Project: MagCage - Textile magnesium implant with specific mechanical and geometric property profile for the treatment of large bone defects in long bones

Partner: Institut für Textiltechnik der RWTH Aachen University (ITA); GER

Project-accompanying committee consisting of German SMEs and large companies

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Mission Statement:

In orthopaedic surgery, large bone defects are still a central problem for which there is no optimal solution. One treatment approach is the titanium bone cage, which contains the body's own bone fragments and bone substitute material as a kind of cage structure to promote local regeneration. After successful treatment, the cage is explanted in a further treatment step. This is directly associated with negative consequences. The quality of life of the patients decreases due to the multiple interventions. In addition, the later mobilisation and the associated later re-entry into the labour market lead to immense indirect costs.

The aim of this research project is a resorbable, textile and tubular bone cage made of magnesium wire for the treatment of large bone defects in long bones. This is intended to avoid the aforementioned deficits.

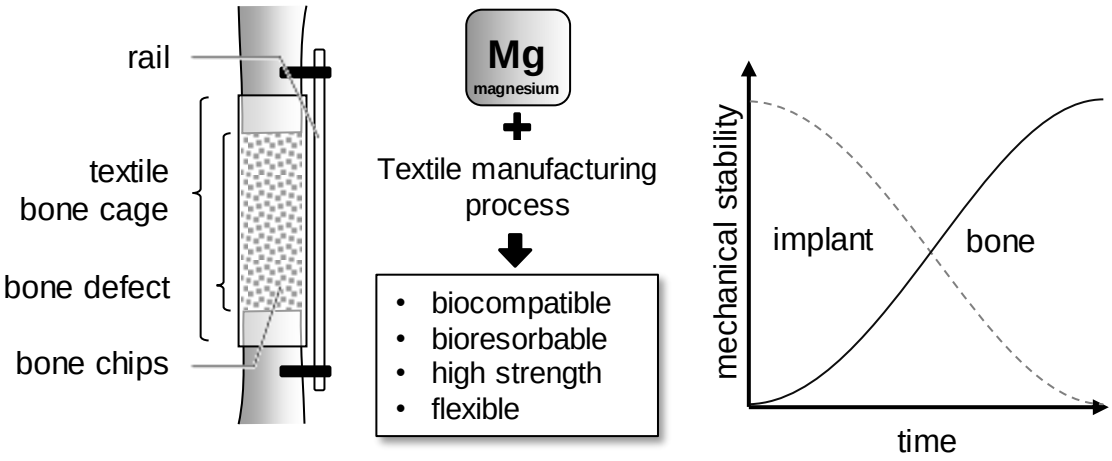

Figure 1: Mission image

Results:

After defining the requirement profile for the wire-based magnesium cages, a suitable magnesium alloy and an aluminium replacement alloy for the manufacture of the bone cages were selected as part of a material research project. Based on the previously determined requirements, different wire diameters of the aluminium and magnesium wires were produced for the textile processing investigations.

The transferability of the textile processability of aluminium as a substitute alloy to the selected magnesium alloy was ensured by mechanical characterisation methods.

Within the framework of experimental plans, the relationships between the manufacturing parameters of the textile processing technologies (braiding, knitting, weaving) and the geometric and mechanical properties of the textile hose implants were investigated. The processing of the wires in the conventional braiding and knitting process could be carried out successfully after machine adaptations. Due to the adaptations in the tube weaving process on a conventional shuttle weaving machine which could be realised within the scope of the project, the production of usable tube fabric was not possible.

Based on the interrelationships determined, braided and knitted bone cages made of magnesium were then produced and characterized. To determine the radial strength of the bone cages, a test setup based on BULLENS ET AL. was developed.

The degradation tests with untreated and ceramicized magnesium showed that a significant reduction of the degradation rate and controlled degradation can be achieved by surface treatment of the magnesium wires.

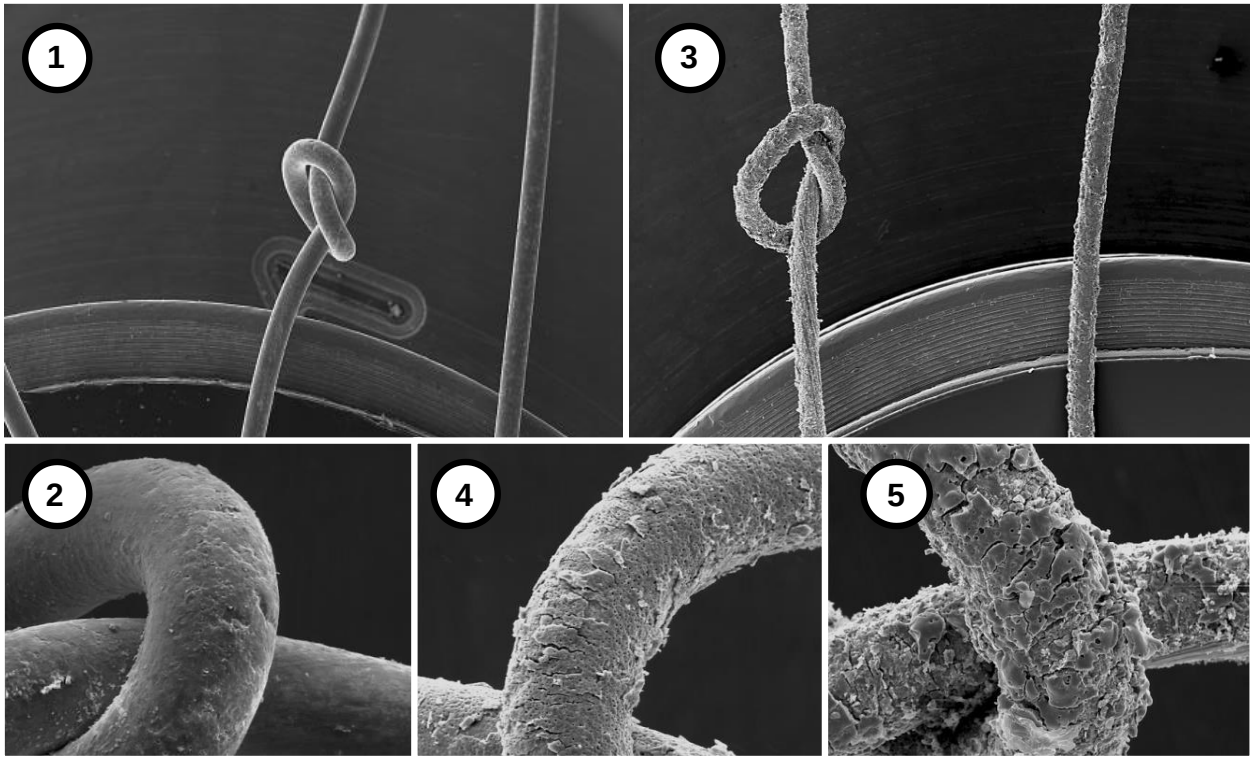

Figure 2:SEM images of the untreated & ceramicized magnesium wires. (1) and (3) are untreated, (2) and (4) are coated with a thin ceramic layer and (5) are ceramicized with a thick layer.

Within the scope of a benefit analysis to determine the most suitable textile process for the production of wire-based bone cages for the treatment of large bone defects in long bones, knitting (or weaving) was selected as opposed to braiding.

Finally, the knowledge gained was used to prepare a guideline for the design of textile magnesium wire implants.

The final report of the completed research project is available to the interested public in the Federal Republic of Germany.

Acknowledgement:

The IGF project 18880 N of the Forschungsvereinigung Forschungskuratorium Textil e.V. (Research Association for Textile Research) (FKT) on the topic "Processing fine yarns using the example of a textile stent graft for "ultra-low pro-file" catheter systems" was funded by the AiF within the framework of the programme for the promotion of industrial joint research and development (IGF) of the Federal Ministry of Economics and Energy on the basis of a resolution of the German Bundestag. We are grateful for this support. We are also grateful for the support of the FKT. We would also like to thank the companies represented on the project committee for their technical support.

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