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ADVANCED CROSSLINKING FOR KERATOCONUS AND LOW-GRADE MYOPIA

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av medicine doktorsexamen framläggs till offentligt försvar i Hörsal B, målpunkt 1D T9, Norrlands universitetssjukhus, fredagen den 6 december, kl. 13:00.
Avhandlingen kommer att försvaras på svenska.

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Abstract
Corneal crosslinking (CXL) is an established treatment for progressive keratoconus (KC). In this thesis, Advanced CXL refers to a further development of conventional CXL, which aims to improve the treatment outcomes in KC and can also be used as a refractive treatment for low-grade myopia (near-sightedness). Transepithelial (epi-on) CXL with high oxygen has emerged as an approach to reduce the post-treatment inconveniences. The aim of the three prospective, randomized, intra-individually compared, single-masked studies in this thesis was to continue developing advanced CXL for KC and low-grade myopia.

Studies I and II sought to assess the treatment effects and subjective ocular discomforts in epi-on photorefractive intrastromal crosslinking (PiXL) in high oxygen as a refractive treatment for low-grade myopia using three different illumination protocols. In Study I, 23 healthy subjects (46 eyes) were randomized to a central 4.0 mm homogenous illumination zone (area) in one eye and a 4.0 mm annular zone with a central 2.0 mm sparing (ring) in the fellow eye. Both protocols improved uncorrected distance visual acuity (UDVA) and manifest refractive spherical equivalent (MRSE) at 1 month, which remained stable throughout 24 months. The ring protocol was reported to cause less ocular discomfort at 1 week. In Study II, 27 healthy subjects (54 eyes) were randomized to the previous ring protocol in one eye and a 3.5 mm annular protocol with a central 1.5 mm sparing (small ring) in the fellow eye. The small ring rendered less ocular discomfort the first day post-treatment and slightly better improvements in UDVA and MRSE, but there was a transient reduction in low-contrast visual acuity (LCVA). In both Studies I and II, no changes in endothelial cell count (ECC) and best corrected visual acuity (BCVA) were seen and no adverse events were registered.

Study III aimed to compare the treatment effect and subjective ocular discomfort scores of customized topography-guided epi-on CXL in high oxygen with customized topography-guided epi-off CXL in room air for KC. At 24 months, both treatments had halted the disease progressions and had improved UDVA and BCVA. LCVA at 10% contrast improved for both protocols, but LCVA at 2.5% contrast improved for epi-on CXL only. No changes were seen in ECC, and no adverse events were registered. The epi-on eyes were reported to have less ocular discomfort throughout the first week post-treatment.

In conclusion, advanced CXL can be used to improve vision and halt progressive KC, and it also improves uncorrected vision and reduces low-grade myopia in healthy eyes. In low-grade myopia, the initial ocular discomfort may be reduced with a ring illumination PiXL protocol. A larger treatment effect may be seen with a smaller treatment zone, but likely at the expense of a transient decrease in LCVA. In KC, customized topography-guided epi-on CXL in high oxygen is a viable alternative to customized topography-guided epi-off CXL in room air, with faster improvements in BCVA and LCVA and less early ocular discomfort.

Keywords
Keratoconus, Myopia, Corneal Cross-linking, Transepithelial CXL, Aberrations, corneal wavefront, Corneal topography, Prospective study

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