Challenges of the future: non-wearing artificial joints

Quality of life for the elderly: key to achieving this ideal is maintaining mobility in old age - a great challenge, not least for medical technology. Joints in particular are subject to constant and extreme strain over the course of a long life, and more and more people now require prostheses. Scientists from the Institute of Mechanical Engineering at Magdeburg-Stendal University of Applied Sciences are developing a technology to enable superfinishing procedures from the field of mechanical engineering to be applied to medical technology. New machines equipped with the hardware and software developed in Magdeburg are able to produce artificial joints which do not wear, and therefore do not need to be replaced.

Professor Harald Goldau from Magdeburg-Stendal University of Applied Sciences reels off some striking figures from the German Federal Statistical Office: in Germany in 2010, 209,000 hip replacement operations were carried out and 175,000 artificial knee joints implanted. The costs per operation were around 7,400 euros.
"As life expectancy increases, diseases such as arthrosis will become more widespread. And patients will most likely require more than one replacement", predicts the manufacturing technology expert: the wear rate for prostheses is relatively high. Why? "Because of the surface properties of artificial joints", he explains. "Prostheses rub and wear, worsening the fit, and making them looser."
Creating a "non-wearing joint" is the stated goal of the researchers from the Engineering and Industrial Design Department.

Goldau's concept is to apply developments from the field of mechanical engineering, on which he once worked in Wuppertal, to the field of medical technology. With the superfinishing, or microfinishing, procedure, mechanical engineers made a great leap forward in quality: the non-wearing functional surface - for use in the automotive industry, for example. "The smoother a ball bearing runs, the more energy-efficient the machine", says the professor, highlighting the development's environmental aspect.

Professor Goldau places an artificial knee joint on the table in front of him. It is a conventional endoprosthesis, the type currently used. You can see your reflection in its titanium alloy surface. "Finishing is a special procedure. The vibratory movements in abrasion create even better surface properties", explains Professor Goldau. So the surface is made even smoother? He prefers to put it like this: "finishing changes the microstructure of the surface; it produces a grooved structure which absorbs the body's own lubricant and moves it towards the knee joint".

Goldau's pioneering research concepts have already inspired a number of companies from the mechanical engineering sector and users from the automotive industry. Together, these businesses have set up the "FumOFin" network (finishing for functional micro-structured surfaces) and are always interested in new partnerships offering further potential in the field.

An important local partner is Otto von Guericke University, Magdeburg. The main focus of this partnership is the medical benefits of microfinished endoprostheses.
"We have tested samples of tissue from around artificial knee joints and found them to contain particles from the prostheses. This is one sign that the behaviour of the surface of the artificial joints is less than ideal", says Professor Goldau. "Firstly, these particles can cause inflammation, and secondly, bacteria can grow on the worn surface of the prosthesis." He stresses that neither scenario is possible with the microfinished surface.

In order to demonstrate their innovative research, most importantly to the "users" from the medical technology sector, the scientists from Magdeburg have developed technology for a machine which is currently being constructed in Trossingen (Baden-Württemberg). The prototype is due to be delivered to Magdeburg-Stendal University of Applied Sciences in November and is eagerly awaited. From the cast blank to the finished knee implant, the "finishing centre" (Schleif-Finish-Center) will clearly demonstrate this completely new process.

Caption: Using the model, Prof. Harald Goldau demonstrates the artificial knee joint and where it is most subject to wear.

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