

Long-term corneal biomechanical results and histology 1, 4 and 8 months after WST-D and Near Infra-Red (NIR) treatment in rabbits

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Financial Disclosure

Jurriaan Brekelmans	None
Alexandra Goz	None
Alexander Brandis	Steba-Biotech(P)
Yoram Salomon	Steba-Biotech(P)
Mor Dickman	None
Rudy Nuijts	Abbot (S), Acufocus (S), Alcon (C, L, S), Asico (C, P), Bausch & Lomb (S), Carl-Zeiss (S), HumanOptics (S), Ophtec (S), Oculentis (S), PhysiOL (S), Gebauer (S), TheaPharma (C)
Avigdor Scherz	Steba-Biotech(C, P)
Arie Marcovich	Steba-Biotech(P)

Purpose

To determine **long-term** follow up **safety and efficacy** of **WST-D/Near infrared (NIR)** treatment for corneal stiffening

Introduction

WST-D

- Derived from bacteria; bacteriochlorophyll
- Systemic safety established (phase III clinical trial)
- Dextran 500kDa limits **penetration to anterior ~200µm**

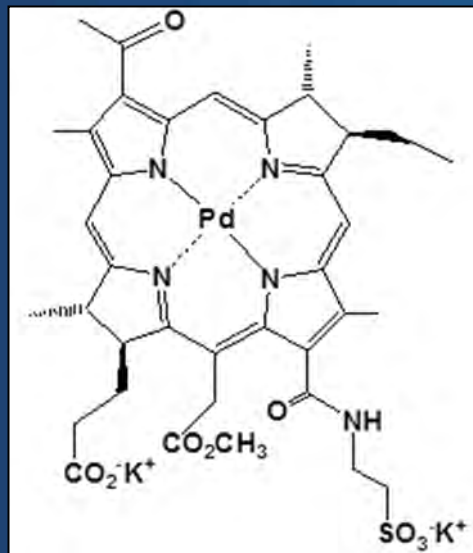


Fig. 1 Structure of WST11
Ashur et al. (2009)

Introduction

Near Infrared Light

- Near Infrared light (NIR)
- Safe wavelength of **755nm**
 - **Non-toxic** for patient and physician
 - $10\text{mW}/\text{cm}^2$
- **No limitations in corneal thickness**
- Deep penetration
 - Scleral stiffening for myopia

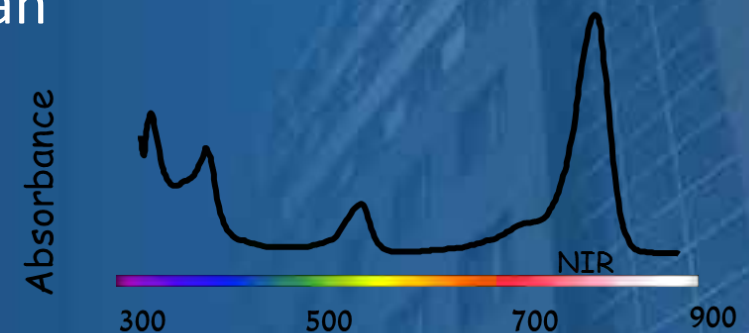


Fig. 2 Absorbance spectrum of WST11

Introduction

Near Infrared Light

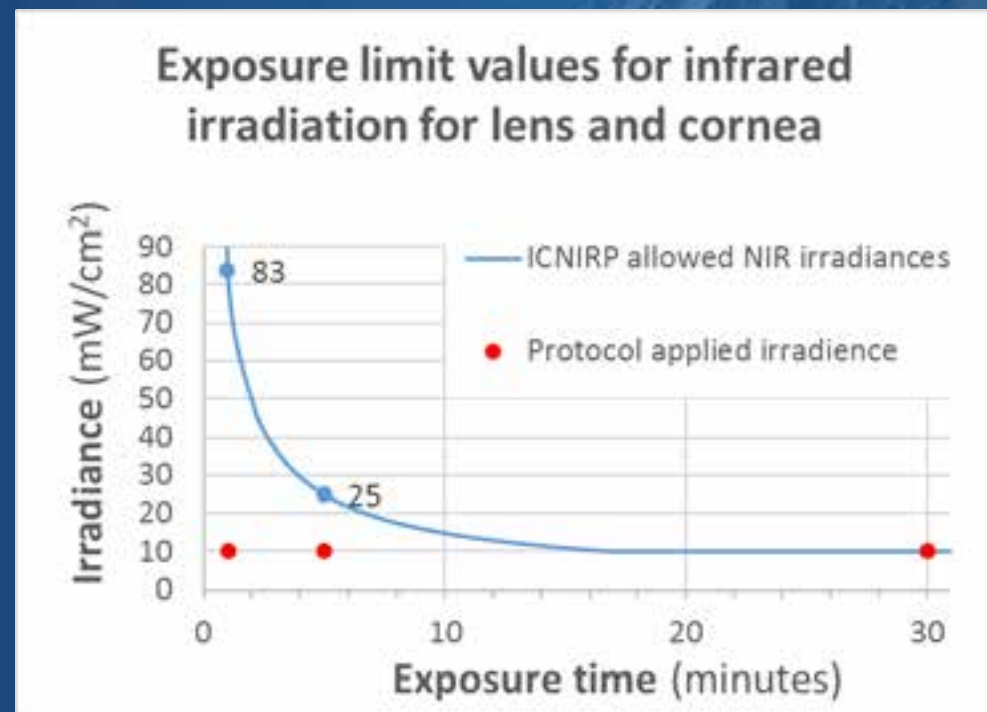
Current study protocol:

- 20 minutes WST-D impregnation
- **30 minutes** NIR irradiation at 10 mw/cm²

Irradiation dose: 18 J/cm²

Fig. 3 Norm irradiance values for thermal lesions for cornea and lens.

International Commission on Non-Ionizing Radiation Protection. Health Phys 1997;73



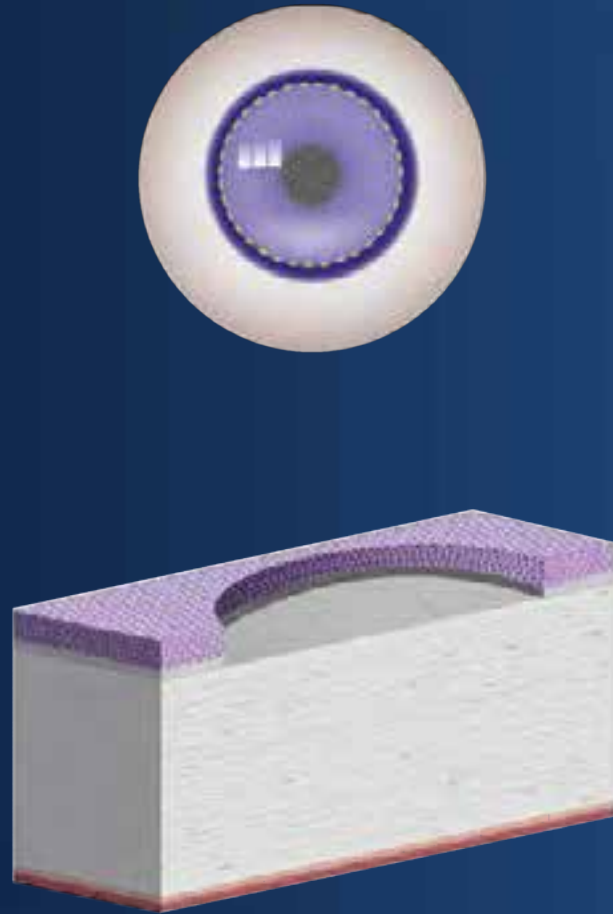
Methods

Treatment

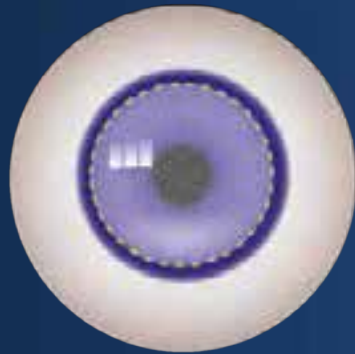
- In vivo, New Zealand White (NZW) rabbits
- Treated at **age of 3 months**
- 4 groups, sacrificed:
 - **1 week** after treatment (immature, n = 4)
 - **1 month** after treatment (immature, n = 6)
 - **4 months** after treatment (mature, n = 9)
 - **8 months** after treatment (mature, n = 4)
- Contralateral eye served as control

Methods Treatment

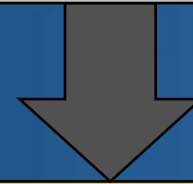
Full mechanical de-epithelialization



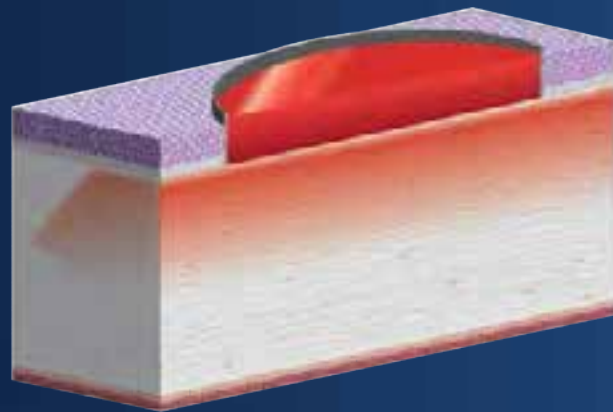
Methods Treatment



Full mechanical de-epithelialization

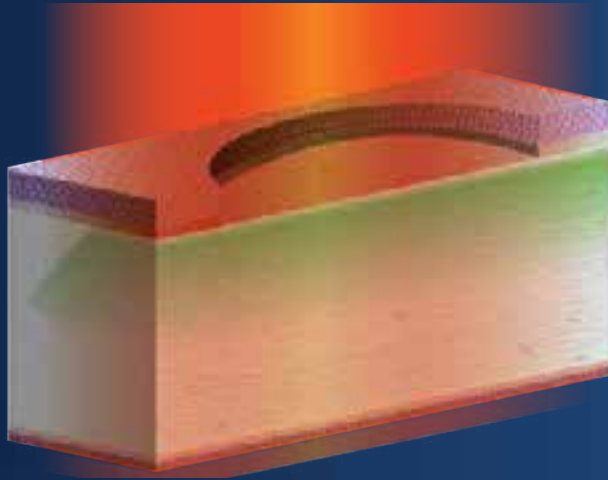
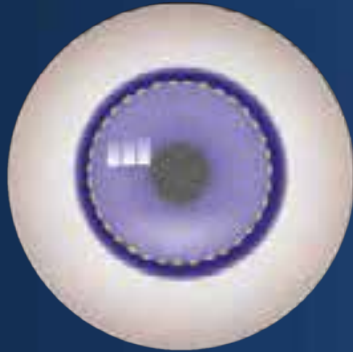


20 minutes WST-D impregnation



Methods

Treatment



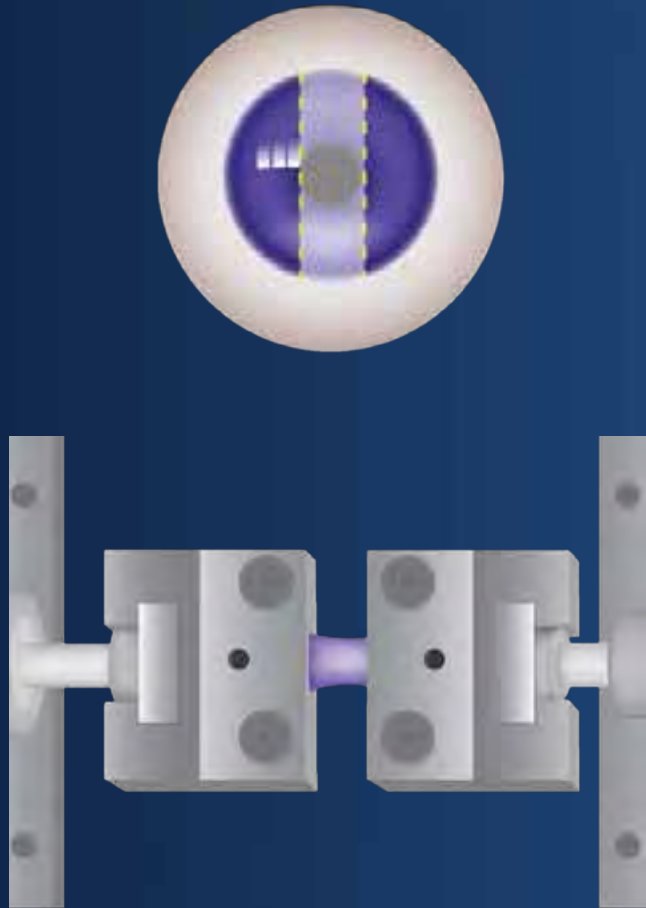
Full mechanical de-epithelialization

20 minutes WST-D impregnation

30 minutes NIR irradiation

Methods

Treatment



Full mechanical de-epithelialization

20 minutes WST-D impregnation

30 minutes NIR irradiation

1 week

1 month

4 months

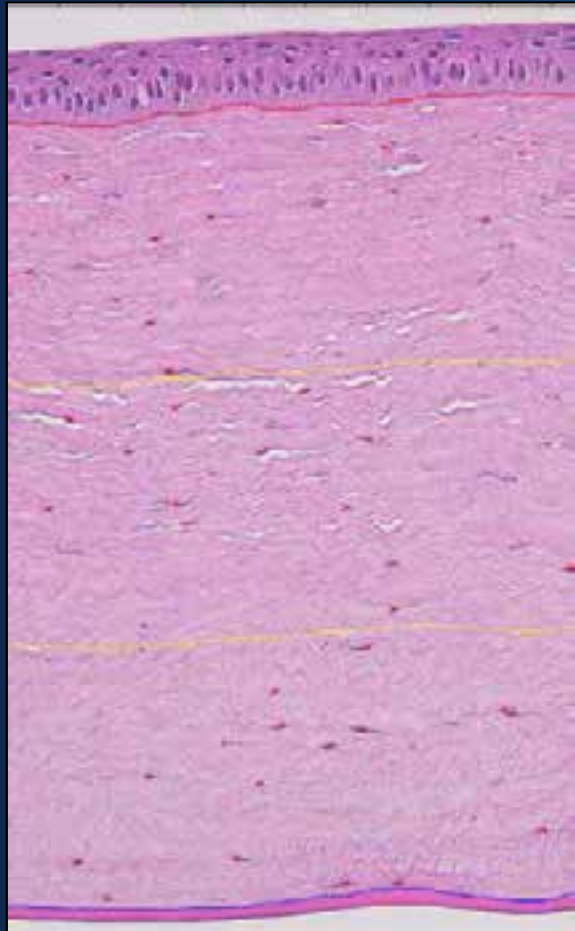
8 months

Histology

Strip extensiometry

Methods

Treatment



Full mechanical de-epithelialization

20 minutes WST-D impregnation

30 minutes NIR irradiation

1 week

1 month

4 months

8 months

Histology

Strip extensiometry

Results

Pachymetry

Follow-up	Timepoint	n	Control	Treated	P-value
1 Week	Pre-treatment	4	401.3 ± 16.0	399.5 ± 16.3	0.275
1 Month	Pre-treatment	6	387.2 ± 31.4	395.5 ± 39.1	0.436
	Pre-extendedometry	6	378.8 ± 23.2	398.1 ± 41.2	0.380
4 Months	Pre-treatment	9	411.7 ± 22.3	411.9 ± 23.4	0.842
	Pre-extendedometry	9	426.1 ± 21.1	422.8 ± 28.6	0.645
8 Months	Pre-treatment	4	355.5 ± 5.4	363.8 ± 7.8	0.133
	Pre-extendedometry	4	399.8 ± 20.4	422.1 ± 24.2	0.087

Table 1. Corneal pachymetry ± SD (in μm).

Results

Biomechanical Results

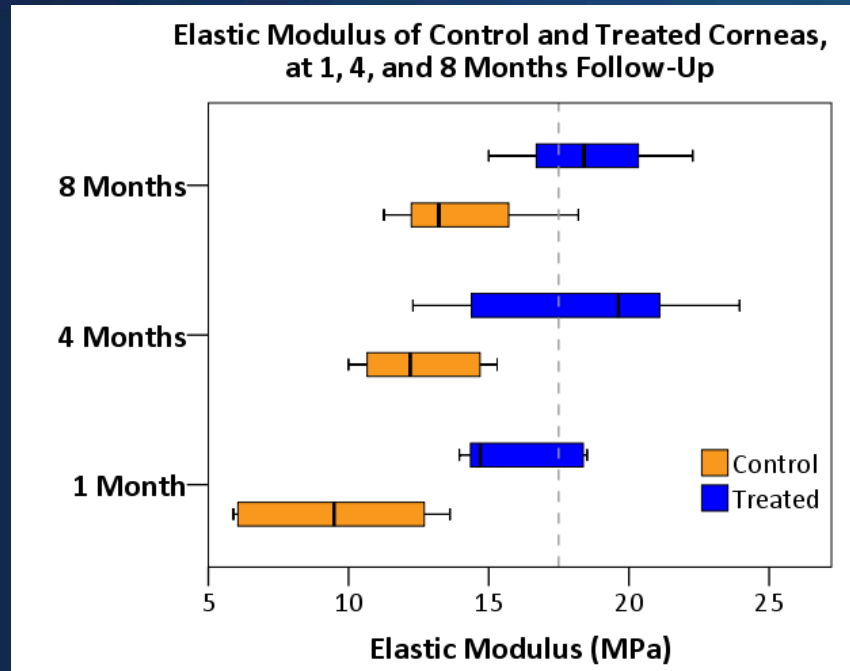


Fig 2. Boxplot of elastic modulus per protocol and follow-up. Dashed line indicates overall mean after treatment.

Follow-up	n	Control	Treated	P-value
1 Month	5	9.6 ± 3.6	16.0 ± 2.3	0.008
4 Months	7	12.6 ± 2.3	18.1 ± 4.5	0.003
8 Months	3	14.2 ± 3.6	18.6 ± 3.6	0.010

Table 2. Mean elastic modulus ± SD (in MPa).

Results

Keratocyte Count

1 Week:

Region	n	Control	Treated	P-value
Anterior	4x5	19.0 ± 4.1	1.5 ± 1.7	0.002
Middle	4x5	12.8 ± 1.6	12.1 ± 2.0	0.640
Posterior	4x5	12.9 ± 0.9	14.4 ± 3.2	0.463

8 Months:

Region	n	Control	Treated	P-value
Anterior	3x5	14.5 ± 2.5	15.9 ± 1.1	0.562
Middle	3x5	11.2 ± 1.8	12.1 ± 4.1	0.810
Posterior	3x5	11.2 ± 0.9	12.4 ± 1.5	0.355

Conclusion

- **Long term stiffening**, from young age until after maturation.
- **Repopulation** of keratocytes has occurred after 8 months
- Alternative for **thin corneas**

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Thank You for Your Attention

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CXL Experts' Meeting – Zurich, December 3rd 2016

