More flexibility for knee production at Howmedica

Although the bionic man is not yet a reality the possibility does exist to replace substantial parts of the human skeleton with engineered prostheses. These can provide much of the functionality that we take for granted with the natural item. Metal and plastic toes, ankles, knees, hips, wrists, elbows and shoulders are all available off the shelf to replace diseased, broken or worn-out originals.

One of the leading companies in this field is Stryker Howmedica Osteonics, which manufactures a range of orthopaedic prostheses at its factory on the outskirts of Limerick, Ireland. While the company is committed to development of high performance prosthetic products it is equally keen to achieve a high levels of efficiency in the methods that it uses for their manufacture. This company-wide philosophy is underlined by the US parent company's award winning status; Stryker Osteonics in New Jersey was nominated as one of the best factories in the USA in 1998 based on its lean manufacturing performance.

Among the recent successes in this regard has been the adoption of Horn Type 311 groove milling tooling for generation of important features of the knee joint component used in the Howmedica Modular Resection System - HMRS for rotating distal femur replacement. HMRS comprises a kit of components that can replace any part or all of the femur from the knee to the hip joint, and has been successfully used to treat cancer sufferers since the mid 1990s.

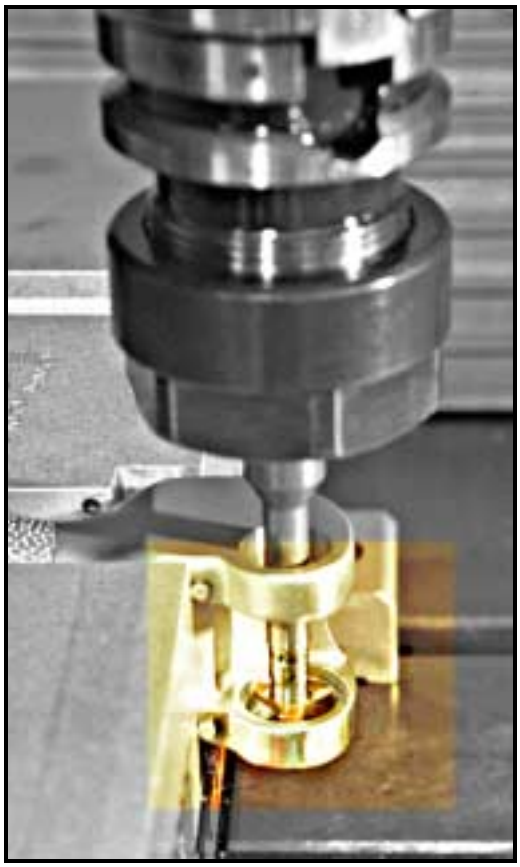
Benefits arising from use of the Horn tooling - which replaced custom manufactured carbide T-slot cutters - include 50 to 100 per cent increase in tool life and significantly reduced replacement tool cost - as only the tip need be replaced compared with the entire tool. It has also proved possible to develop the machining process so that the Horn tool can be used to square off the inner faces of the knee casting, replacing what was formerly a surface grinding operation and thereby allowing the component to be machined in one, rather than three, set-ups.

Says a Howmedica production engineer. "The component is produced from a Vitallium lost wax casting. The material is a proprietary alloy similar to cobalt chromium and is difficult to machine. The operation that we use the Horn tool on is machining of a recesses on the inner face of the U-shaped hinge joint. On this particular knee the joint is constructed as a hinge with an axle pin passing through the U, supported on 'top-hat' style nylon bushings. The bushings locate in drilled and reamed bores which are recessed on the inner face so that the brim of the top hat keeps them in place."

Diameter on the recess is held to ± 0.1 mm while the depth of the rebate is held to ± 0.05 mm. In addition the space between the legs of the U is opened out by about 1.0 mm either side to ensure true square-ness for operation of the assembled hinge.

Mr Fitzgerald explains. “These components are needed in relatively small quantities and are produced in batches of four. However, we apply Kaizen continuous improvement principles to all of our activities in an effort to find the most cost effective process of manufacture.”

The recess for the bushings has been machined using circular interpolation from the outset; for this Howmedica used a custom-manufactured solid carbide T-slot cutter which had just enough clearance to pass through the 18 mm bore. Machining is done on a vertical machining centre using a special fixture to locate the casting using a pair of cast-on lugs which are subsequently removed. The sequence of operation was to machine the lower recess and then index upwards to machine to upper recess.



When the product was new the recesses were cut as the third stage of a machining process which began with drilling and reaming of the bores to size. The component was then set up on a grinding machine to square up the side cheeks using the bores as the reference and the part finally returned to the vertical machining centre for recess cutting.

“The route was satisfactory in terms of quality but it was very labour intensive.” The engineer confirms. “Tooling costs were also quite high; we were getting around 25 components from the customised cutters but after that the entire tool had to be replaced. We therefore looked for an improved method of machining the parts.”

Horn UK’s Irish distributor, Flately Engineering, suggested substitution of the coated Horn Type 311 groove milling cutter/insert and the associated carbide shank toolholder for the customised cutter. With its swept diameter of 17.7 mm the insert just fits through the 18 mm bore.

“The immediate benefit of switching to the Horn tool was a tool life increase of up to 100 per cent compared with the solid carbide tooling.” Mr Fitzgerald reports. “Moreover the combined cost of the Horn shank and insert is about the same as we were paying for the solid carbide tool, but when the Horn insert becomes worn replacement cost is only about 25 per cent of that for the solid cutter so we achieve a substantial tool cost saving.”

There was more to come, however, as Howmedica decided to try using the Horn cutter to square off the internal faces of the component as well in a front and back facing operation, again using circular interpolation. The engineer reports. “There were some major benefits to be gained from this as it would allow us to consolidate all of the steps associated with bore and recess machining into a single operation. In the event it worked very well and has allowed the machining operation to be developed as a well controlled repeatable process. Overall we’ve been very pleased with the performance of the Horn tooling; the success of this application opened the door to their tooling being considered for any applicable project in the factory.”