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## New theory and efficacy of CXL

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We will present a new analytic  $Z^*$  formula for corneal cross linking (CXL). CXL safety the criteria for the validity of Bunsen-Roscoe law (BRL) for accelerated CXL and its comparison to the new nonlinear law will be discussed. New formulas for CXL efficacy for both type-I and type-II will be presented. The minimum corneal thickness given by a  $Z^*$ -formula,  $Z^*=(1/A') \ln(E^*/Ed)$ , where a steady state effective absorption constant given by  $A'=2.3[m\epsilon_2 G(z)C_0+Q]$ , where  $Ed$  is the endothelial cell's cytotoxic damage energy threshold ( $Ed$ ). CXL efficacy (for type-I) is given by  $C_{eff}=1-\exp(-S)$  with  $S$  being the rate function. The Bunsen-Roscoe law (BRL) is based on the Beer-Lambert law for UV light intensity without RF depletion, such that  $S=akE$ , which is a linear function of the dose  $E=(tI)$ . In comparison, using a time-dependent generalized Beer-Lambert law, we obtain  $S=\sqrt{(4kCo/aIo) \exp(A'z) [1-\exp(-0.5aE)]}$  which is a nonlinear function of  $E$  and has a steady-state proportional to  $\sqrt{(Co/aIo) \exp(A'z)}$ . Our nonlinear law predicts that high UV intensity requires longer exposure time than what is calculated based on BRL. In addition, for the same dose, higher intensity depletes the RF faster and reaches a lower steady-state efficacy than that of lower intensity, consistent with the recent clinical data. The CXL efficacy (for type-II) is given by  $C_{eff}=1-\exp(-S)$  with  $S$  is the time integral of the singlet oxygen concentration, given by  $S(z,t)=(k_1/k_4)b_1 \int_0^t V(z,t)[1-b_2 V(z,t)] dt$ , where  $V(z,t)=\ln(1+Bt)$ , with  $B=apqI(z)X_0$ , where  $X_0$  is the initial oxygen concentration,  $p$  and  $q$  are the type-I and type-II quantum yield, respectively. The  $S$  formula provides the role of oxygen in type-II efficacy.

## Biography

Jui-Teng Lin has completed his PhD in Physics from the University of Rochester in USA. He is currently the Chairman and CEO of New Vision Inc., and Visiting Professor at HE Medical University in China. He has served as a Visiting Professor at National Chao Tung University and was the Associate Professor at the University of Central Florida. He holds over 45 patents and is the Inventor of flying spot LASIK procedure. He has published over 55 book chapters and over 150 peer review journal papers including 75 SCI-impacted papers.

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