

Non Invasive break-up time: automatic computerized versus manual assessment.

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Disclosure

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Associations and retail

ASSOTTICA (consulting relationships and speaker honoraria)

Grand Vision (consulting relationship)

Instruments

CSO (research support)

Nikon (consulting relationship)

Contact Lenses-Eye drops

Alcon (research support, consulting relationships and speaker honoraria)

Bausch & Lomb (consulting relationships and speaker honoraria)

Cooper Vision (consulting relationships and speaker honoraria)

Johnson & Johnson (consulting relationships and speaker honoraria)

Schalcon (consulting relationships)

Ophthalmic lenses

Essilor (speaker honoraria)

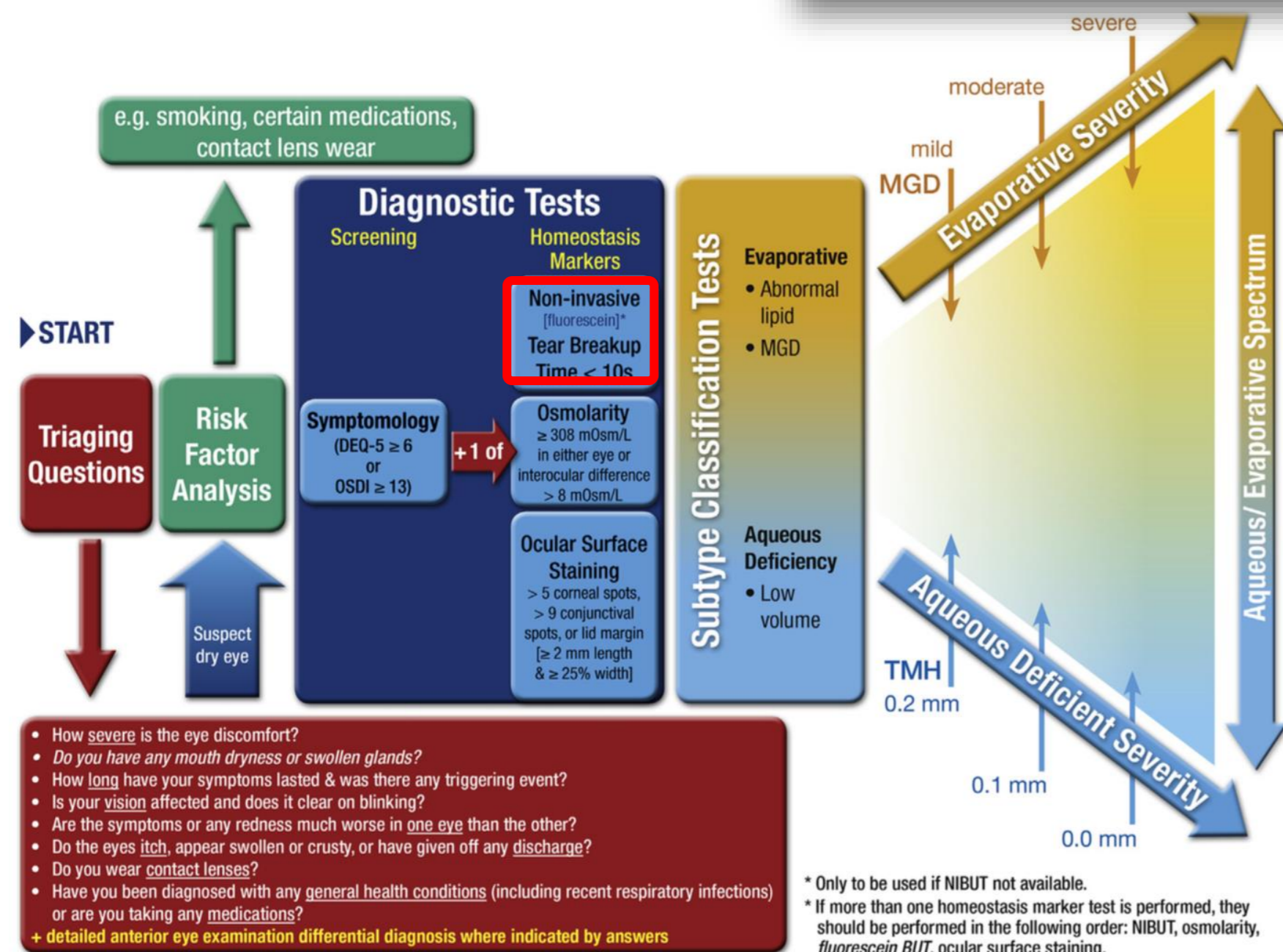
Hoya (research support, consulting relationship)

Tear Film instability



DEWS II proposal for a DED diagnostic test battery

J.S. Wolffsohn et al. / The Ocular Surface 15 (2017) 539–574



CLEAR - Evidence-based contact lens practice

James S. Wolffsohn^{a,*}, Kathy Dumbleton^b, Byki Huntjens^c, Himal Kandel^d, Shizuka Koh^e, Carolina M.E. Kunnen^f, Manbir Nagra^g, Heiko Pult^h, Anna L. Sulleyⁱ, Marta Vianya-Estopa^j, Karen Walsh^k, Stephanie Wong^k, Fiona Stapleton^l

3.2.1. Tear film

The tear film is an essential component in contact lens wearing comfort [139] and can impact contact lens drop out (section 7.3 and see CLEAR Maintenance Report and CLEAR Anatomy Report) [127,140]. Consequently, an appropriate examination of the tear film, the ocular surface and quantification of symptoms, is vital in contact lens fitting and aftercare [14,141]. The tear film should be observed in its natural appearance with non-invasive techniques [142], such as using cold light illumination (section 3.6.1). The pre-lens tear film can also be observed to assess the *in vivo* wettability which is affected by lens deposition [139] and by the lens material and surface characteristics (see CLEAR Maintenance Report) [140].

“Dry eye is a multifactorial disease of the ocular surface characterized by a loss of homeostasis of the tear film, and accompanied by ocular symptoms, in which **tear film instability** and hyper-osmolarity, ocular surface inflammation and damage, and neuro-sensory abnormalities play etiological roles.”

CraigJP,NicholsKK,NicholsJJ,CafferyB,DuaHS,AkpekEK,etal.TFOSDEWS II Definition and Classification Report. Ocul Surf 2017;15:276e83.

Tear film instability assessment: Breakup time

Experimental Eye Research 117 (2013) 28–38

Contents lists available at ScienceDirect

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Review

Tear film stability: A review

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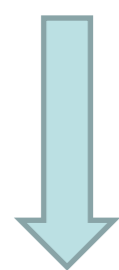
CrossMark

tear film stability is measured by its lack of stability

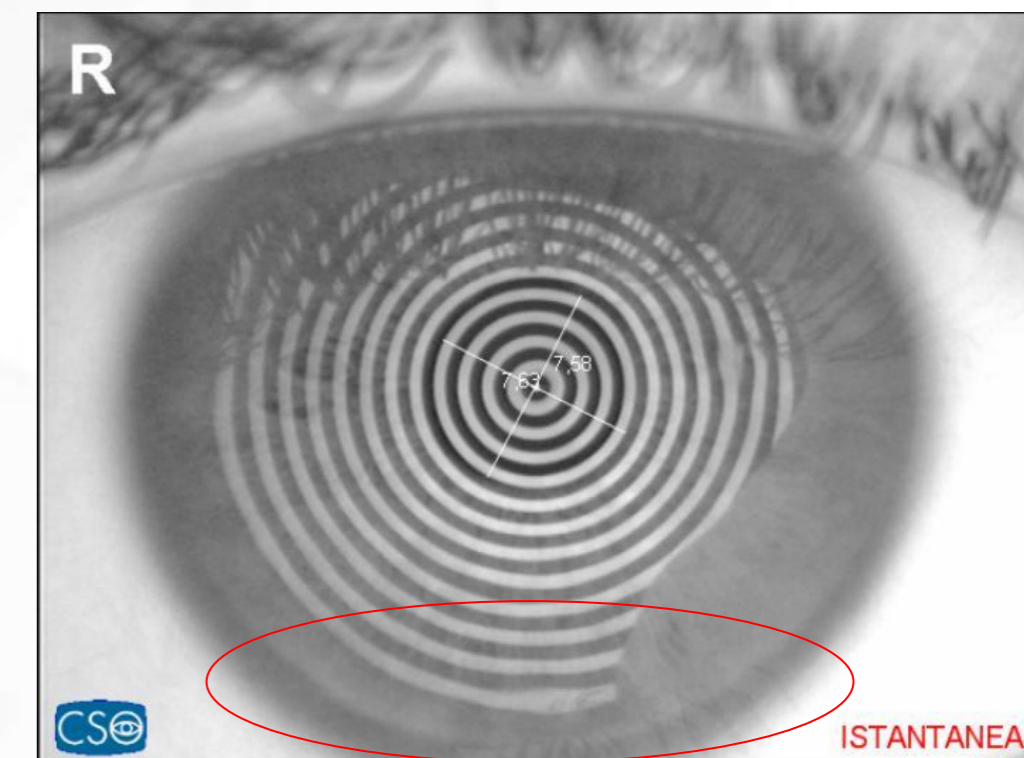
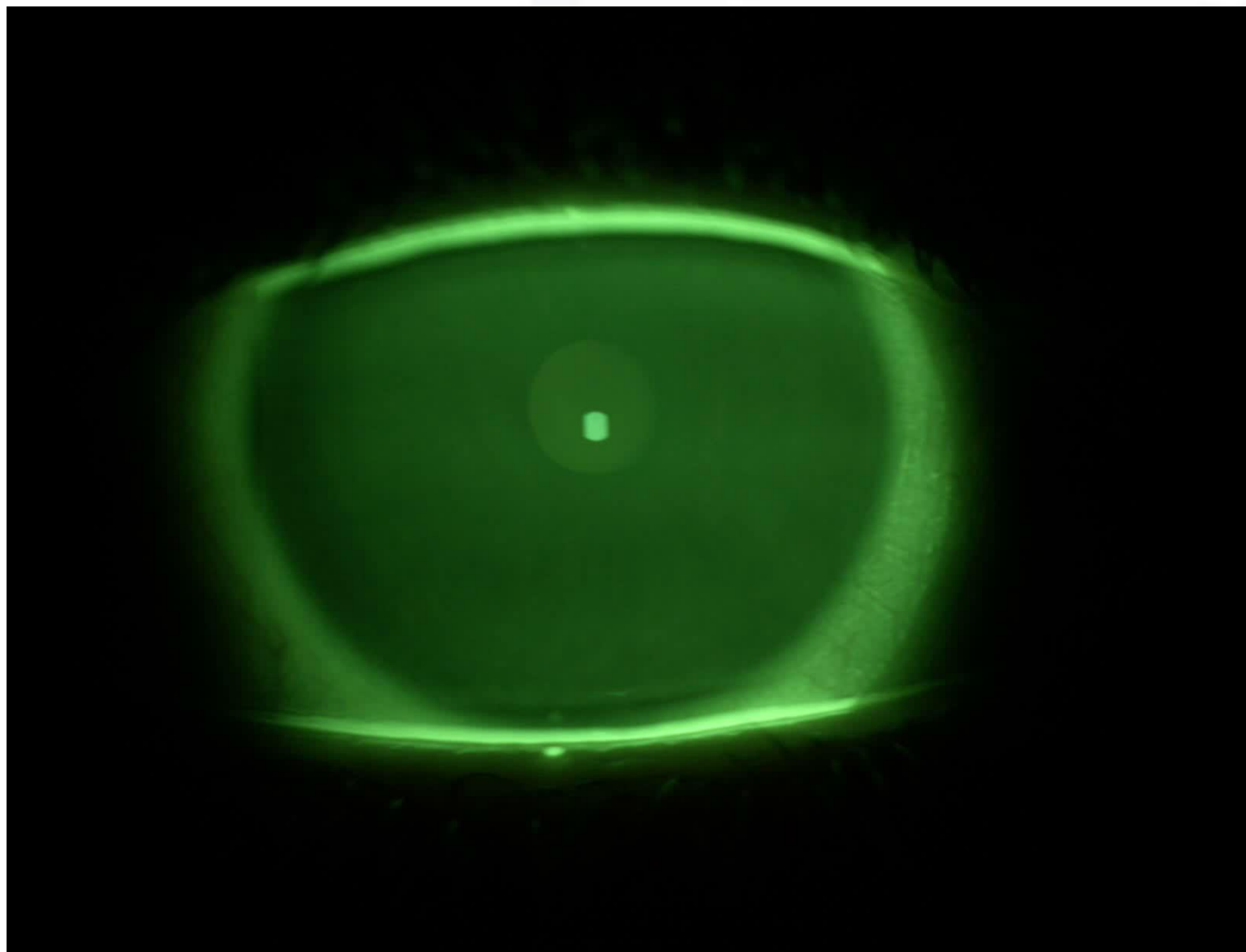
Fluorescein breakup time fBUT

(Norn, 1969)

the interval of time that elapses between a complete blink and the appearance of the first break in the tear film



The magic number 10



Non invasive breakup time NIBUT

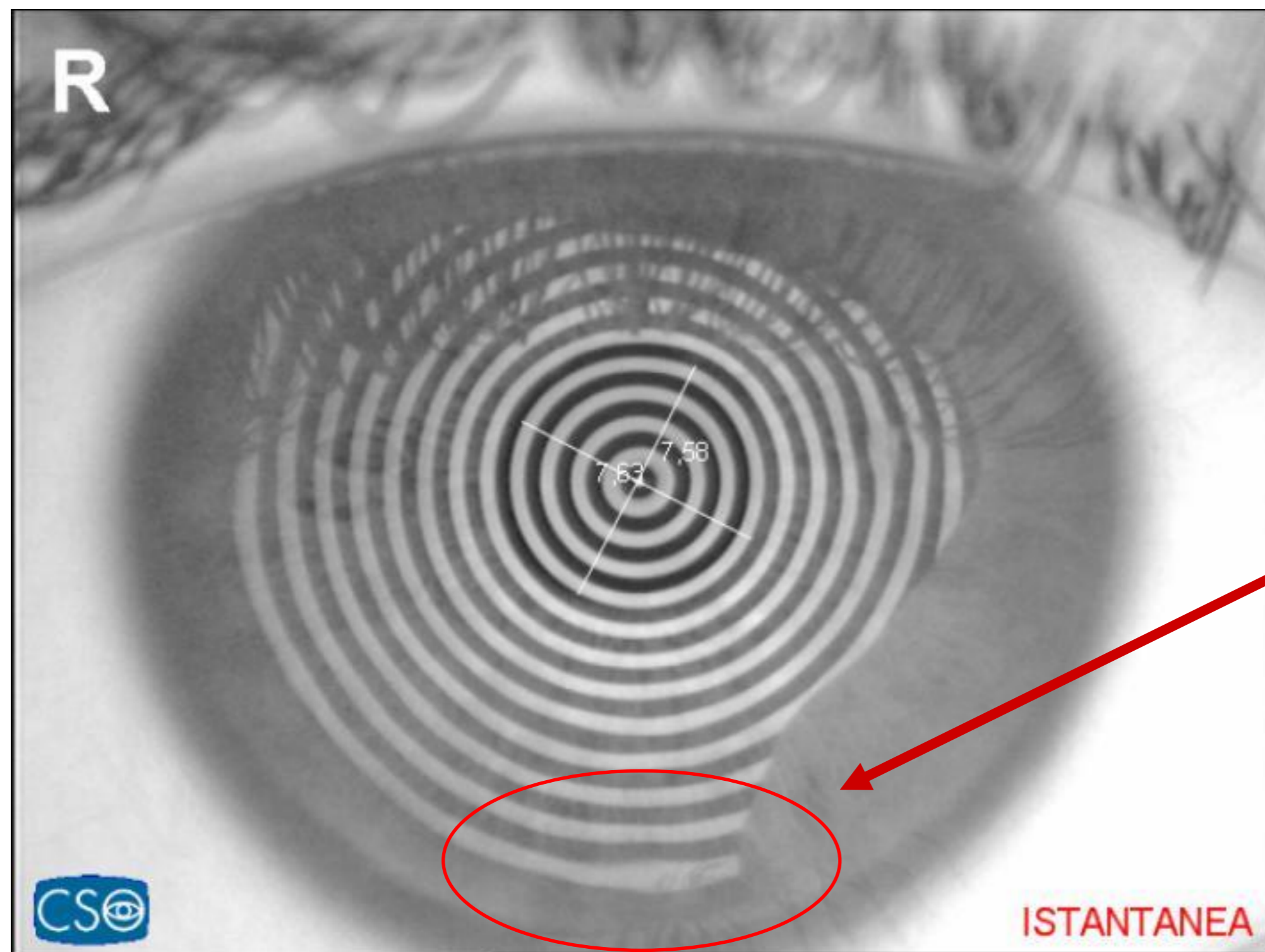
(Lamble et al, 1976; Holly 1981)

the interval of time that elapses between a complete blink and the appearance of a discontinuity or break in the image of a mire or a grid pattern (keratometer mire or Placido disc) reflected on the anterior tear film surface



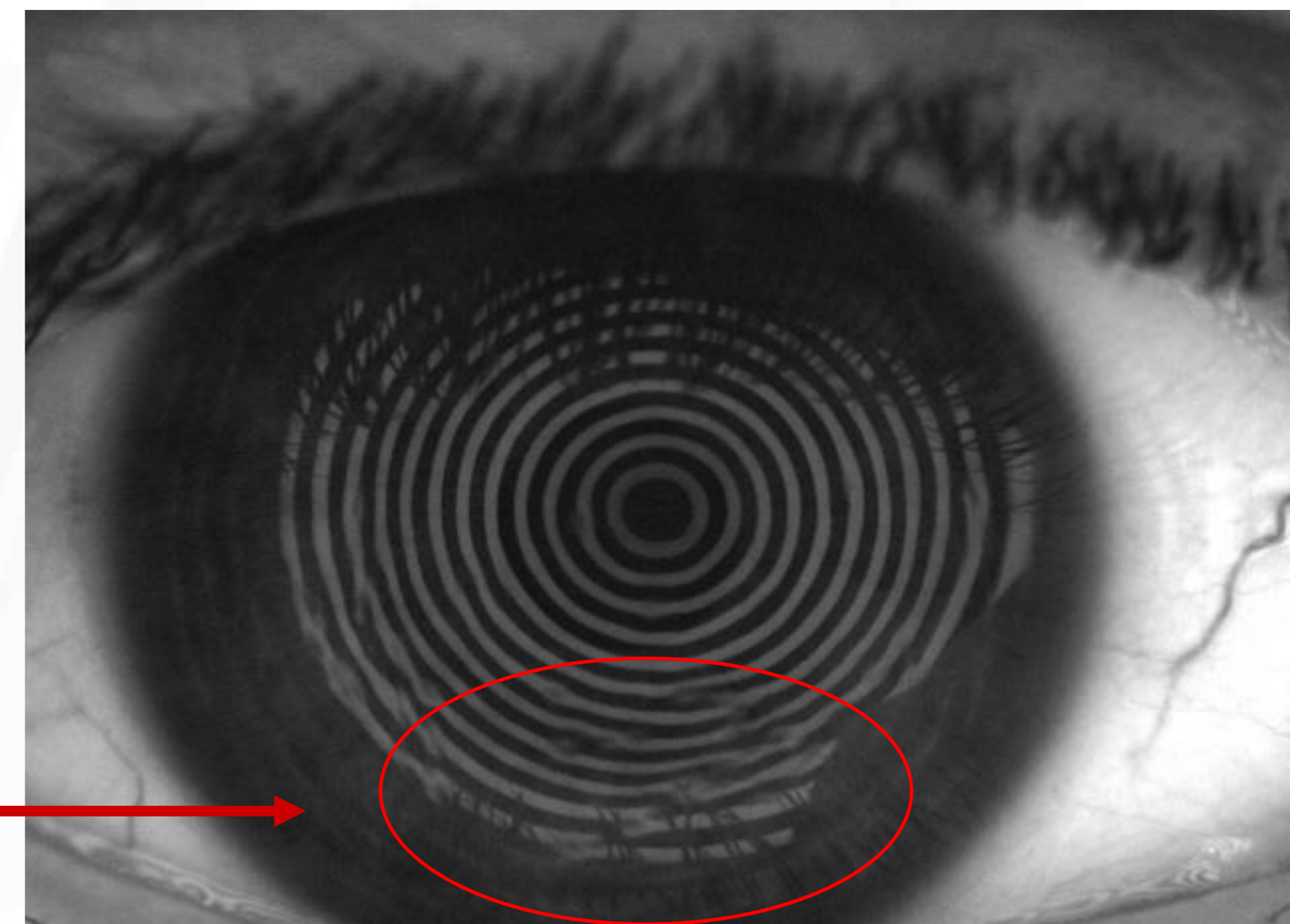
NIBUT > fBU'
20-45 s
(Guillon & Guillon,

NIBUT: how to detect a break-up?



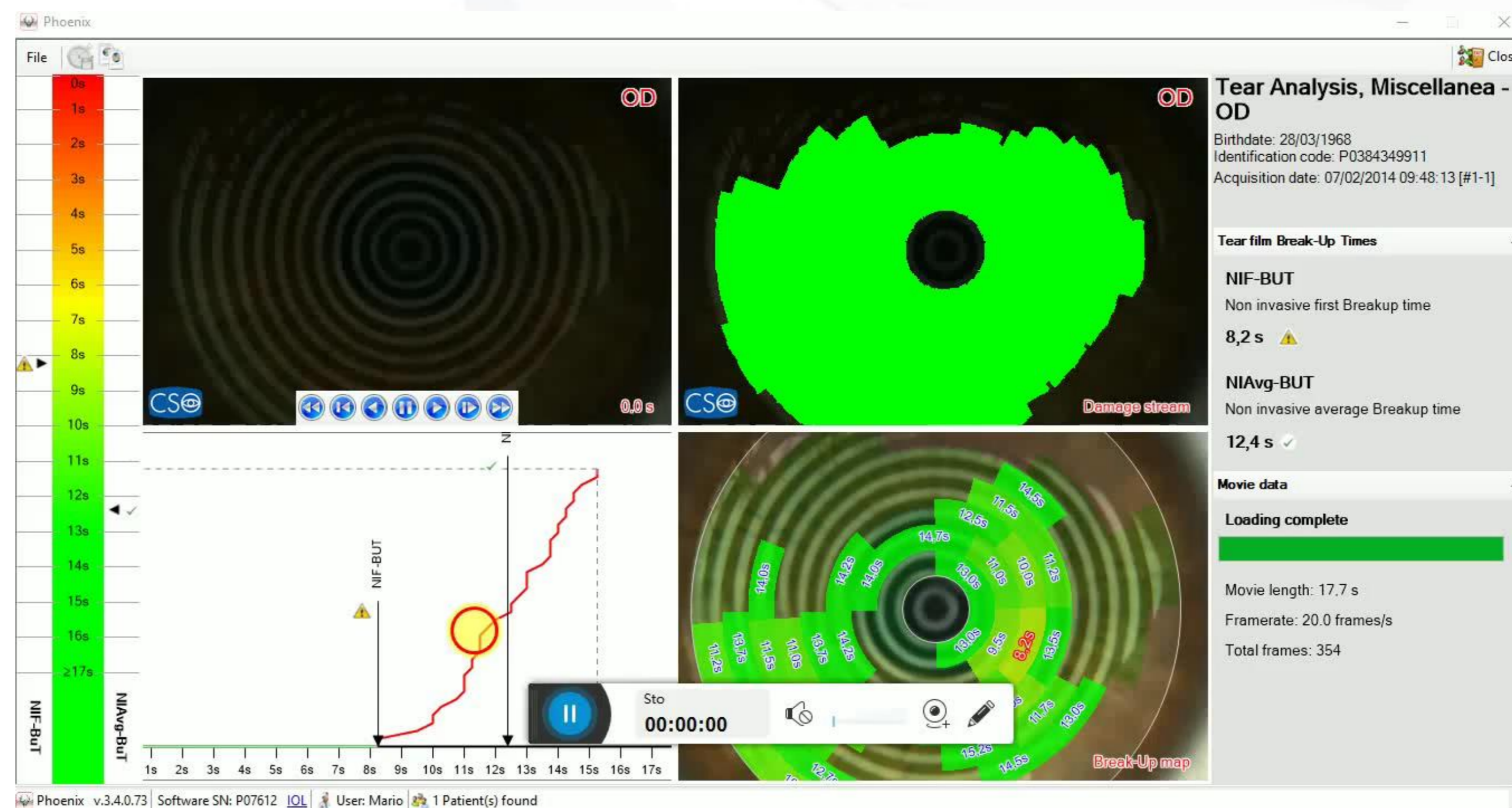
distortion of the grid patterns can be interpreted as a thinning of the film (tear thinning time; TTT i.e. pre NIBUT)

discontinuity or break in the image of the rings= break-up (NIBUT)

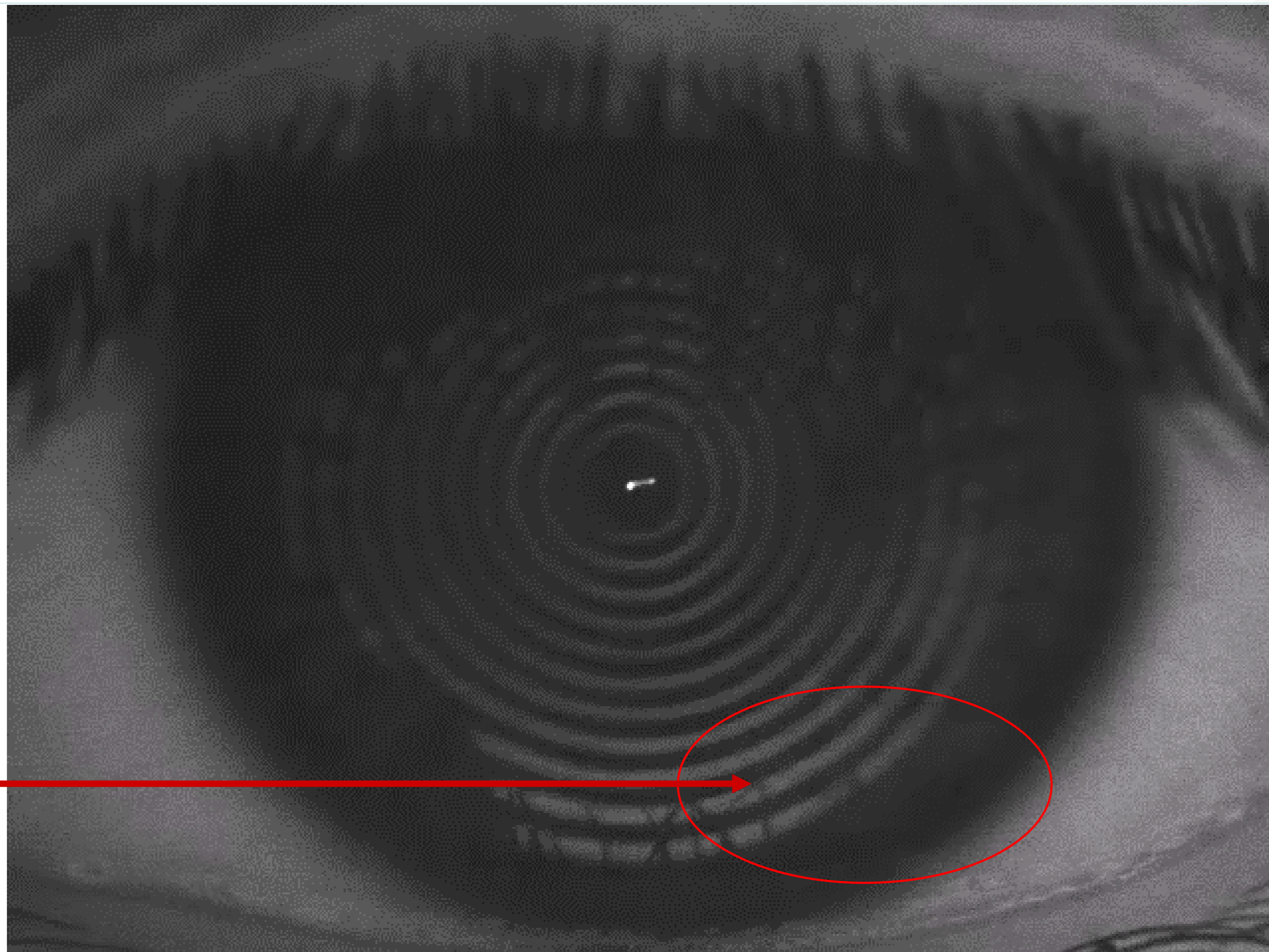


Automated NIBUT: how does it work?

- The image of the Placido disk reflected on the tear film cornea is divided in small areas of similar size (tiles).
- An automatic algorithm (examiner-free) identifies the first break-up (disruption of the projected ring) works on each of the different tiles. If at the end of the video the disruption in a tile is repristinated then every changed happened before is ignored.
- Break-up map: break-ups are displayed topographically.



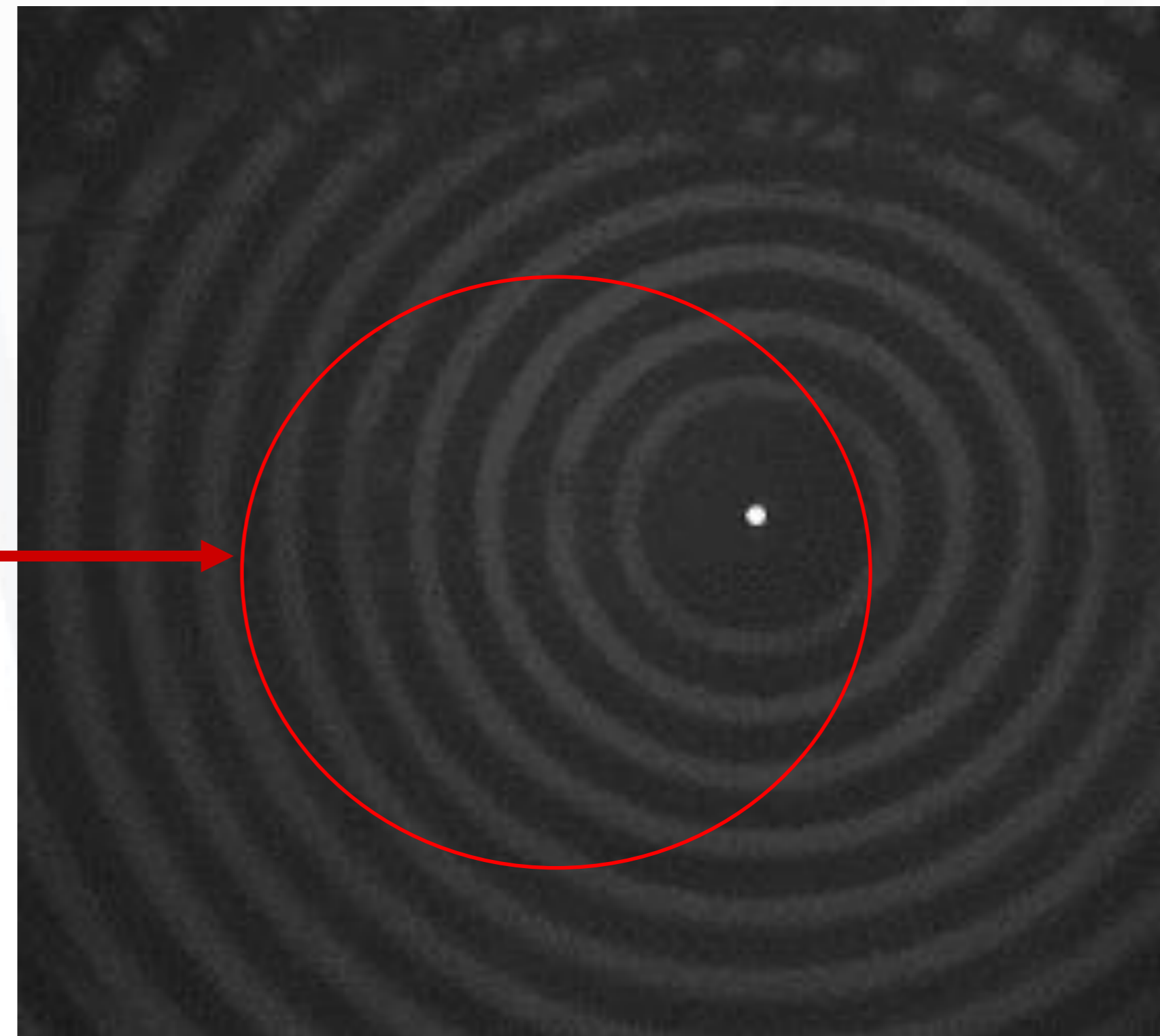
Automated NIBUT: how to detect a break-up?



Break-up
(discontinuity)

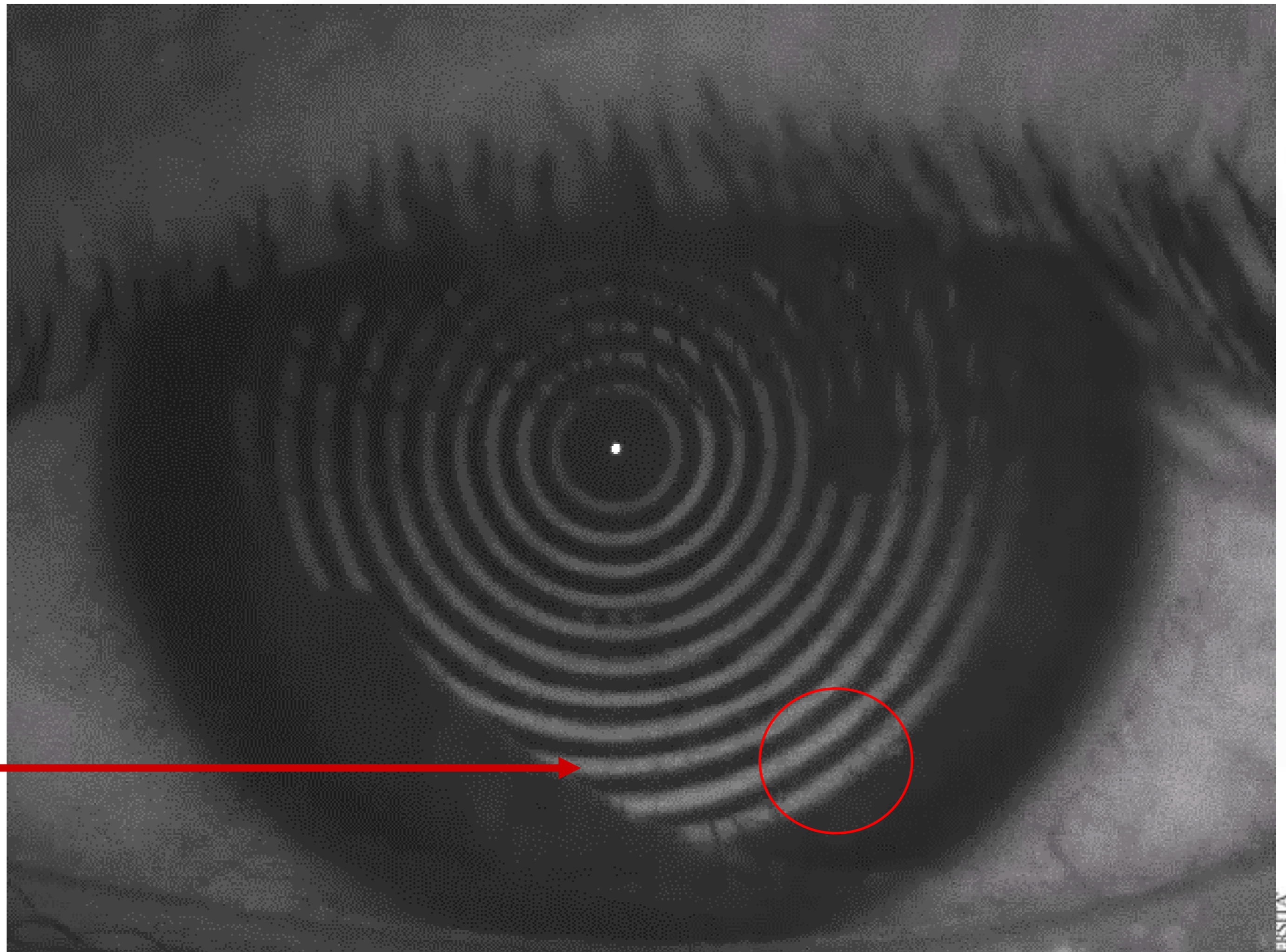
Automated NIBUT: discharging artifacts (tear thinning, density change in tear, bubbles, post blinking flow, lashes shadow etc)

TTT: changes in the sharpness of the edge

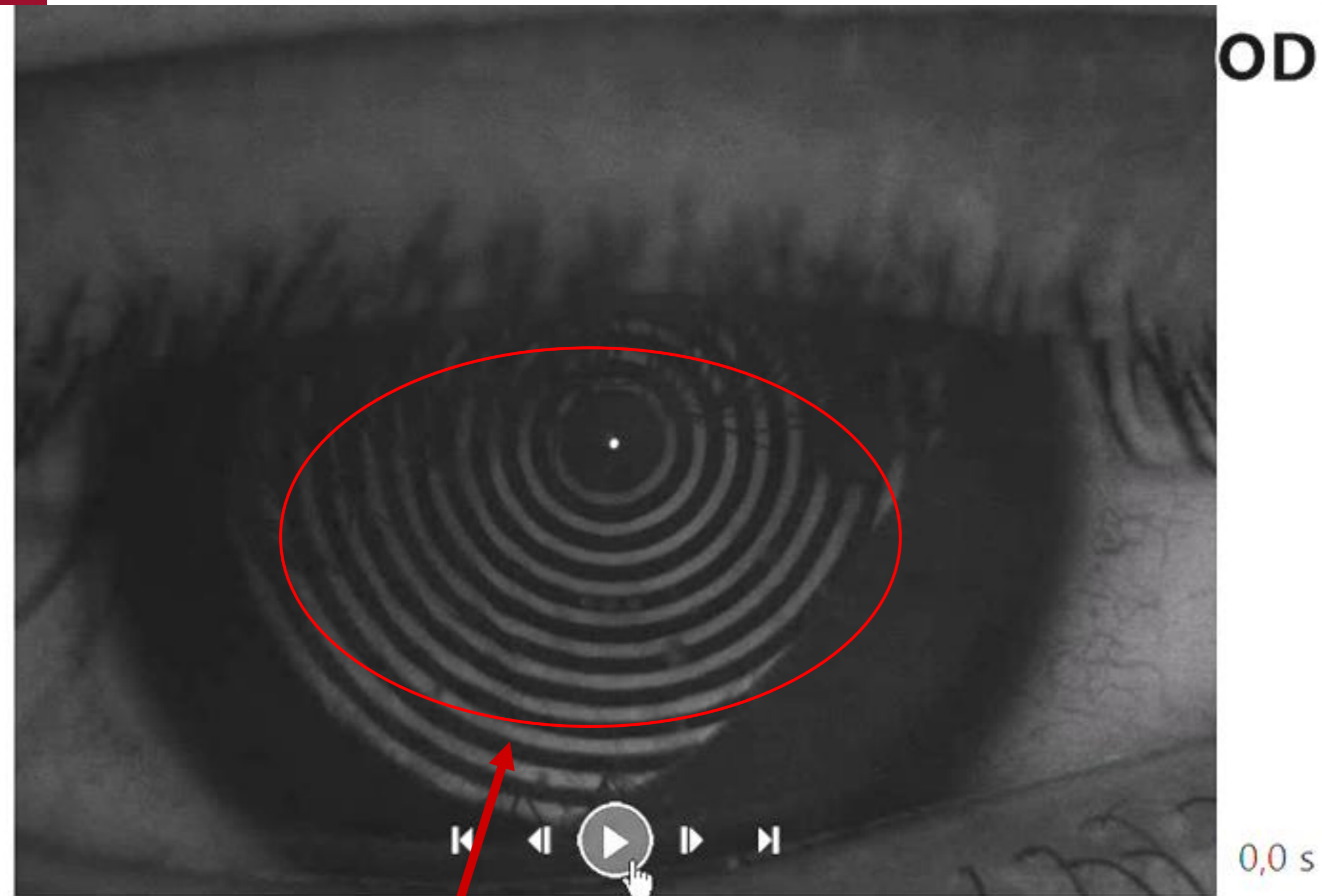


Automated NIBUT: discharging artifacts (tear thinning, density change in tear, bubbles, post blinking flow, lashes shadow etc)

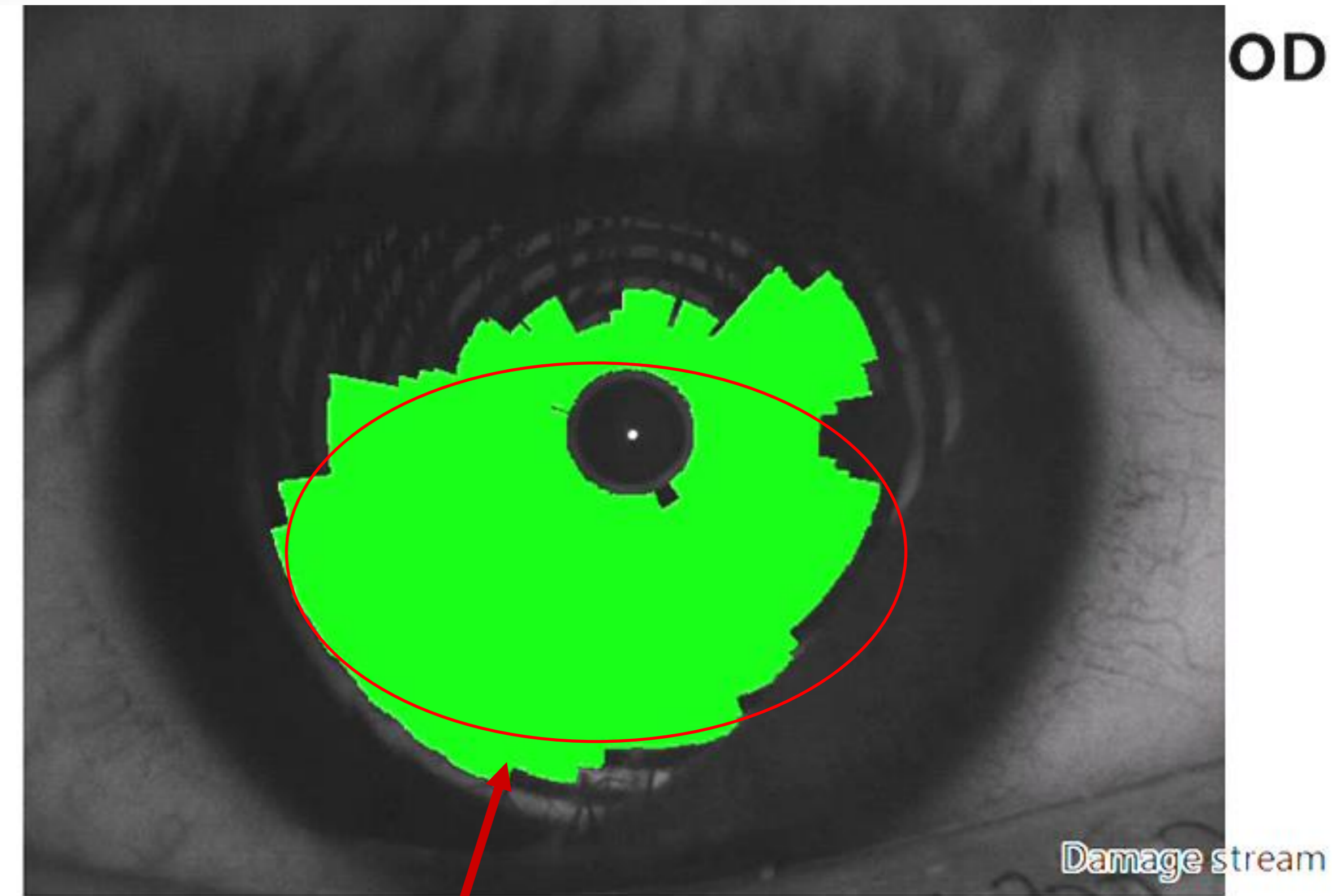
density change in tear



Automated NIBUT: discharging artifacts (tear thinning, density change in tear, bubbles, post blinking flow, lashes shadow etc)

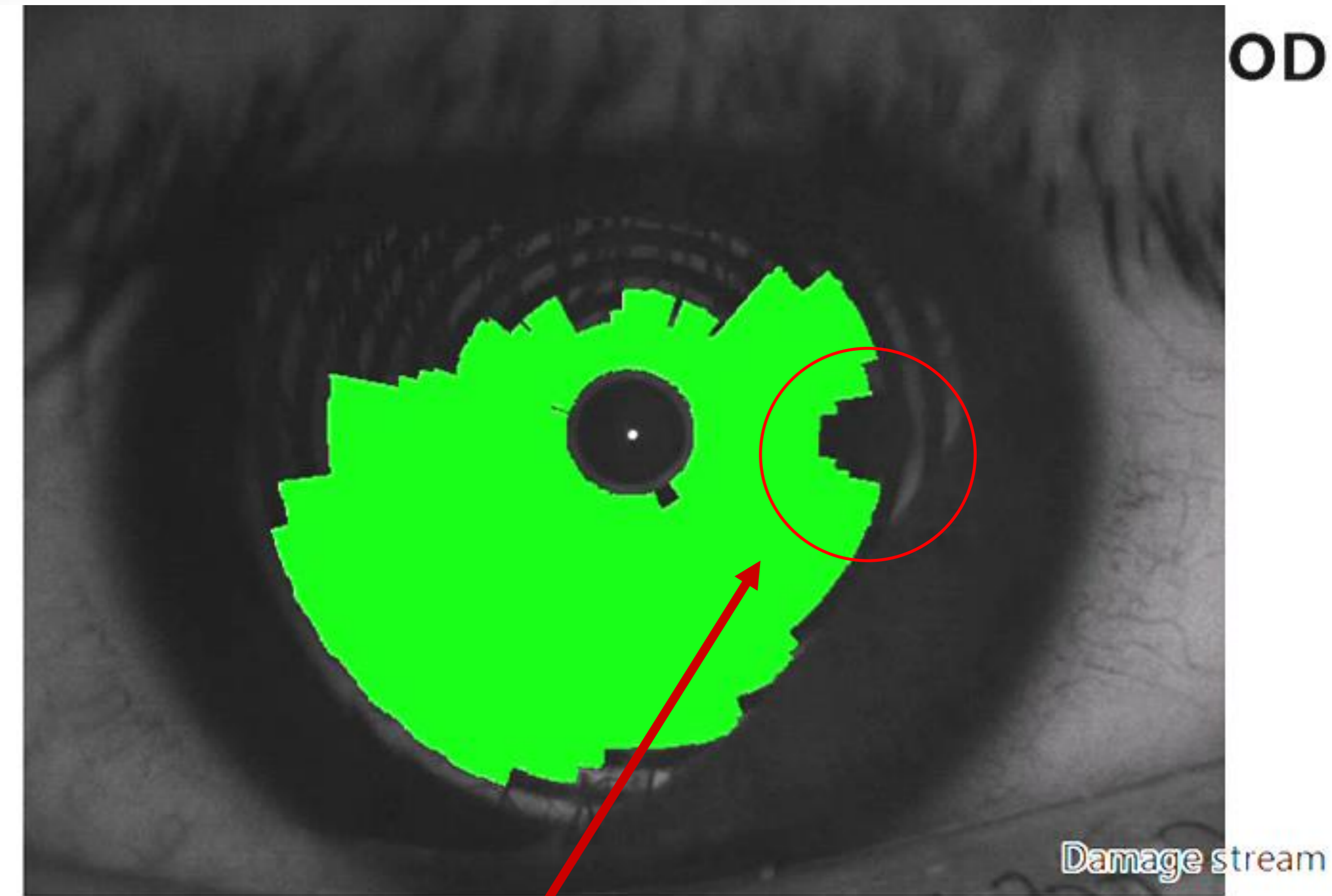
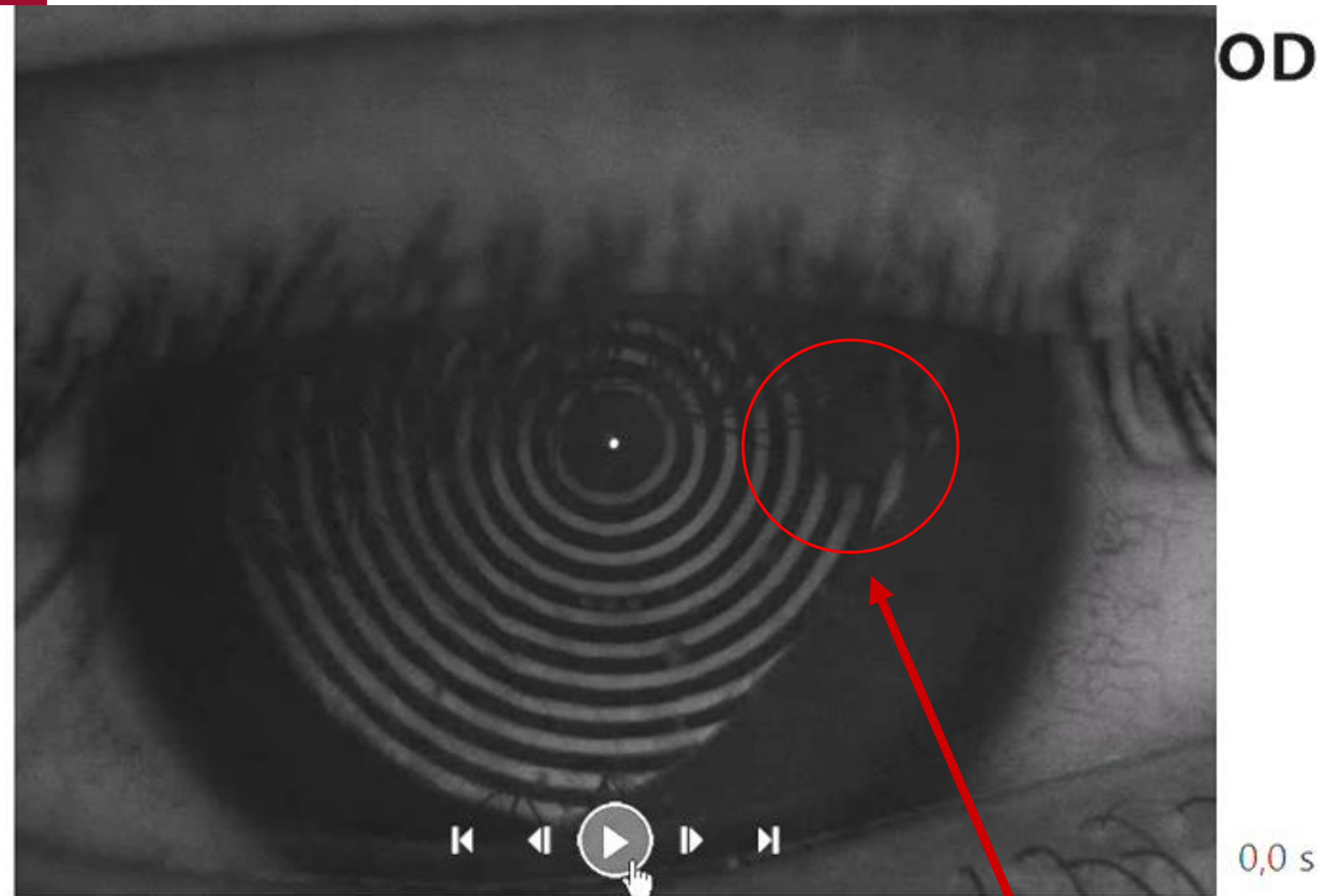


density change in tear



No break-up detected

Automated NIBUT: discharging artifacts (tear thinning, density change in tear, bubbles, post blinking flow, lashes shadow etc)

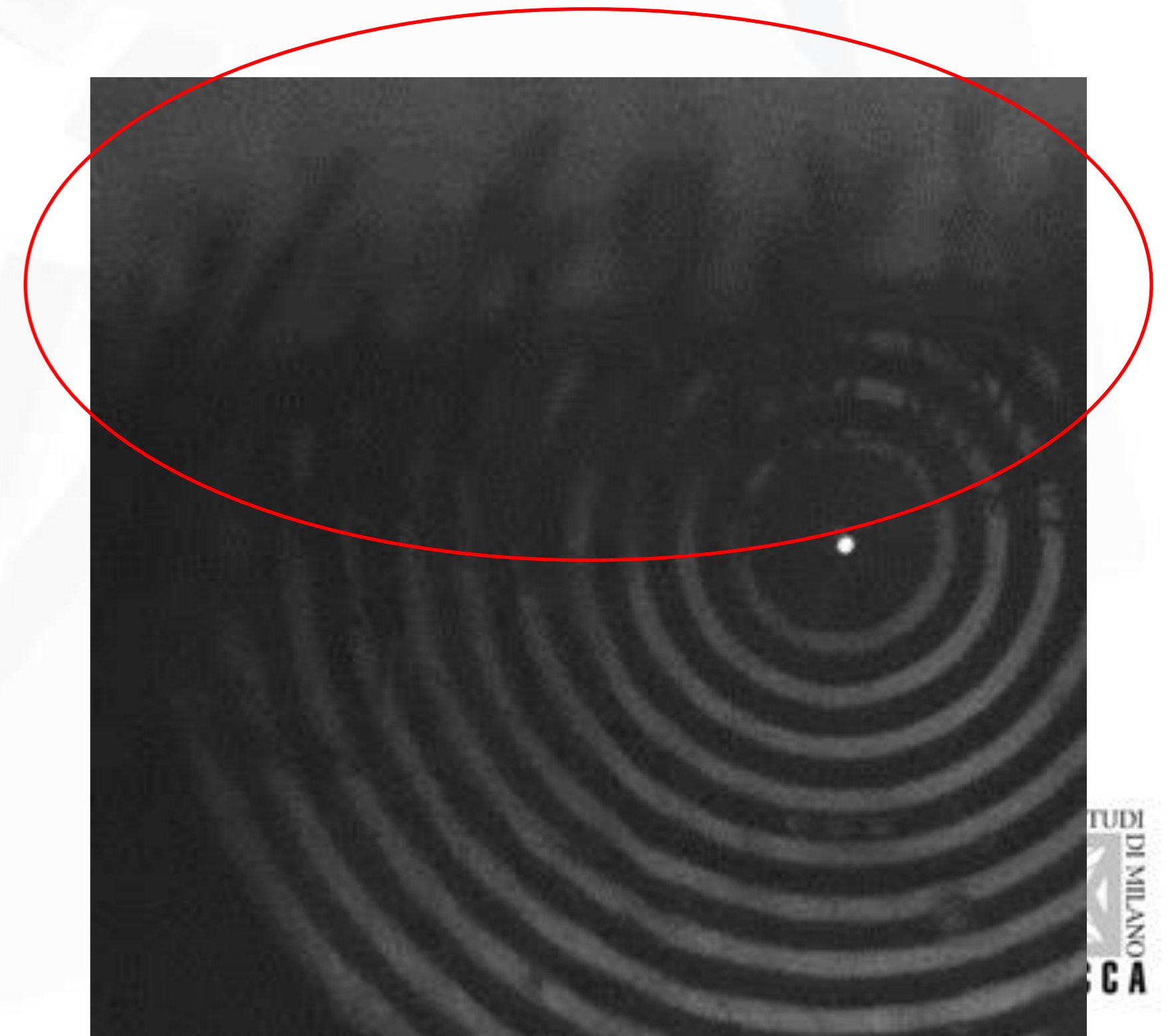


Scheinpflug camera: deleting part of information

Automated NIBUT: how to detect a break-up?



Lashes shadow: deleting part of information



Tear film instability assessment: automated NIBUT

Contact Lens & Anterior Eye 35 (2012) 171–174



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BCLA
British Contact Lens Association



Clinical evaluation of the Oculus Keratograph

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the first comparison between automated software to achieve a NIBUT by a topographer (Keratograph 4; OculusOptikgerate GmbH, Wetzlar, German) and a manual NIBUT performed by Keeler Tearscope showed a shorter time with the former.

Automatic versus manual NIBUT

Aim



- To evaluate the agreement between automatic and manual NIBUT measurements
- To assess the effect of clinical experience on manual NIBUT measurements

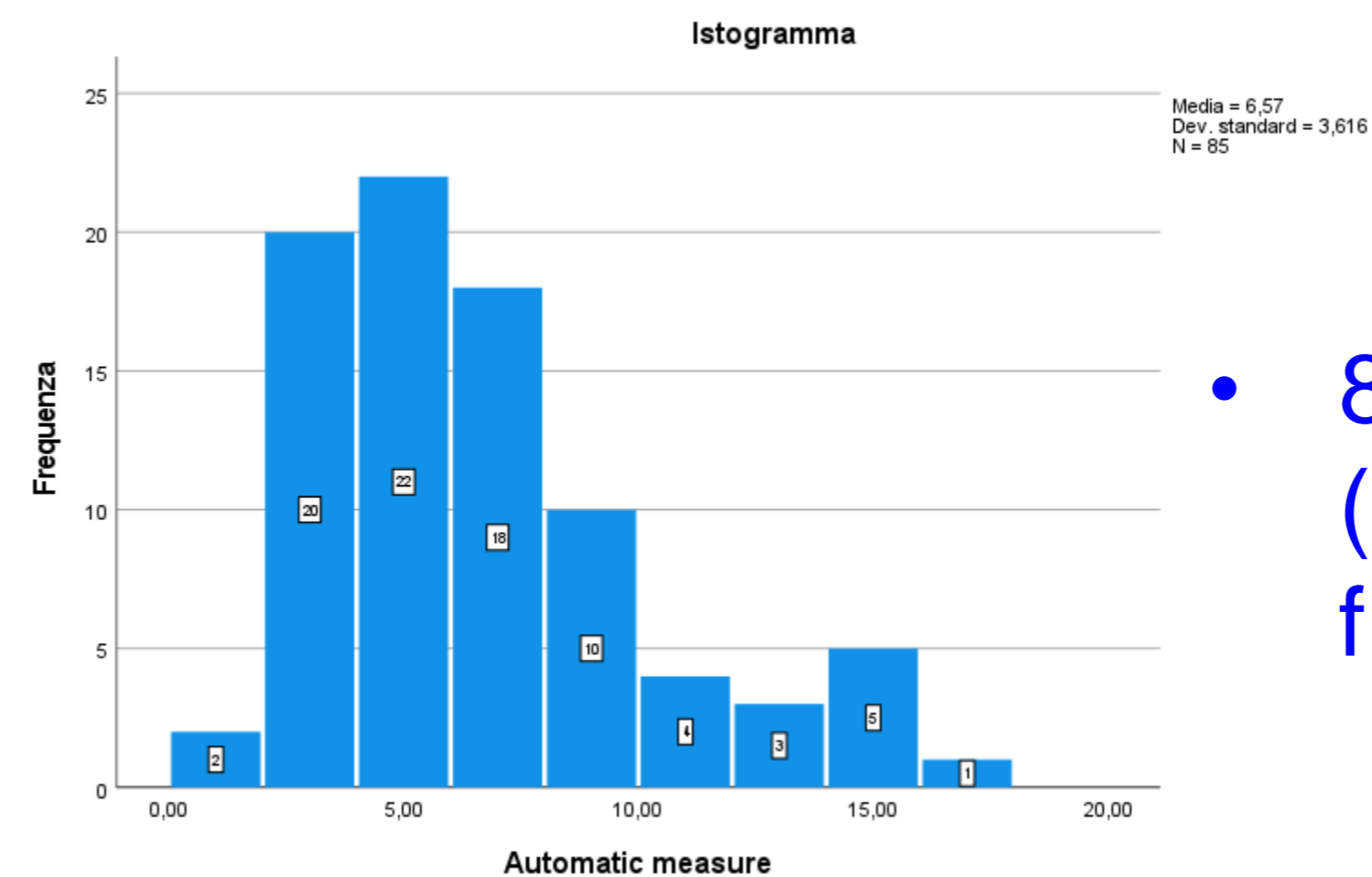
Retrospective randomised crossover study

Sample



Inclusion Criteria:

- Video without blinking during the length of the recording
- Video with a first NIBUT no longer than 17 seconds (limiting the study to length compatible with tear film instability in which information about the difference between manual and automatic assessment is more useful)
- Video presenting areas or zone grossly out of focus
- Video presenting fixation missing (due to movements of the eye or head)
- Video presenting poor quality of keratoscopic image for the presence of irregularity in the tear film (mucus, air bubble etc).



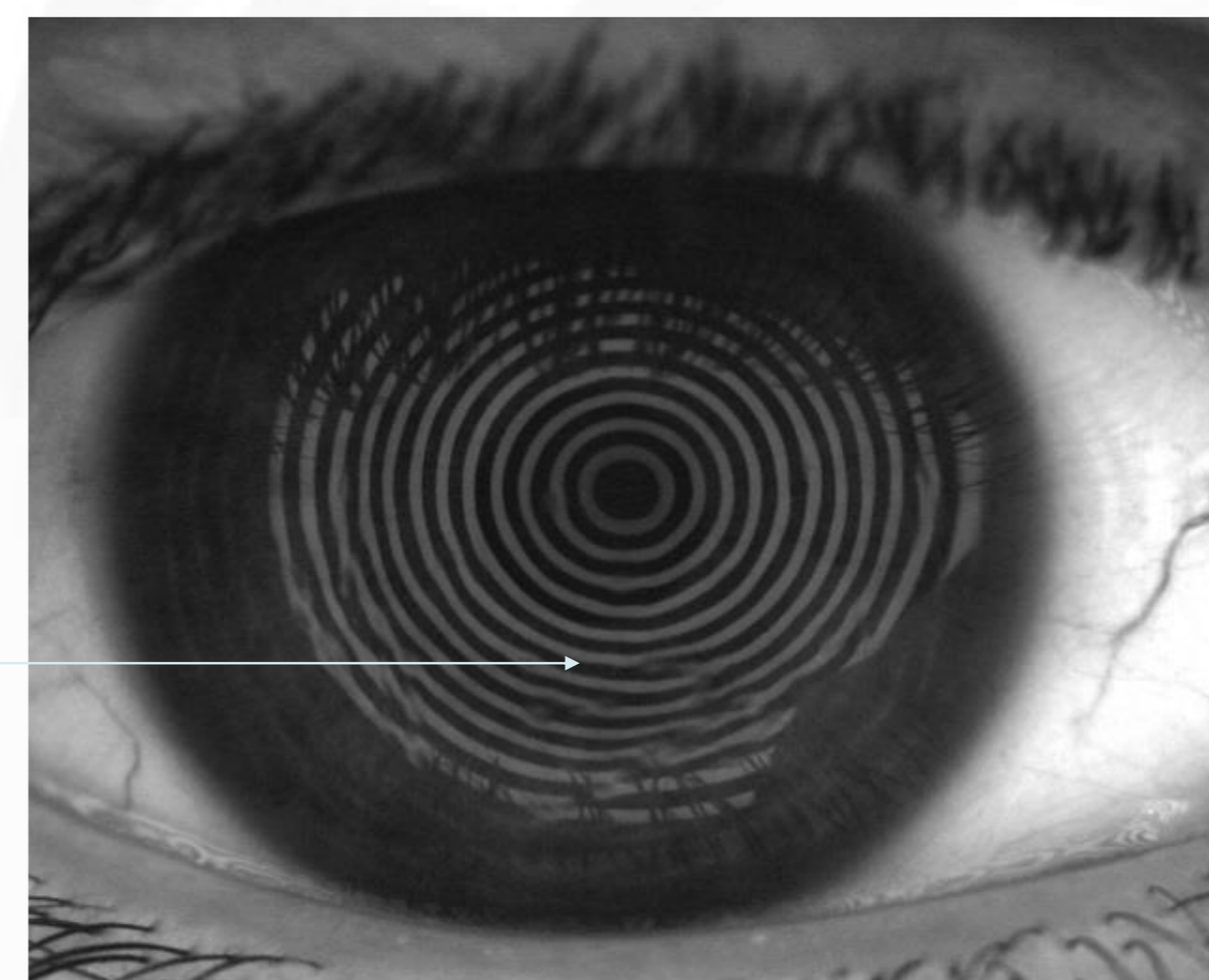
- 85 videos performed by Sirius+ (CSO, Florence) were selected from the COMIB database

Automatic versus manual NIBUT



Study Design: Retrospective randomised crossover study

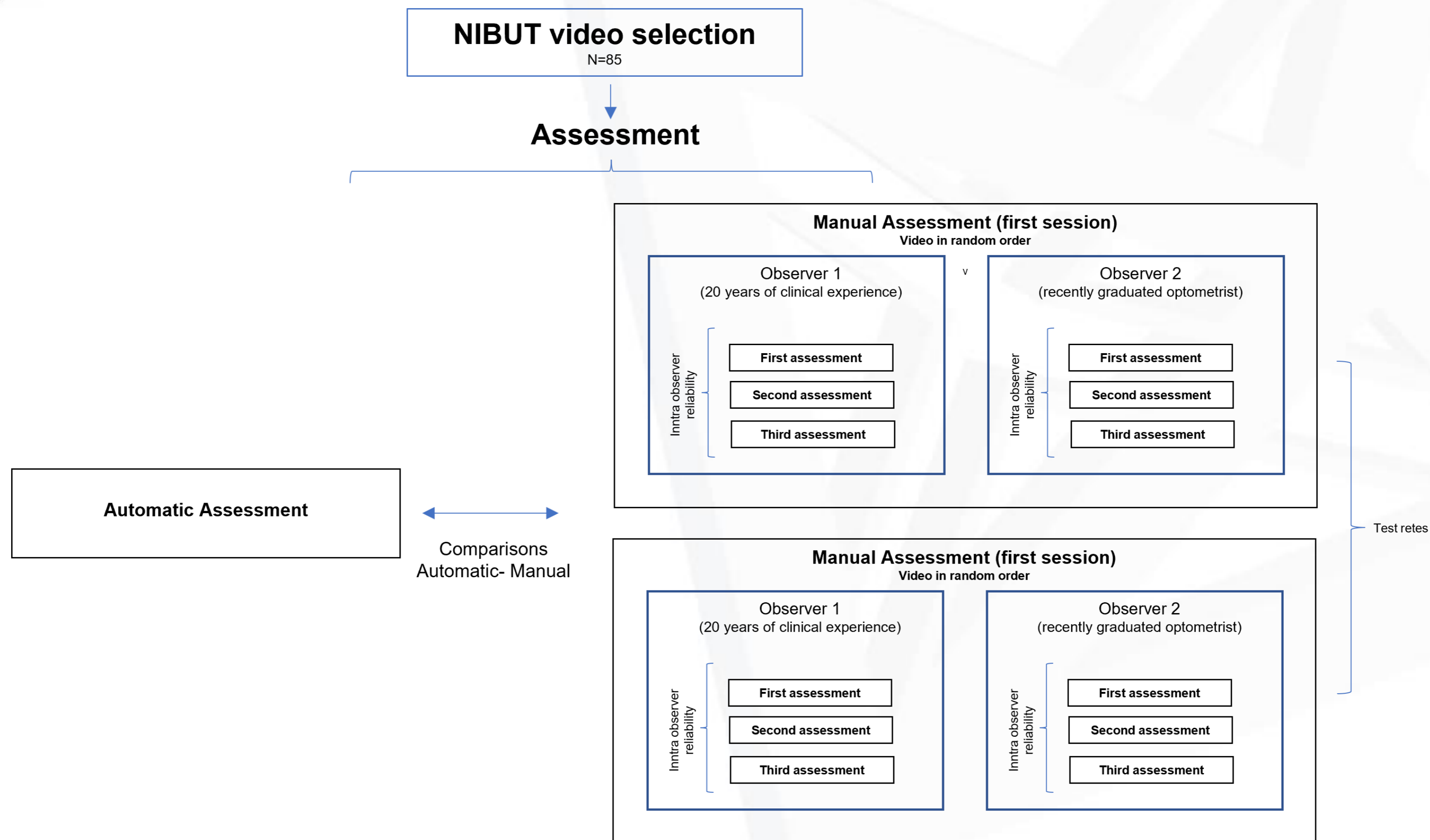
- **Observer 1:** Optometrist with more than 20 yrs of clinical experience (Senior)
 - **Observer 2:** 1 recent graduated in Optometry (Junior)
-
- **Procedures:** Each observer had to assess the videos (played in freeware software) in random order, measuring the NIBUT.



Automatic versus manual NIBUT

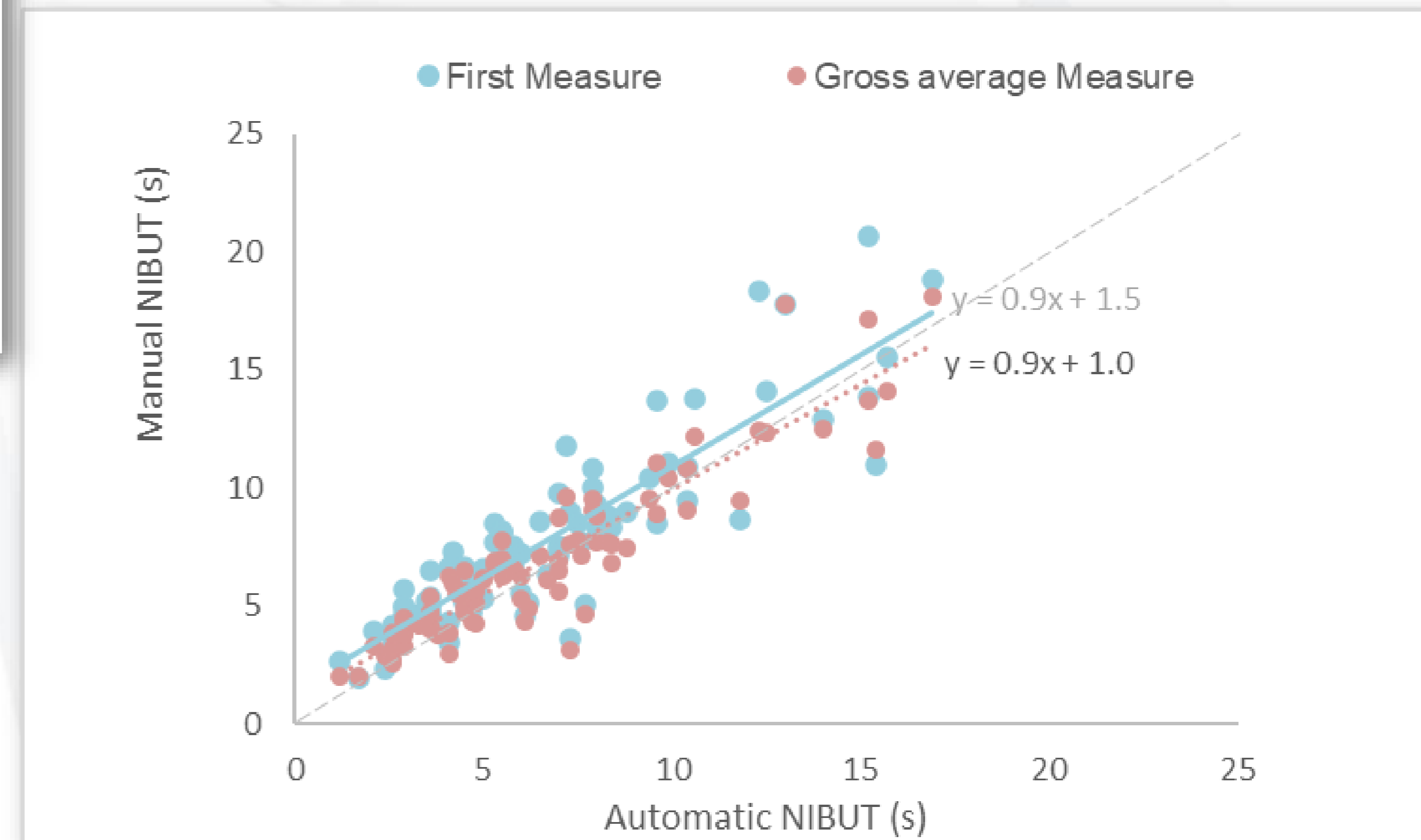
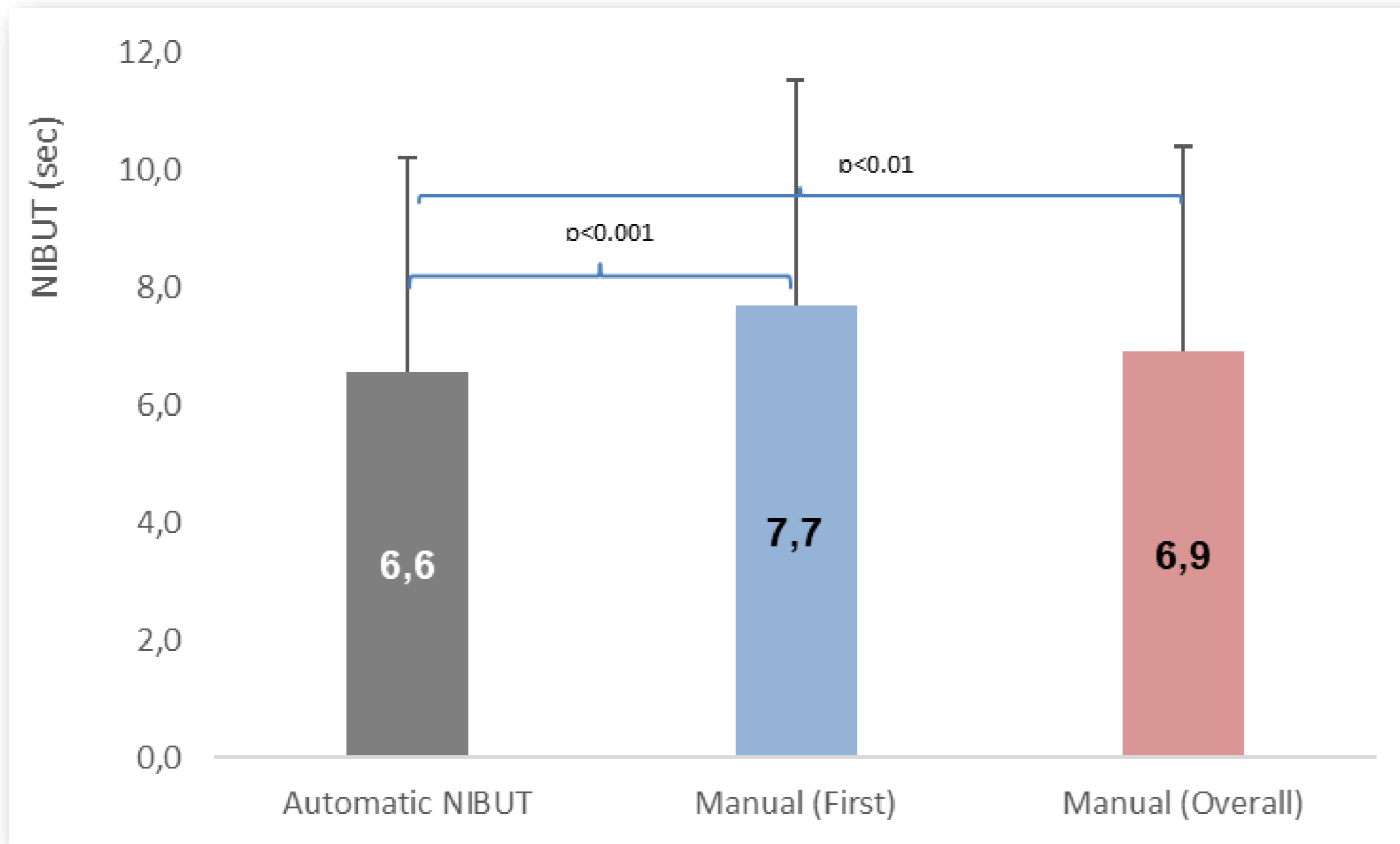


Study Design: Retrospective randomised crossover study





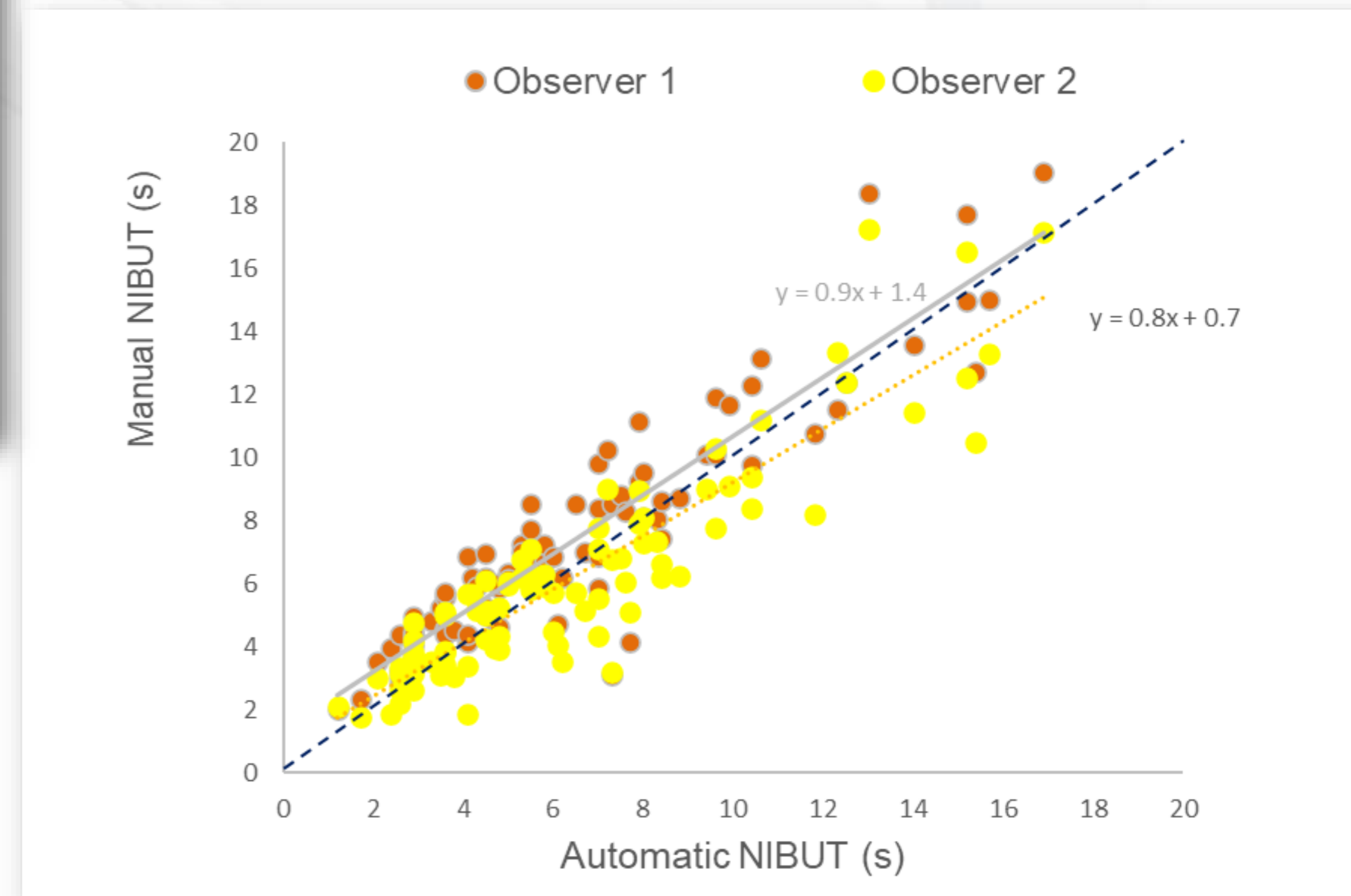
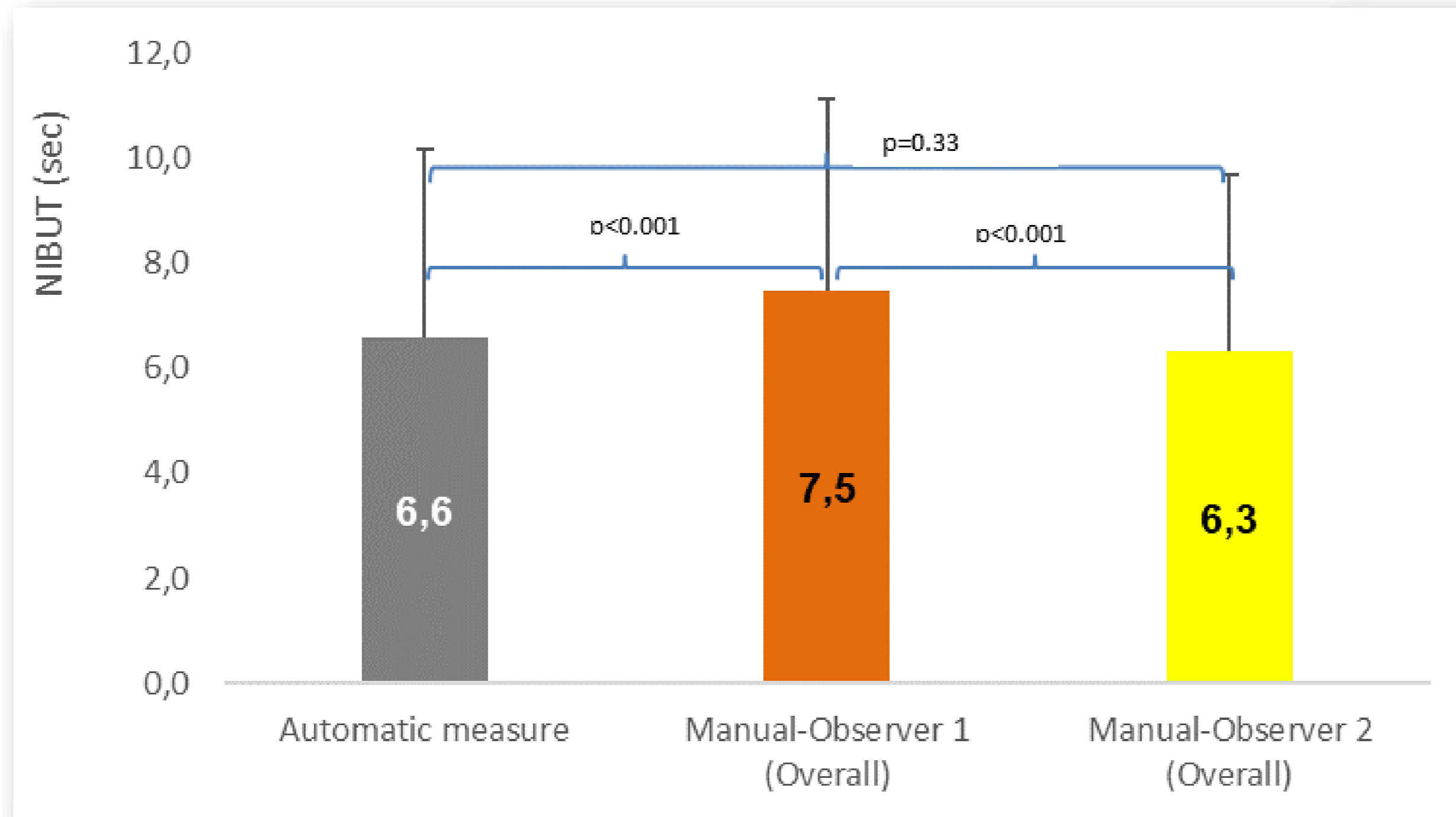
Agreement and correlation between automatic and manual NIBUT



Correlation Automatic and Manual First
Spearman Rho=0.89 (p<0.001)
Correlation Automatic and Manual Overall
Spearman Rho=0.90 (p<0.001)



Agreement and correlation between automatic and manual NIBUT: observer experience

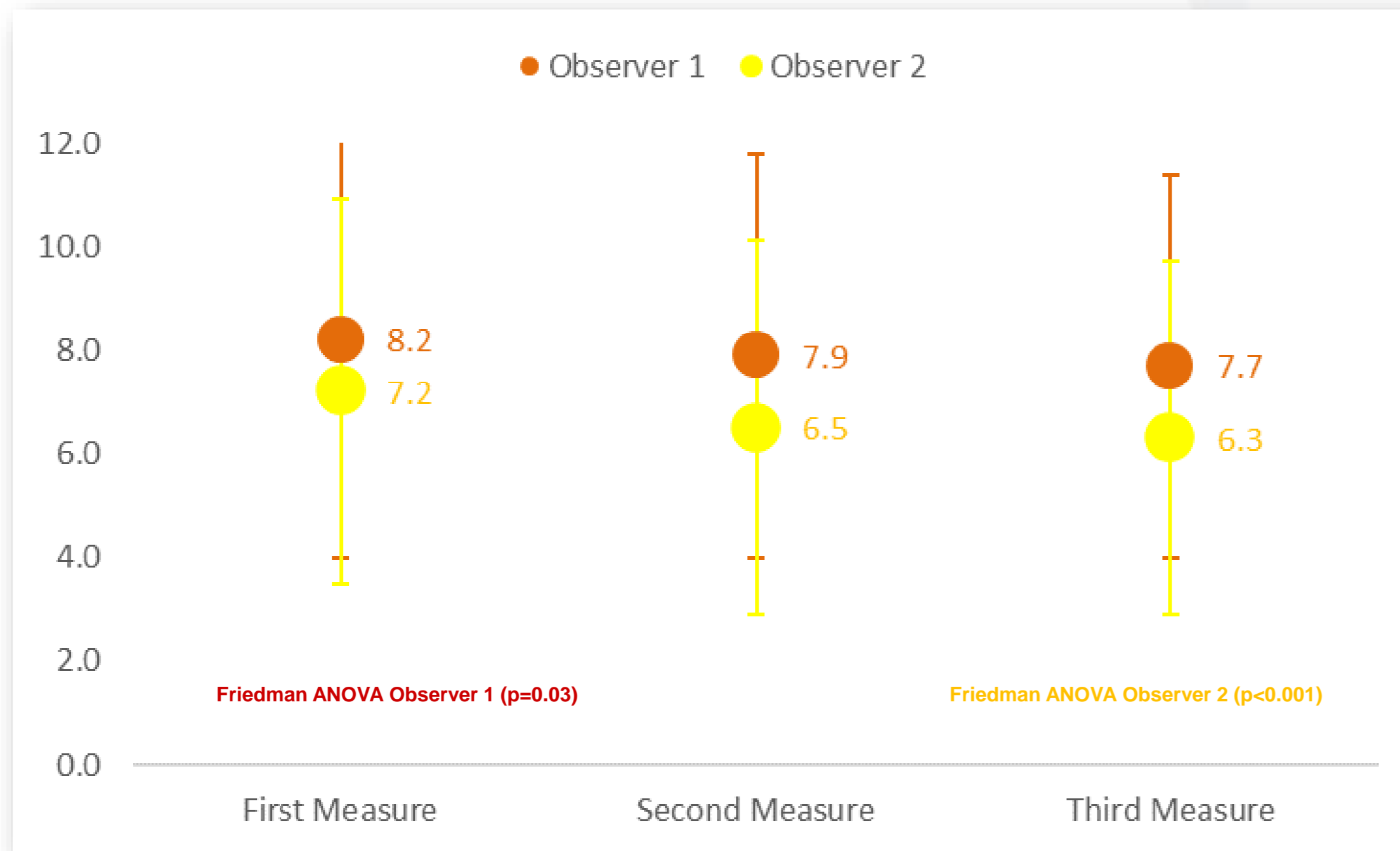


Correlation Automatic and Manual
Both Observers (overall manual)
Spearman Rho=0.87 (p<0.001)

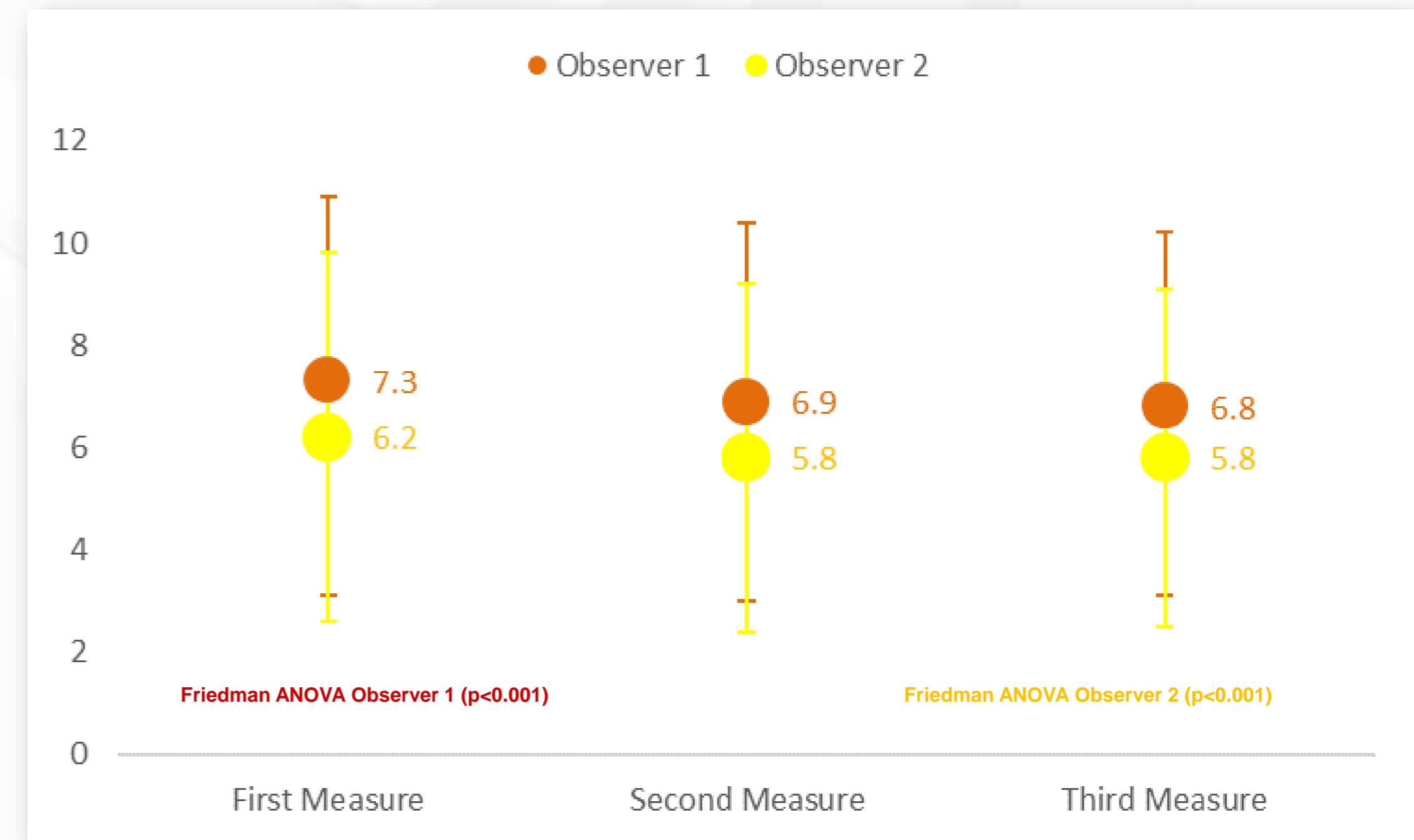


Observers bias in repeated measurement of the same video

First Session (Test)



Second Session (retest)



All paired comparisons Obs 1 - Obs 2 for the same measure (Wicoxon test; $p<0.001$)



Manual NIBUT reliability: intrasession

	Observer 1	Observer 2
Test	CP=1.68 s; CR= 2.37 s; CV=0.11	CP=1.71 s; CR= 2.41 s; CV=0.13
Retest	CP=1.31 s; CR= 1.85 s; CV=0.10	CP=1.32 s; CR= 1.87 s; CV=0.11

Coefficient of precision (CP), coefficient of repeatability (CR) and coefficient of variation for the manual measures of NIBUT performed by Observer 1 and Observer 2 in the first session (test) and in second session (retest).

fBUT

CP=4.5 s

CR= 6.4 s

CV=0.30



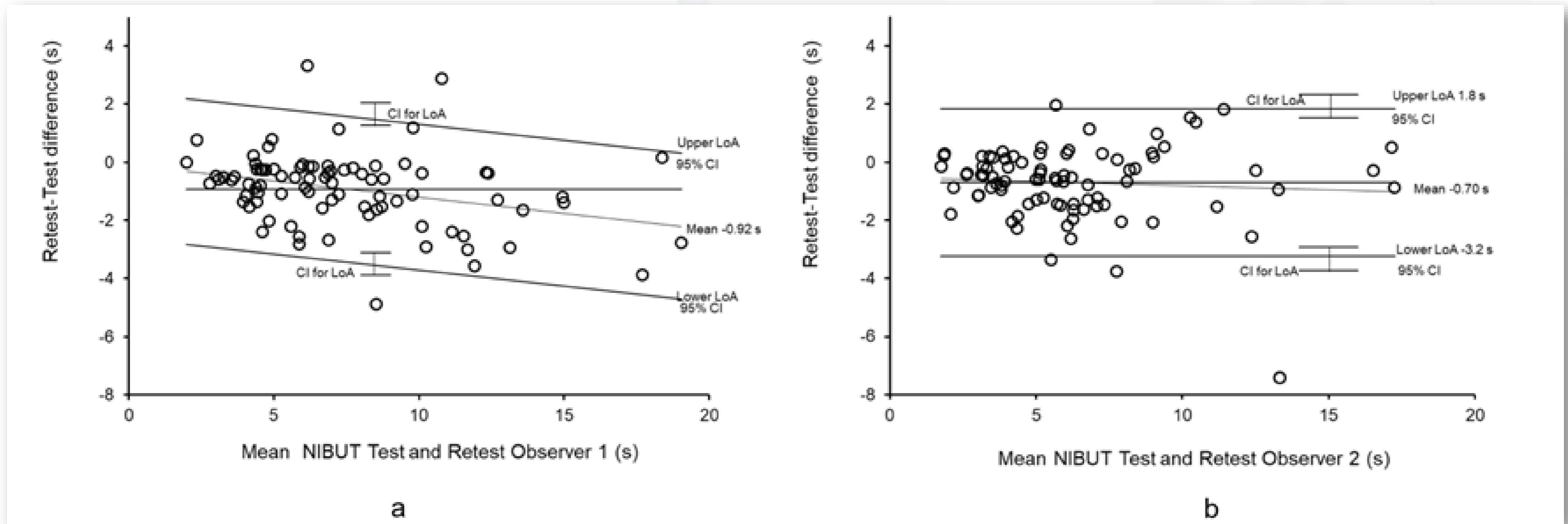
Manual NIBUT reliability: test retest

Procedure	Test Mean \pm SD (Range) (s)	Retest (sec) Mean \pm SD; Median	ICC and 95% confidence intervals	Comparison (p value of Wilcoxon test)
Observer 1 (Mean of three measurements)	7.9 \pm 3.9; (2.0-20.4)	7.0 \pm 3.5; (2.0-18.4)	0.95*** (0.84 - 0.98)	P<0.001
Observer 2 (Mean of three measurements)	6.7 \pm 3.5; (1.7-17.7)	6.0 \pm 3.4; (1.2-17.4)	0.95*** (0.90 - 0.98)	P<0.001
Average of observers	7.3 \pm 3.6; (1.9-18.7)	6.5 \pm 3.4; (1.6-17.6)	0.97*** (0.82 - 0.99)	P<0.001

Coefficient of precision (CP), coefficient of repeatability (CR) and coefficient of variation for the manual measures of NIBUT performed by Observer 1 and Observer 2 in the first session (test) and in second session (retest).



Manual NIBUT reliability: test retest



so what?

Conclusions

Automated vs Manual assessment



- Strong correlation between automated and manual NIBUT
- Differences between automatic and manual measurement are affected by the observer and the repetition of manual measurement, but in any case clinically negligible

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comib
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