AUTOMATED DENTAL MILLING MACHINES

REVOLUTIONIZE DENTAL TECHNOLOGY

CAD/CAM systems with RFID are gaining ground in dental practices:
On-site production of dental prostheses with automated milling tool management

The Automated Revolution for Dentures?

Optimum availability, consistently documented manufacturing processes, seamless tool management –machining centers produce individual dental products such as bridges, crowns, inlays, veneers, full dentures and abutments for implants at the push of a button. Process chains of conventional tooth replacement production can be shortened from several weeks to a few minutes. Processing centers are available in various designs and performance levels – from individual production directly in the dental practice or a dental laboratory to machines in dental medical care centers that can perform several processing steps simultaneously.

Neosid develops miniaturized RFID transponders that are successfully used to identify tools and materials in dental processing machines. In an interview with *RFID & Wireless IoT Global*, Yilmaz Benzer, Managing Director, and Matthias Höß, Head of R&D and Project Management, Neosid, spoke about how comprehensively the use of transponders supports the market spread of machining centers and how this is changing implantology in favor of the patients.

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DENTAL TECHNOLOGY

Dental Care: A Growing Market in the EU

The EU spends around €80 billion a year on dental treatment – on average around €156 per EU citizen. Public spending on dental care is between three and eight percent of the national healthcare expenditure, depending on the country. The trend in spending is rising. Expenditure by the German statutory health insurance funds (GKV) on dental prostheses was 3.35 billion euros – almost one billion euros more than in 2005.

The Dental Technology Market in Germany

The dental technology market is subject to major changes. Owner-run dental laboratories are increasingly unable to find new recruits. Personnel development is also difficult. Since the year 2000, the number of trainees has decreased by more than a third. According to the German Federal Statistical Office, the dental technology trade is in fifth place in the negative ranking of all branches of industry in the German trade, with a share of over 17 percent of marginally paid employees. This is another factor that increases the pressure on dental laboratories: Almost one third of all dental practices in Germany had their own practice laboratory by 2018 – 55 percent of them with dental technicians.

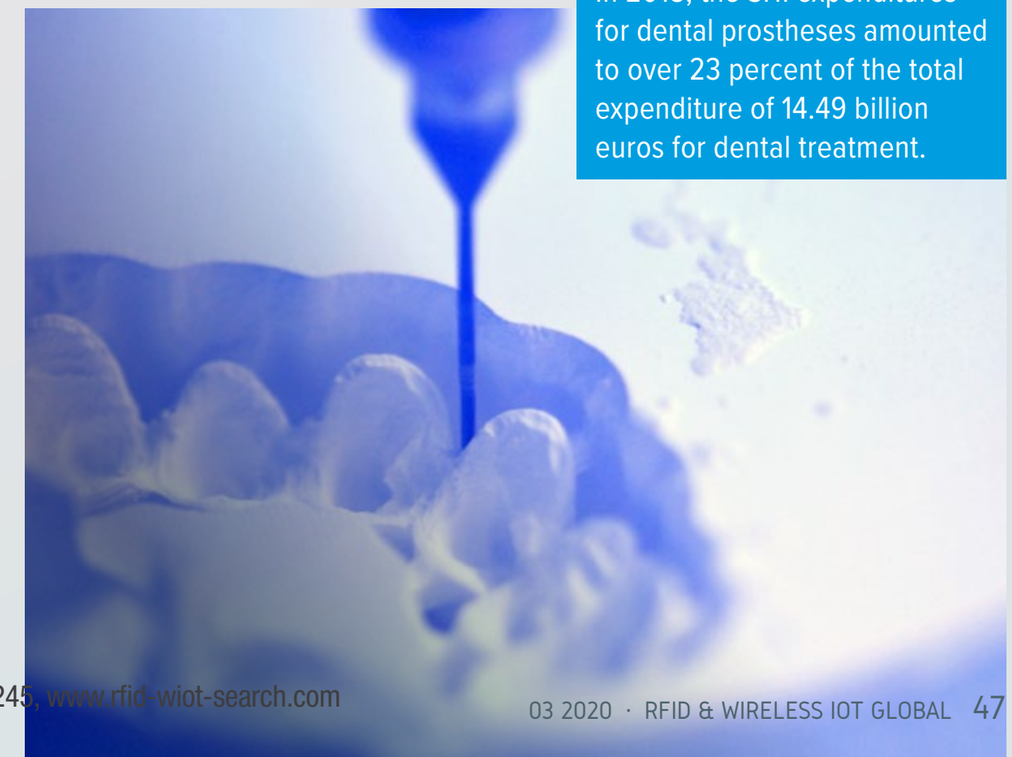
Up to 30 Percent of Dentures from Abroad

Dental restorative products from abroad create additional competitive pressure on conventionally operating laboratories. According to the Society for the Promotion of the Dental Industry (GFDI), the market share of dentures manufactured abroad is estimated to be between 10 and 30 percent. More than half of the imported products are manufactured in China. Other countries of origin with high shares are Turkey and the Philippines.

Dentures in a Few Hours Instead of Weeks

The patient's tooth and jaw situation is captured directly by camera scan or via laser scanning. If the treating dentist takes a conventional impression of the dentition, this impression is digitized with a scanner. The tooth and jaw correlation data are transferred to special dental CAD/CAM software programs. Once the digital processing program has been created, the production of the desired dental prosthesis starts. In semi-automatic production systems, the operating personnel manually select the required tools and materials. This is different with fully automated machining centers: the desired product is selected at the push of a button. The system takes over the provision of the required material. The selection of the tool from a magazine located in the machine for the respective processing step is fully automatic and robot-supported. Tools and materials are changed according to the selected machining job. An additional, downstream processing step is the curing of pre-sintered materials. If parts of sintered ceramic materials were milled or cut in their final state, they could break or splinter. It takes less than 60 minutes from the scan of the dental impression to the finished dental product. The manufactured product can be used immediately by the dentist.

In 2018, the SHI expenditures for dental prostheses amounted to over 23 percent of the total expenditure of 14.49 billion euros for dental treatment.



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Once the digital processing program has been created, the production of the desired dental product can begin. The desired tool and the desired material body are selected at the push of a button.

RFID IN THE DENTAL MILLING MACHINE

Up to 100 Different Tools in Use

Depending on the materials being machined, between 50 and 100 different tools are used in a machining center. The tools used differ in the material compositions and the areas of application.

Tools and Materials in Machining Centers

- Tools for milling, grinding, polishing, laser cutting and engraving
- Dental relevant raw materials such as sintered metals, ceramics, titanium, cobalt-chrome alloys, zirconium oxide and aluminum oxide or plastics such as PMMA or PEEK

Industry 4.0 in the Dental Practice Laboratory

"The process of tool management in a dental machining center is very similar to that in an industrially used CNC machine", says Matthias Höß and continues: "The fully secure and documented assignment of tool to workpiece, the recording of tool life and the automatic parameterization of machining programs are just as essential when machining components in vehicle engines as they are when creating and machining individual dental implants". RFID transponders, integrated into each individual tool and material body, are the best prerequisite for reliable processes with regard to:

- Security against mix-ups
- Wear and service life monitoring
- Tool management
- Plagiarism protection
- Optimization of the material usage
- Seamless documentation
- Traceability.

Absolute Precision Required in Transponder Development

Modern machining systems work with tools that are only 0.5 millimeters thick at the tool head, in order to create fissures in the relief of the chewing surface of the molars, for example. "The tools for the precision machining of dental prosthetic materials leave little room for the use of RFID transponders in terms of construction", says Matthias Höß, describing one of the main challenges in the implementation of an RFID application for the identification of dental tools. "Mechanical, thermal, chemical constraints place additional demands on all materials used in the transponder".

Automatic Parameter Setting with RFID

Clear communication between machine, workpiece and tool is crucial for the quality of dental restorations. The large number of possible combinations requires the exact setting of parameters such as tool speed, feed rate and machining direction. Details of the respective machining process can be completely digitally documented, in order to detect and replace worn tools at an early stage, for example. The transparency of tool life minimizes material losses, optimizes the time required and, in extreme cases, protects the machining center from damage. The use of RFID technology can further increase the degree of automation in dental processing machines. "Special calibration inserts can be used to determine tool wear, machine precision, the need for revision of the equipment, and to determine the necessary service. This results in further advantages for manufacturers and users of such digitalized machining centers", explains Matthias Höß.

A Further Step in Miniaturization Was Crucial

"We have upgraded our production facilities for the NeoTags used in dental systems in such a way that we can produce reliable miniature tags with a diameter and depth of less than two millimeters," reports Yilmaz Benzer. Without this further reduction in the size of the tags, their use in dental milling tools would not have been possible. "Only the smallest installation spaces are available. Absolute precision in production is essential. We are continuously researching and developing in order to optimize the manufacturing process and to realize smaller sizes with comparable transponder designs," explains the Managing Director of Neosid.

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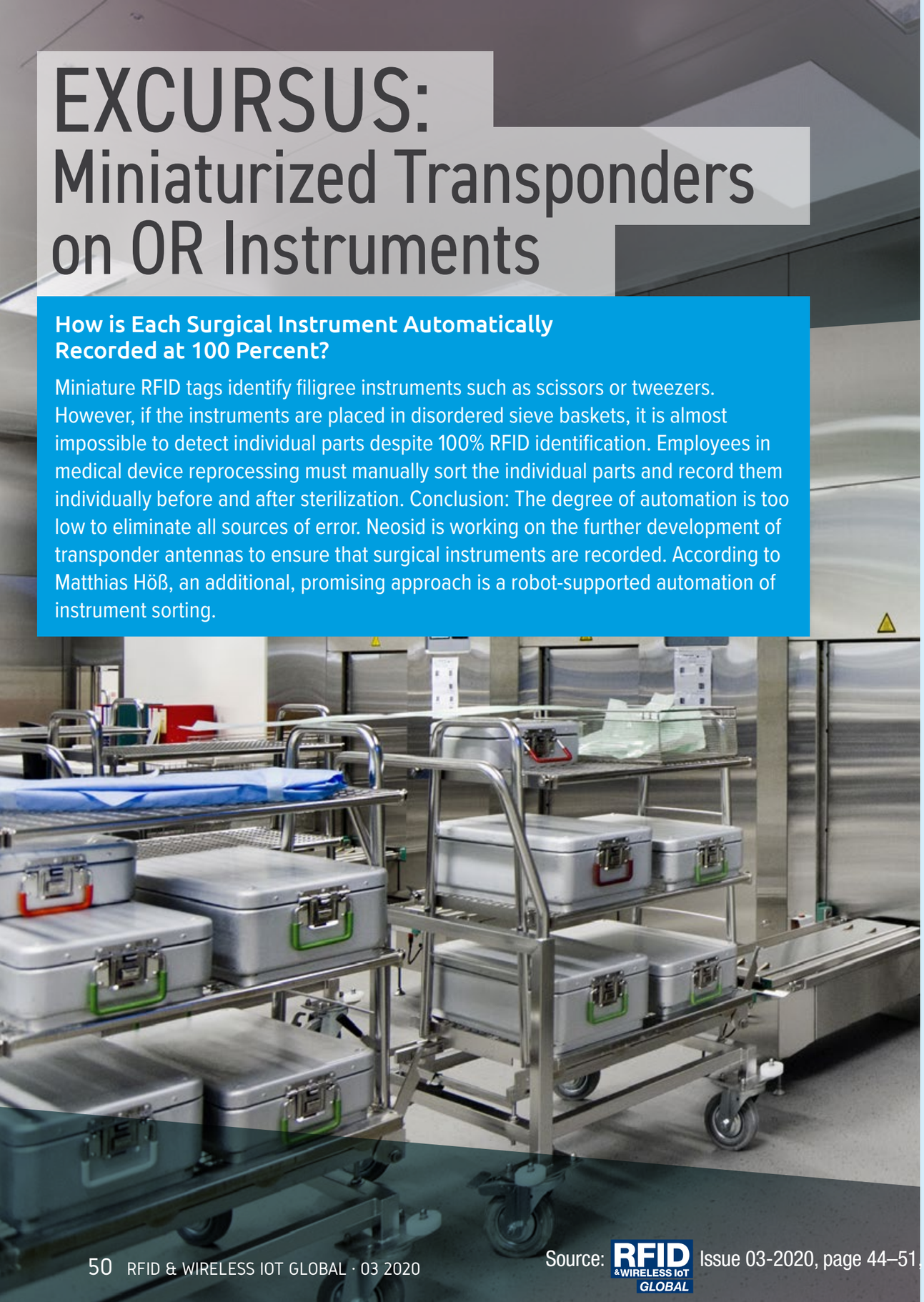
EXCURSUS: Miniaturized Transponders on OR Instruments

How is Each Surgical Instrument Automatically Recorded at 100 Percent?

Miniature RFID tags identify filigree instruments such as scissors or tweezers. However, if the instruments are placed in disordered sieve baskets, it is almost impossible to detect individual parts despite 100% RFID identification. Employees in medical device reprocessing must manually sort the individual parts and record them individually before and after sterilization. Conclusion: The degree of automation is too low to eliminate all sources of error. Neosid is working on the further development of transponder antennas to ensure that surgical instruments are recorded. According to Matthias Höß, an additional, promising approach is a robot-supported automation of instrument sorting.



Matthias Höß,
Head of R&D and Project Management,
Neosid

> “If RFID transponders can be detected via several axes in space, numerous applications in the medical environment can be optimized – or even realized in the first place. The alignment of the transponders to the read antenna is crucial for the reliable detection of instruments. Transponders with 3D-detectable antennas are still much too large to identify small surgical instruments. We at Neosid are working at full speed to further advance miniaturization.”

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