PHOTOPOLYMERIZABLE ADHESIVES FOR BONE FRACTURE FIXATION

Patrick Steinbauer,[a,b] Lisa Sinawehl[a,b], Robert Liska[b], Stefan Baudis[a,b]

[a]Christian Doppler Laboratory for Advanced Polymers for Biomaterials and 3D Printing
[b]Institute of Applied Synthetic Chemistry, TU Wien/E163-MC, 1060 Vienna (Austria)

Due to an increase of aging populations across the globe, the number of osteoporosis-related bone fractures rises steadily. Complicated bone traumata such as comminuted fractures are difficult to fix with conventional means such as metal plates and screws and often result in severe loss of bone. The use of biocompatible and biodegradable bone adhesives could revolutionize fracture fixation with possibly shorter operation times, better stabilization, lower infection rates and no need for removal operations [1]. Despite three decades of research, no practically applicable system for such an adhesive has been identified yet, due to lack of biocompatibility, sufficient bonding strength and ease of usage [2]. In this work, we present an easily applied adhesive system, based on photoinitiated free radical thiol-ene “click” chemistry, which is curable with UV light in a surgically realizable one-step process. The innovative ternary glue formulation is comprised of thiol-ene component and adhesive molecules, so-called primers. These newly synthesized primers with high binding affinity to bone and implants consist of adhesion motif, spacer and polymerizable group for network incorporation. The adhesion motifs chosen were inspired by nature and self-etching properties of dental materials. Previously they were investigated according to their adhesive forces at nanoscopic level [3, 4]. Different polymerizable groups attached to primer molecules were tested leading to improved primer incorporation into the polymer network. Results show, that the one-step biocompatible thiol-ene system exhibits exceptional shear bond strengths on different surfaces, which are as high as for commercially available medical glues based on acrylates. Noteworthy, high adhesion strength to implant surrogates was observed, as well. The unprecedented ease of applicability of this one-step system, rapid photocuring and excellent bonding strength solves challenges exhibited by past adhesives and paves the way towards future treatment of comminuted fractures as well as for stabilization or fixation of implants in the cancellous part of bone.

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