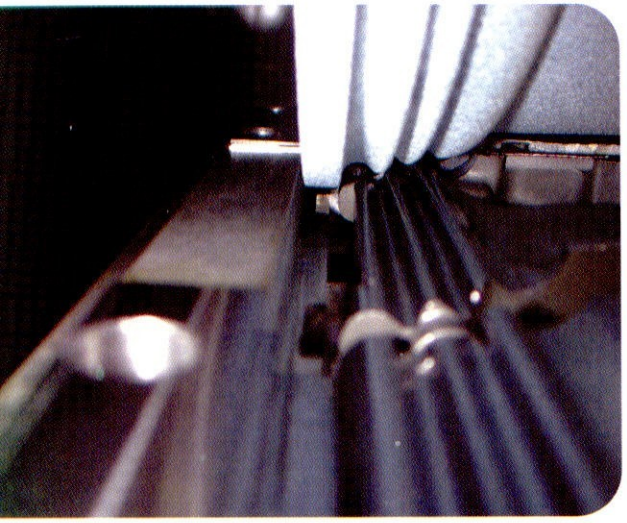
There is often an unrecognized engineering aspect to the medical breakthrough stories that we hear of lately. The better success rates in routine and not so routine surgeries are an example. High quality gripper components are staples that may be taken for granted, including gripper components that have miniscule teeth capable of securely holding very small surgical needles. These small teeth allow surgeons to accurately and easily manipulate needles for suturing, which helps cut time needed for surgery. The grippers also keep a tight enough hold to ensure that needles do not slip out and get lost in the patient's body during surgery. Surgeons rely on these grippers so heavily that the teeth actually wear out and need to be replaced.



A needle holder is shown with a variety of grippers that Abrasive-Form grinds.

This scarcely recognized surgical tool component is in turn fabricated by a similarly under recognized manufacturing process called creep-feed grinding. While one might try to cast teeth into the part before it is sintered, the quality of such cast parts is inferior to that found in creep-feed ground grippers. The sharper points and more geometrically coplanar teeth made possible by a creep-feed process are what it takes to make surgical needles into the high-functioning instruments that they are.

What is creep-feed grinding? Unfortunately, its very name tends to lead many astray, in that they assume there is some type of conventional grinding process where very small amounts of material are removed over long periods of time. Actually, creep-feed grinding usually removes a significant amount of material, as much as 20 cubic inches per minute. This misnomer also might mistakenly imply a process requiring significant downtime to dress grinding wheels, when in fact, creep-feed grinding often involves a continuous dress process with no dress downtime mid cycle. Creep-feed grinding is an abrasive machining process that has stock removal capabilities of the traditional milling and broaching processes but with the precision and surface finish associated with grinding. Creep-feed can be used both with hard and soft materials and creates parts that are effectively burr-free.



Typical grinding wheel in the creep-feed grinding process can be used by medical device and other industries.

There are sixty plus variables that need to be controlled for a successful creep-feed process, which explains both its lack of popularity and the reliance of many companies that use the process to rely on qualified outsources with cross-industry experience and proven track records to apply the process for them. Indeed, the time required to master creep-feed grinding is no small matter.

There are many high quality parts that rely on the tighter tolerance delivered with creep-feed grinding - creep-feed tolerances are in the range of 0.0001" to 0.001", compared with typical milling or broaching tolerances in the range of 0.001" to 0.010". From 3-foot fan blades of aircraft engines to 0.017" grippers for surgical needles, creep-feed grinding is the unseen hand that makes these high quality and high functioning parts.

Reportedly the largest dedicated outsource for creep-feed grinding in North America, Abrasive-Form serves many surgical equipment OEMs, as well as many of the firms whose business is to repair surgical instruments. To serve these markets, and especially the repair industry, Abrasive-Form developed a proprietary method to overcome the fixturing difficulties inherent in parts this small. Each part might be as thin as 0.017" with 0.006" deep teeth, with as many as 10,000 points per square inch. The customized fixturing allows Abrasive-Form to offer a very short delivery time, typically in the range of 5,000 parts within 2-3 days. This turnaround time is especially noteworthy given the extreme variety in tooth pattern forms and shapes of parts. The process has been optimized for routine efficiencies, with all the parts made from carbide, so that only diamond grinding can be used and milling or broaching are not options.

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