Hydrolytic degradation of thermoplastic polyurethane filaments for suture material

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Abstract:

Introduction:

Leakages or insufficiencies of pancreatic anastomoses are one of the most common causes for postoperative complications in pancreatic surgery. Insufficiency rates of up to 20 % have been reported in the literature for pancreatic anastomoses after resections of the pancreatic head [1].

For anastomoses in the gastrointestinal tract resorbable, non-elastic, and stiff suture materials such as polydioxanone have been used. These sutures typically have a diameter in the range of 150-199 µm (USP 4-0). Due to their non-elastic and stiff properties, conventionally used suture materials can cut into surrounding tissue under high tensile loads, causing mechanical damage. This damage is visible in histological sections as a 'comet tail defect'. [2]

In previous work, the hypothesis was proven that the suture quality of an intestinal anastomosis can be positively influenced by changing the suture elasticity. Highly elastic sutures were developed and the low stiffness was identified as a positive influencing factor. Due to the non-resorbable polymer, the suture had to be removed after healing, resulting in increased patient stress. [2]

To address both the mechanical benefits and the issues of increased patient stress, resorbable thermoplastic polyurethane (TPU) is being investigated as a suture material. TPUs are composed of hard and soft segments, which can result in low stiffness and elastic behaviour. These structures are created by reacting an isocyanate with a long-chain polyol (soft segment) or a chain extender (hard segment). The resorption properties of polyurethanes are highly tunable due to the high possibilities of combination of hard and soft segments. [3,4]

Materials and Methods:

Resorbable fibres made of TPU have been melt spun to combine the beneficial results of an elastic, less stiff suture material with the resorbable properties of commonly used sutures. This study investigates the degradation behaviour of fibres in an aqueous, phosphate-buffered saline (PBS) solution, adjusted to a pH value of 7.4 over a period of 90 days.

Results:

The study analyses changes in the mechanics of the fibres over time. Compared to the reference fibre stored outside of the medium, a loss in mechanical strength is measurable which is indicative for a degradation in PBS solution. The strength of the fibres remains above 60 % of the initial values even after 90 days. The degradation study demonstrates that the material is suitable for use as a resorbable fibre in human-like pH surroundings. Additional mechanical properties will be investigated in future studies.

Keywords: *polyurethane, degradation, suture*

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