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Collagen-based biomaterials for tissue engineering and regeneration of the cornea

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There is a pressing global medical need for the development of tissue-engineered alternatives to supplement the scarce supply of human donor corneal tissue for transplantation and vision restorative therapy. There are currently over 10 million people blind due to corneal scarring or disease, with 1-2 million new cases of corneal blindness arising annually. To meet this enormous global demand, our research has focused on developing transparent, tissue-engineered collagen-based hydrogels for implantation in the cornea. In preclinical studies, designs have evolved with respect to collagen composition and use of various synthetic cross-linking agents. Utilizing advanced *in vivo* imaging techniques such as optical coherence tomography and *in vivo* confocal microscopy, we have developed methods to visualize and longitudinally quantify bio-integration, wound healing, and cellular and neural compatibility of the biomaterial implants in rabbit and pig models, in real time. The implantable biomaterials and imaging techniques have also been extended into the clinic, where 10 patients received the first tissue-engineered corneal substitutes, and were followed and documented extensively for over six years postoperatively. In more recent work, our clinical experiences have resulted in refined designs of biomaterials and surgical implantation techniques, with a focus on robustness of materials in the operating room and optimization of the degradation profile of biomaterials *in vivo*, to facilitate host cell invasion and regeneration of tissue. Considerations of cost, raw material availability, and safety for human use are also becoming increasingly important as future efforts are aiming towards large-scale production of tissue-engineered corneas to meet an increasing global demand.

Biography

Neil Lagali is Associate Professor at the Faculty of Health Sciences, Linköping University, Sweden. He completed his PhD in Canada, and has held postdoctoral fellowships in The Netherlands, Canada, and Sweden. His current research interests include *in vivo* imaging in ophthalmology, corneal transplantation, and angiogenesis. He has published over 40 papers in international journals, authored several book chapters and one book, holds several patents and serves as editorial board member for BMC Ophthalmology.

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