



SERVIZIO SANITARIO REGIONALE  
AZIENDA OSPEDALIERA  
SAN GIOVANNI ADDOLORATA



 **SIBO**  
Società Italiana Banche degli Occhi

# XVIII

# CORSO NAZIONALE SIBO

## Novità sulla conservazione delle cornee

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Dr. med. Valentin Jünger  
Dott. Andrea Margarella

 **SIBO**  
Società Italiana Banche degli Occhi



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## Comparative Performance Analysis of Corneal Characteristics During Extended Hypothermic Storage in XTRA4 and Optisol-GS

Mark S Ellison<sup>1</sup>, Megan M W Straiko<sup>1</sup>, Eugenio Ragazzi<sup>2</sup>, Declan Z Chamberlain<sup>1</sup>, Khoa D Tran<sup>1</sup>

33 paired donor corneas stored at 2 to 8°C for up to 28d

- XTRA4 or
- Optisol-GS

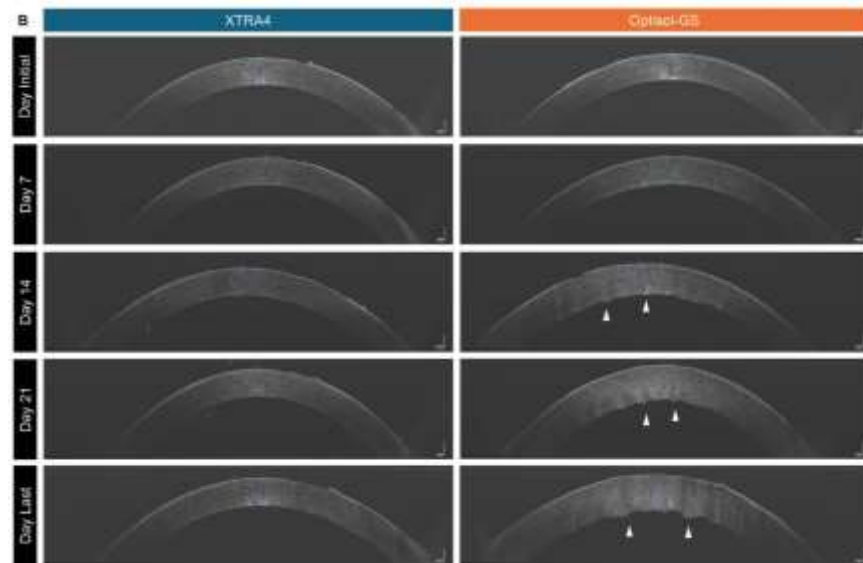
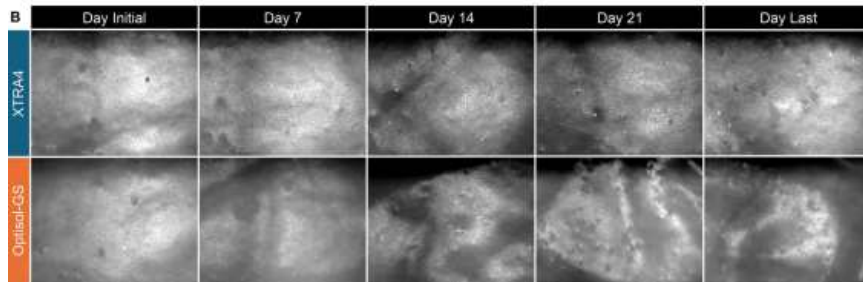
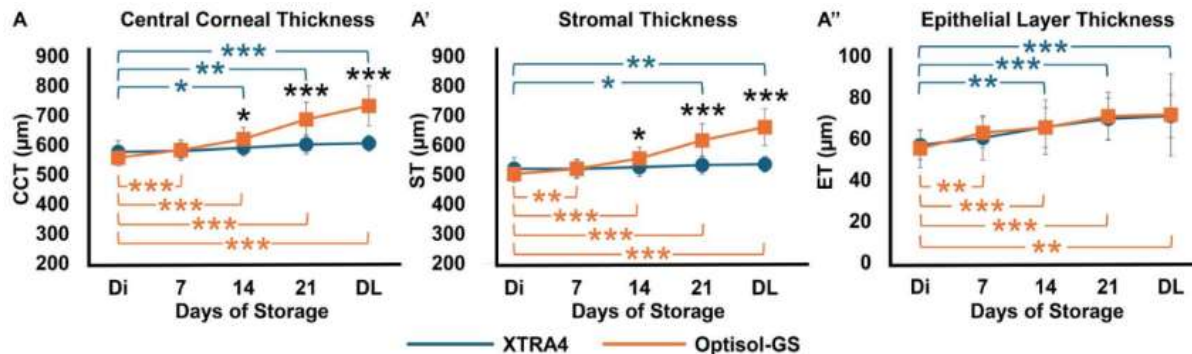
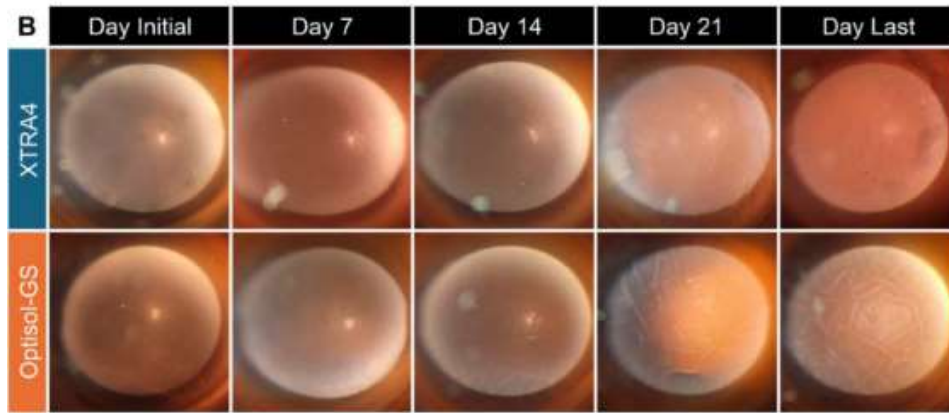
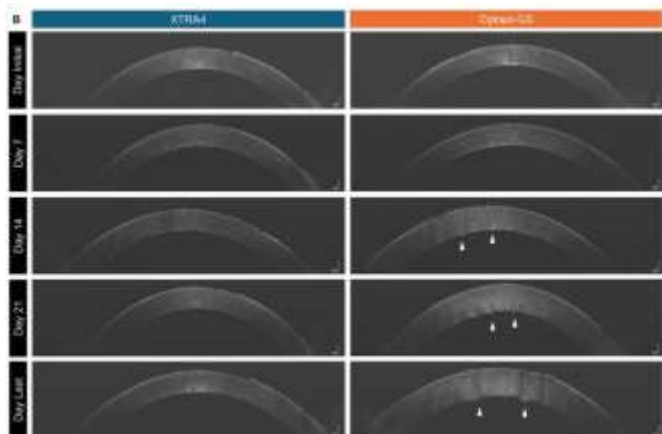


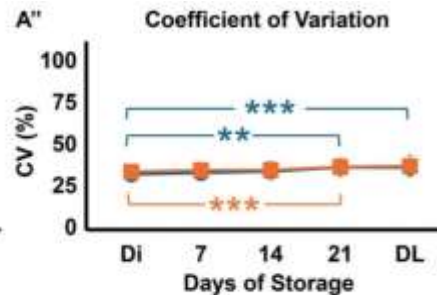
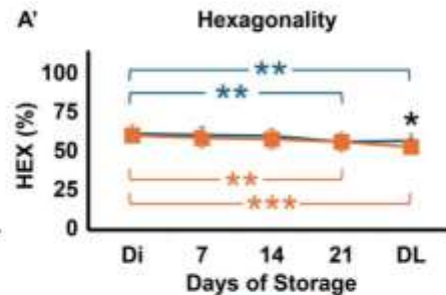
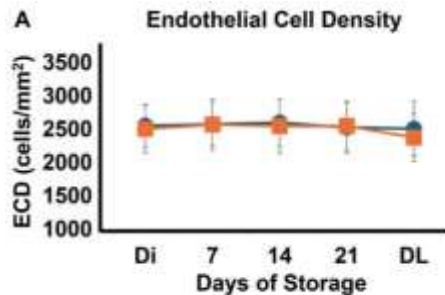
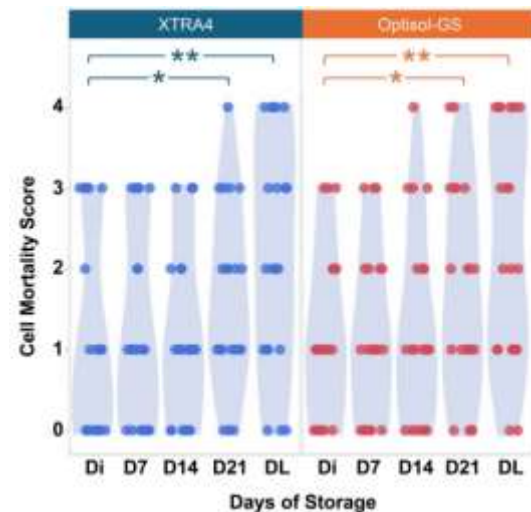
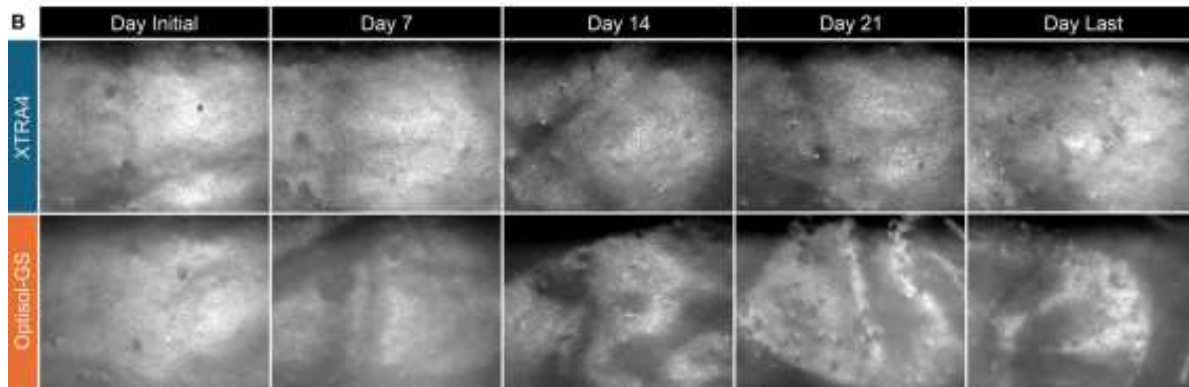
TABLE 1. Comparison of Storage Solution Components

Component	XTRA4	Optisol-GS
Base medium	Minimum essential medium (MEM)	TC-199 and MEM
Additional ATP precursor	Sodium pyruvate	Not specified (sodium pyruvate is contained in TC-199 formulation)
pH Buffer	Sodium bicarbonate + HEPES Specifications: 7.2–7.6 pH units	Sodium bicarbonate + HEPES Specifications: 7.0–7.5 pH units
Antibiotics	100-µg/mL gentamicin sulfate 200-µg/mL streptomycin sulfate	100-µg/mL gentamicin sulfate 200-µg/mL streptomycin sulfate
Deswelling agent	Animal derivative-free hydrophilic biocompatible polymers (proprietary formulation)	Dextran + chondroitin sulfate

# Central Stromal Thickness



# Endothelium – ECD, Morphology, Mortality



— XTRA4 — Optisol-GS

# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

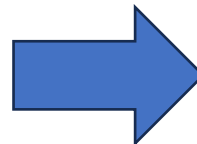
Eye Bank

> Cornea. 2025; Oct 2; doi: 10.1097/FCO.00000000000004001. Online ahead of print.

**Comparative Performance Analysis of Corneal Characteristics During Extended Hypothermic Storage in XTRA4 and Optisol-GS**

Mark S. Elliott<sup>1</sup>, Major M.W. Straker<sup>2</sup>, Jaganek Rajasek<sup>3</sup>, Gordon Z. Charneyville<sup>4</sup>, Alisa D. Sun<sup>5</sup>

**Conclusion:** XTRA4 preserves the corneal endothelium similarly to Optisol-GS for up to 14 days while maintaining consistently thinner corneas for up to 28 days.



Clinic

Clinical results after endothelial keratoplasty (DMEK/DSAEK)?

**Primary Endpoint:** Non-Inferiority XTRA4 vs. EUSOL-C

Relative reduction of recipient CCT (rrCCT) at 1 month post-transplant

$$\text{rrCCT} = \frac{(\text{CCT pre-transplant}) - (\text{CCT at 1 month})}{(\text{CCT pre-transplant})}$$

# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

### Eye Bank

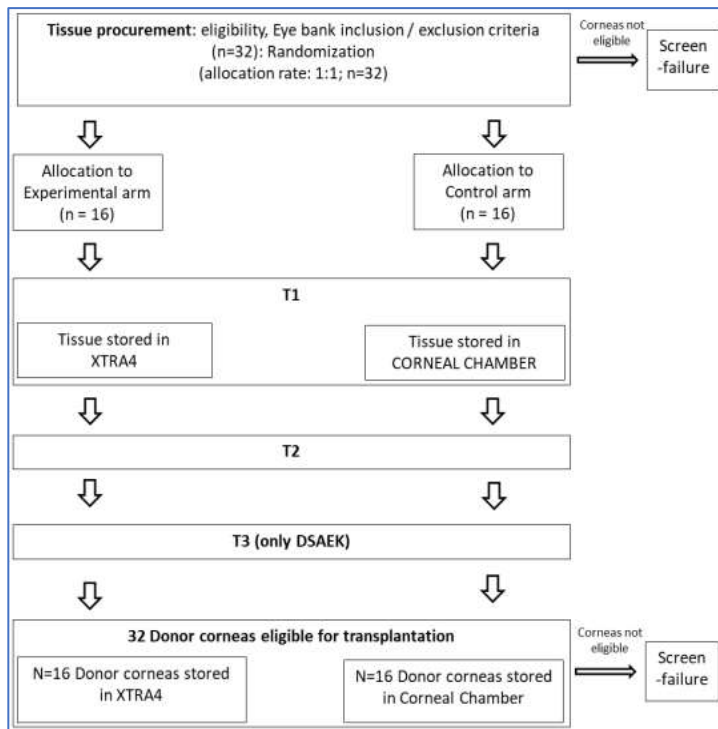


Table 1- Examination of donor tissue for both experimental and control groups

EXAMINATION OF DONOR TISSUE	T0	T1	T2	T3
Tissue procurement and randomization: storage in XTRA4 / Corneal Chamber	X			
Light microscopy		X	X	
Endothelial Cell Evaluation (ECD/ EC mortality)		X	X	
CCT/GT*		X	X	X (GT DSAEK only)
Microbiology analysis**		X		X

\*GT: Graft Thickness

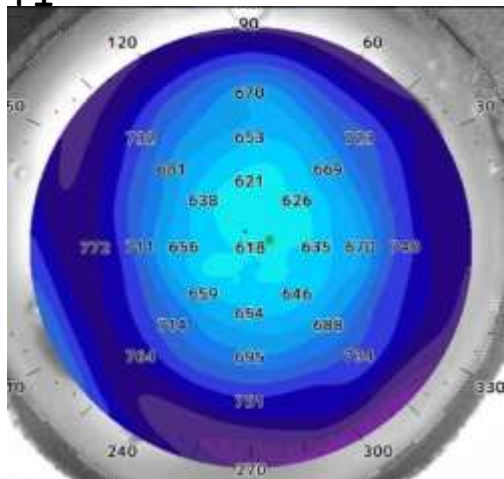
\*\*data available before transplantation

# XTRA4 at the Rome Eye Bank

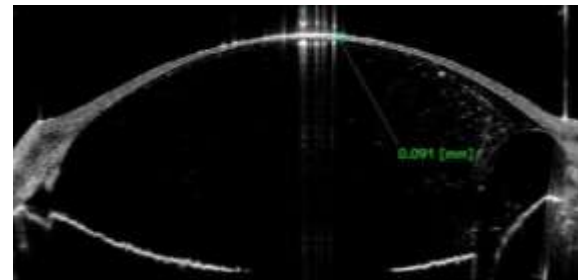
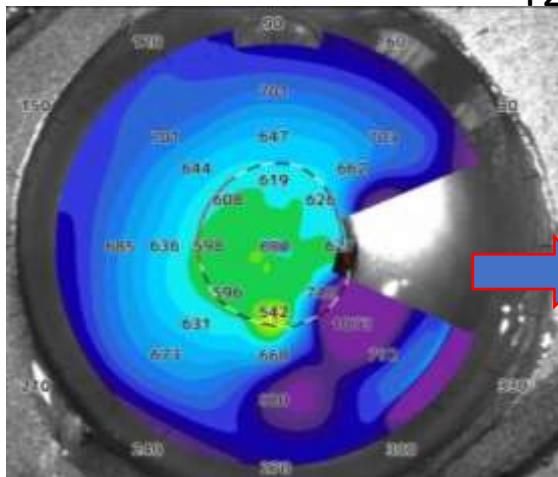
## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

Eye Bank Donor-CCT

T1



T2

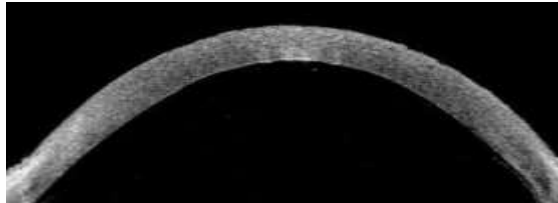
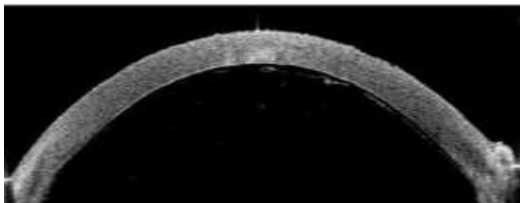


Example Tissue in XTRA4

T1: CCT 618

T2: CCT 600 (7 days)

T3: GT 91

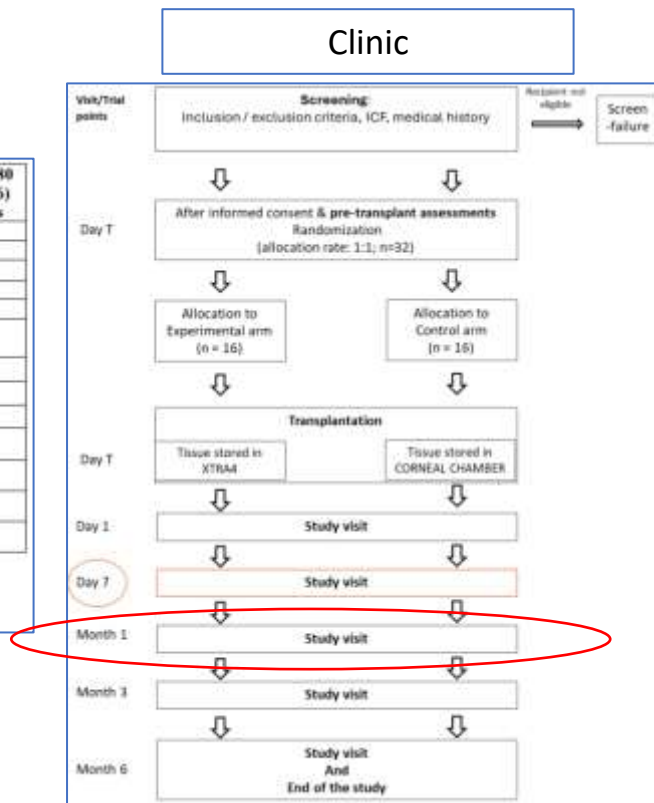


# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

	T 0	Day T Enrollment	Day T Intra- operative	Day T+1	Day T+7	Day T+30 (Month 1) ± 5 days	Day T+90 (Month 3) ± 5 days	Day T+180 (Month 6) ± 5 days
Informed consent		X						
Inclusion and exclusion criteria verification		X						
Randomization	X	X						
Donor and recipient demographics <sup>a</sup>		X						
Medical history <sup>b</sup>		X						
Evaluation of the corneal tissue (appearance / consistency / handling)		X						
Rebubbling				X	X	X		
Graft detachment				X	X	X		
Primary Donor Graft Failure						X		
CCT (AS-OCT)		X		X	X	X	X	X
ECD						X	X	X
Visual acuity (BCVA)		X				X	X	X
Recording of AE/ADE/SAE		X	X	X	X	X	X	X

> T0: Tissue procurement  
 > Day T: Transplantation Day  
 > a. Demographic data: age, sex  
 > b. Medical history: Relevant conditions for corneal transplantation



# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

### Eye Bank CCT

Means	Eusol-C	XTRA4	P-value
Tissues	15	9	
Post-mortem to T1 interval, d	-0.2 (9.8)	3.3 (1.2)	0,23
T1 to T2 interval, d	8.4 (9)	6.4 (3.3)	0,5
Donation to surgery interval, d	9.9 (2.9)	10.4 (3.8)	0,7
CCT T1, $\mu\text{m}$	599	597	0,89
CCT T2, $\mu\text{m}$	608	566	<0.01
Relative CCT reduction T2, %	-1,6 <span style="color:red">↑</span>	5 <span style="color:red">↓</span>	<0.01
ECD T1, cells/mm <sup>2</sup>	2553	2633	0.031
ECD T2, cells/mm <sup>2</sup>	2487	2589	<0.01
Relative ECD loss T2, %	2,6	1,6	0,39
EC mortality T1, %	0,1	0,1	0,53
EC mortality T2, %	0,2	0,3	0,56
EC mortality increase T1-T2, %	0,1	0,1	0,98

### Clinic CCT

Means	Eusol-C	XTRA4	P-value
N patients (DSAEK / DMEK)	8 / 7	3 / 6	
CCT pre-transplant, $\mu\text{m}$	703	731	0,48
CCT W1, $\mu\text{m}$	635 <span style="color:red">↓</span>	686 <span style="color:red">↓</span>	0,52
CCT W4, $\mu\text{m}$	535 <span style="color:red">↓</span>	563 <span style="color:red">↓</span>	0,39
CCT W24, $\mu\text{m}$	510	534	0,31
Relative CCT reduction W1, %	7,9	6,2	0,87
Relative CCT reduction W4, %	22,4	22,1	0,96
Relative CCT reduction W24, %	29,8	29,2	0,92
Graft thickness pre, $\mu\text{m}$	100,4	99,7	0,94
Graft thickness W4, $\mu\text{m}$	87,1	68,3	0,36
Graft thickness W24, $\mu\text{m}$	75,5	79	0,79
ECD W24, cells/mm <sup>2</sup>	1264	1114	0,75

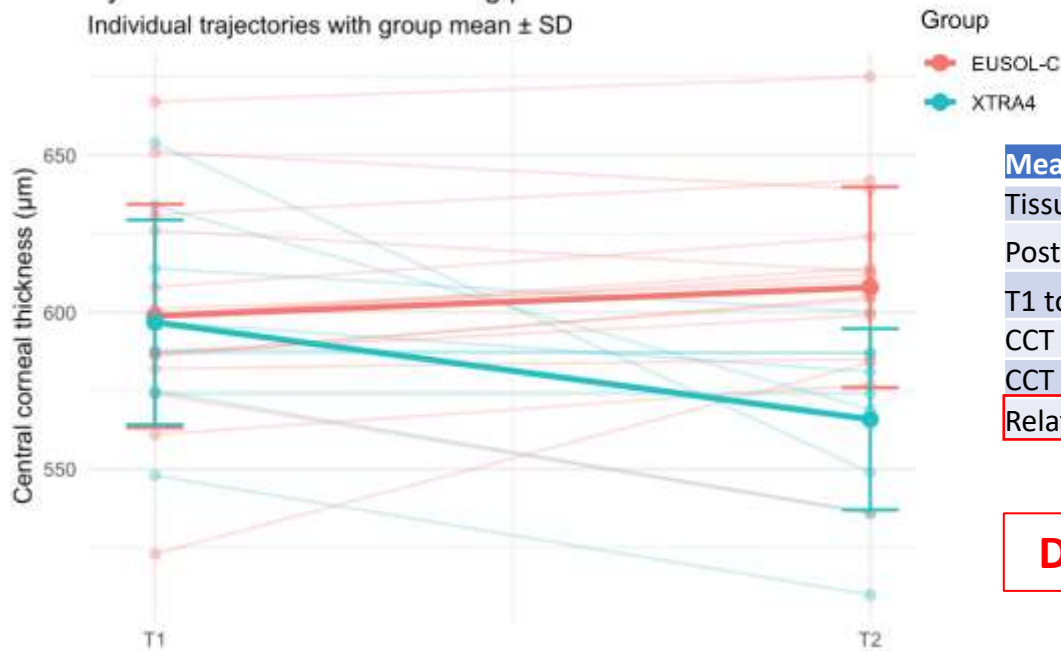
# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

Eye Bank Donor-CCT

### Eye-bank CCT evolution during preservation

Individual trajectories with group mean  $\pm$  SD



## Donor CCT during tissue preservation

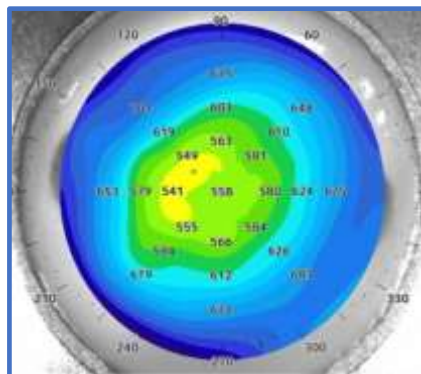
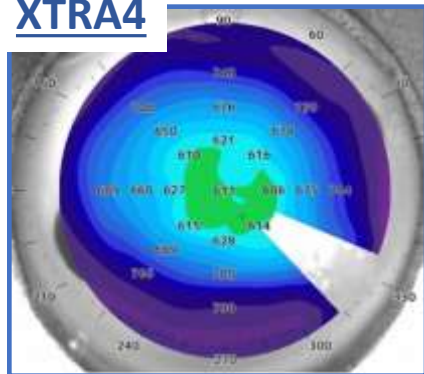
Means	Eusol-C	XTRA4	P-value
Tissues	15	9	
Post-mortem to T1 interval, d	-0.2 (9.8)	3.3 (1.2)	0,23
T1 to T2 interval, d	8.4 (9)	6.4 (3.3)	0,5
CCT T1, µm	599	597	0,89
CCT T2, µm	608	566	<0.01
Relative CCT reduction T2, %	-1,6 ↑	5 ↓	<0.01

Deswelling vs. Swelling during storage

# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

### XTRA4



### Eye Bank Donor-CCT

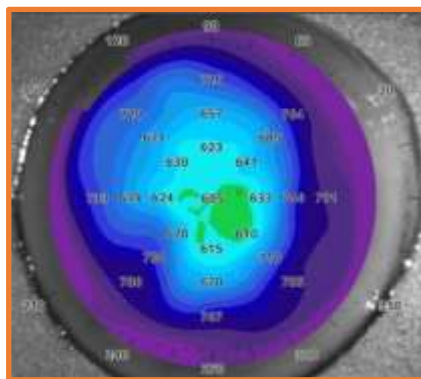
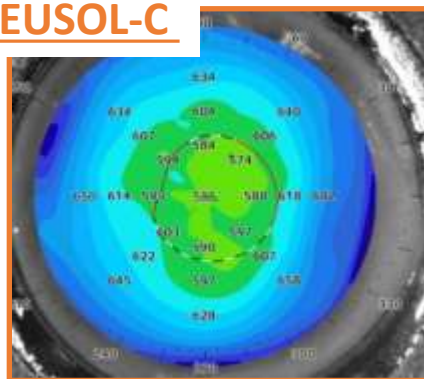
#### Example Tissue in XTRA4

T1: CCT 611  
 T2: CCT 558 (8 days)  
 CCT-Reduction 8,7%  
 -> Tissue used as DMEK

#### Example Tissue in EUSOL-C

T1: CCT 586  
 T2: CCT 605 (7 days)  
 CCT-Increase 3,2%  
 -> Tissue used as DMEK

### EUSOL-C

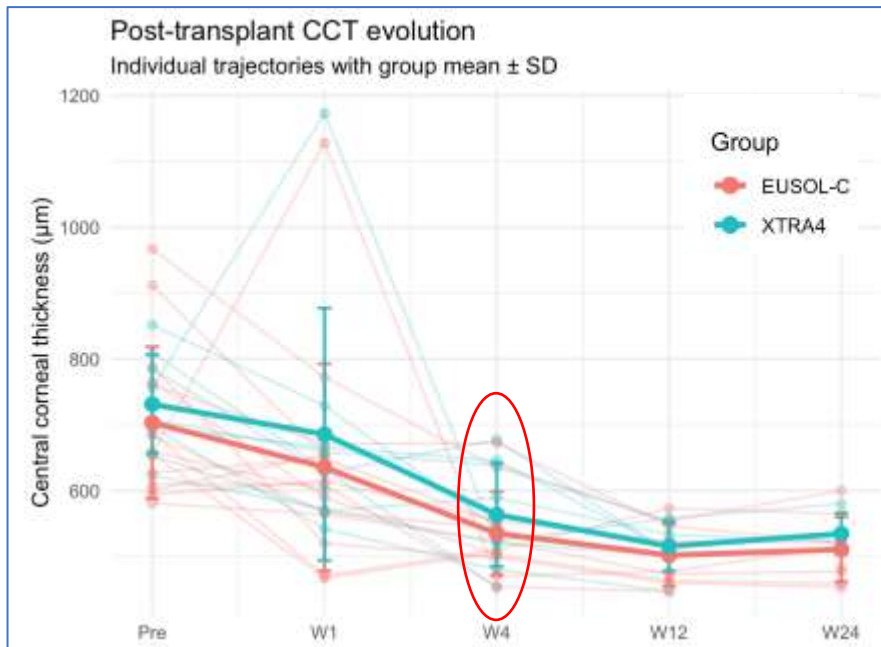


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Post-mortem to T1 interval, d	-0.2 (9.8)	3.3 (1.2)	0,23
T1 to T2 interval, d	8.4 (9)	6.4 (3.3)	0,5
CCT T1, μm	599	597	0,89
CCT T2, μm	608	566	<0.01
Relative CCT reduction T2, %	-1,6 ↑	5 ↓	<0.01

**Deswelling vs. Swelling during storage**

# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C



\* Rebubbling W1, W4, W12



Clinic Recipient-CCT

	Eusol-C	XTRA4	p-value
N (patients)	DSAEK 8 DMEK 7	DSAEK 3 DMEK 6	
CCT pre-transplant	703	731	0.48
CCT 7 days*	635	686	0.52
rrCCT 7 days (%)*	7.8 %	6.2 %	0.87
<b>rrCCT 1 month (%)</b>	<b>22.4 %</b>	<b>22.1 %</b>	<b>0.96</b>

**rrCCT at 1 month: No statistically significant difference**

# XTRA4 at the Rome Eye Bank

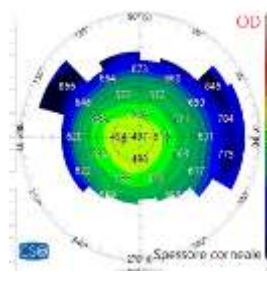
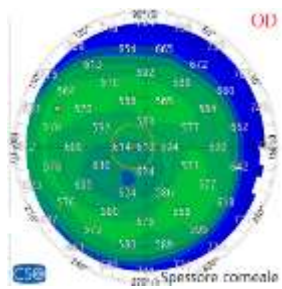
## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

### Eusol-C pre DSAEK GT:65µm

Before DSAEK



1 month after DSAEK

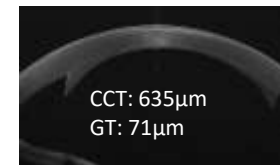
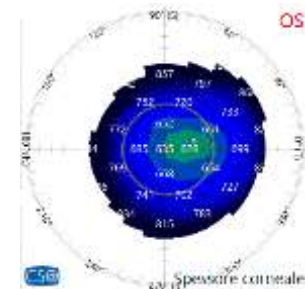
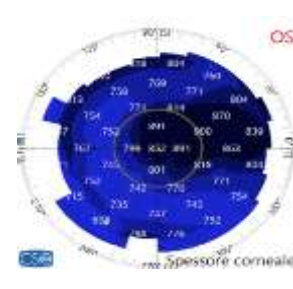
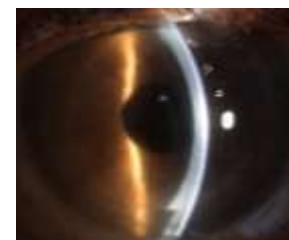


### XTRA4 pre DSAEK GT: 104µm

Before DSAEK

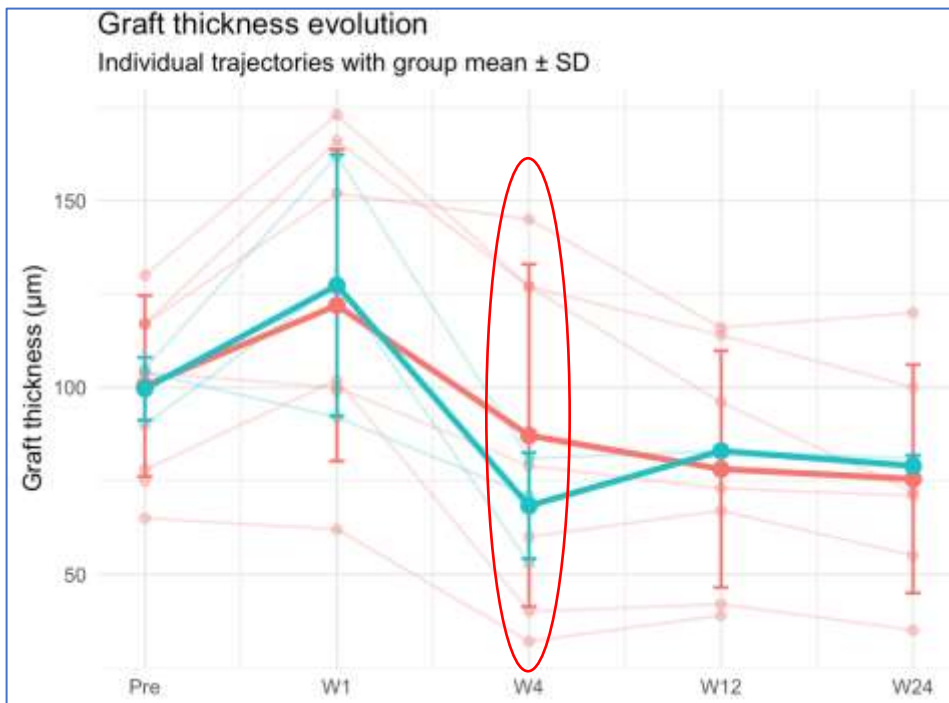


1 month after DSAEK



# XTRA4 at the Rome Eye Bank

## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C



Clinic GT

Means	Eusol-C	XTRA4	P-value
N patients (DSAEK)	8	3	
Graft thickness pre, µm	100,4	99,7	0,94
Graft thickness W4, µm	87,1	68,3	0,36
Graft thickness W24, µm	75,5	79	0,79

**DSAEK Graft Thickness at 1 month:  
No statistically significant  
difference**



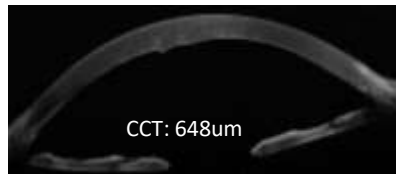
\* Rebubbling W1, W4, W12

# XTRA4 at the Rome Eye Bank

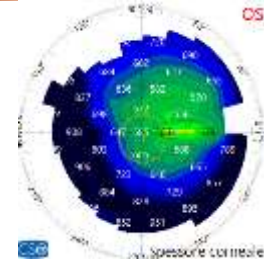
## Preliminary Results from a Non-Inferiority Study: XTRA4 vs. EUSOL-C

**EUSOL-C**

Before DMEK

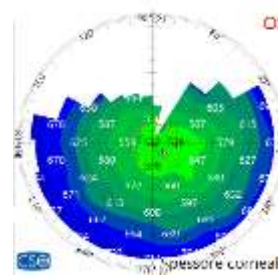


1 week after DMEK

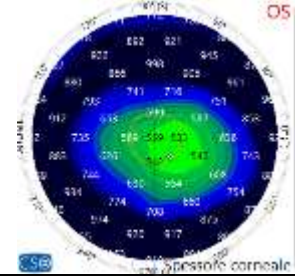


**XTRA4**

Before DMEK



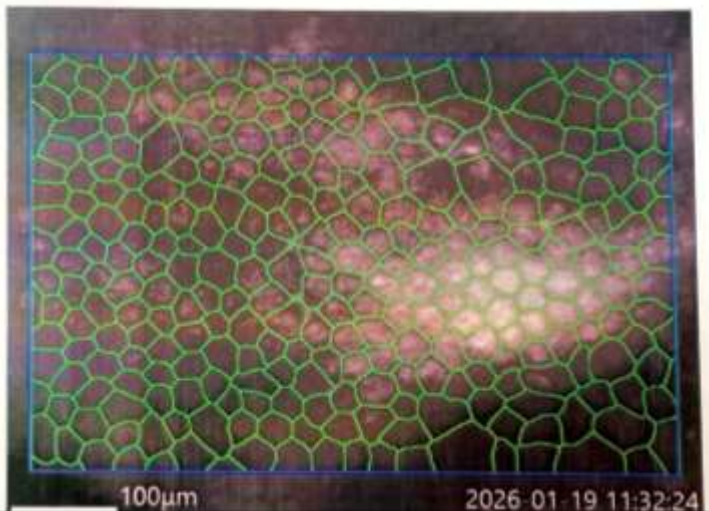
1 week after DMEK



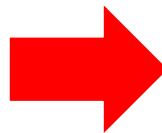
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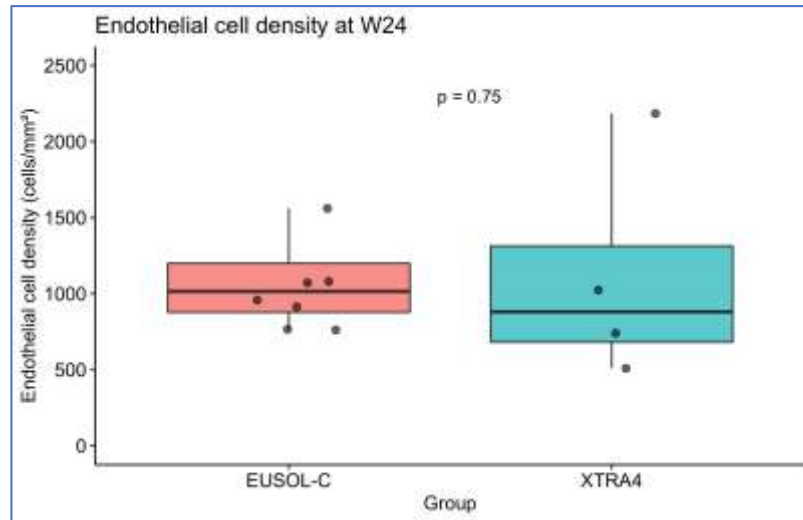
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N patients (DSAEK / DMEK)	8 / 7	3 / 6	
ECD W24, cells/mm <sup>2</sup>	1264	1114	0,75



6 months post DSAEK in XTRA4



Clinic ECD



ECD at 6 month  
No statistical significant difference

# Conclusions

- XTRA4 at the Roman Eye Bank – **Ongoing!**
- Preliminary results
  - **Eye Bank:** Confirmation of laboratory (eye bank) data
  - **Clinic:** Indicate non-inferiority of **XTRA4** compared to **EUSOL-C**
  - **Outlook:** Prolonged storage in **XTRA4** without tissue quality compromises?

Thank You!