

SUPPLEMENTARY MATERIALS

Agreement among the different refraction procedures: J0 component

Descriptive statistics for the J0 are reported in [Table S1](#). The comparison between the instruments was performed on the J0 mean data of CFA, OFA monocular, OFAUTO monocular and Subjective procedure for right eye and left eye separately. On the right eye, the mean data sets for J0 resulted not normally distributed only in the case of the Non-presbyopic group for: all the OFA measures, all the OFAUTO measurements, and the subjective measure (Shapiro–Wilk test; $p < 0.005$). On the left eye, the mean data sets for J0 resulted not normally distributed in the case of Presbyopic group for all the CFA and OFA measures and Subjective refraction and in the Non-presbyopic group for Subjective refraction (Shapiro–Wilk test; $p < 0.005$).

The two-way ANOVA, run for J0 component ([Figure S1a](#)) in the right eye, showed a main effect of procedure (within the subjects) ($F_{(3,144)} = 6.86$; $p = 0.01$), a significant effect of group ($F_{(1,48)} = 12.7$; $p < 0.001$), and a significant interaction ($F_{(3,144)} = 3.1$; $p = 0.03$). Separate post-hoc analyses (with Bonferroni correction) for the right eye showed a significant difference for comparisons between the CFA and OFA procedures both in the Presbyopic group (mean paired difference = 0.10 D, 95%CI = 0.03 to 0.17 D, adjusted p-value = 0.002), and in the Non-presbyopic group (mean paired difference = 0.08 D, 95%CI = 0.01 to 0.14 D, adjusted p-value = 0.01). Also, a significant difference for comparisons was found between the CFA and Subjective procedures in the Non-presbyopic group (mean paired difference = 0.12 D, 95%CI = 0.05 to 0.20 D, adjusted p-value < 0.001).

A similar scenario was found in the case of J0 ([Figure S1b](#)), for the left eye. The main effect of procedure (within the subjects) was present ($F_{(3,144)} = 8.32$; $p = < 0.001$), with a significant effect of group ($F_{(1,48)} = 8.41$; $p = 0.006$), whereas interaction resulted not significant ($F_{(3,144)} = 0.42$; $p = 0.74$).

Separate post-hoc analyses (with Bonferroni correction) for the left eye showed a significant difference for comparisons between the CFA and OFA in the Presbyopic group (mean paired difference = 0.12 D, 95%CI = 0.03 to 0.20 D, adjusted p-value

= 0.003) and between OFA and subjective procedure (mean paired difference = 0.12 D, 95%CI = -0.21 to 0.02 D, adjusted p-value = 0.01).

In [Figure S2 a and b](#) are reported the scatterplots between right eye J0 values achieved with subjective refraction versus objective procedures for the Presbyopic group and the Non-presbyopic group respectively. In [Figure S2 c and d](#) are reported the scatterplots between left eye J0 values achieved with subjective refraction versus objective procedures in the Presbyopic group and the Non-presbyopic group respectively.

The correlation analysis resulted exactly as the one achieved for the M vector component. In the right eye of the Presbyopic group, a significant correlation was found between the J0 value measured with subjective refraction and the objective methods: Spearman's Rho resulted 0.95, 0.90, and 0.87 ($p < 0.001$), for the relations subjective-CFA, subjective-OFA, and subjective-OFAUTO respectively. Also, in the right eye of the Non-presbyopic group a significant correlation was found between the J0 value measured with subjective refraction and the objective methods: Spearman's Rho resulted 0.68 ($p < 0.001$), 0.69 ($p < 0.001$), and 0.60 ($p = 0.001$), for the relations subjective-CFA, subjective-OFA, and subjective-OFAUTO respectively.

Similarly, in the left eye (Presbyopic group), a significant correlation was found between the J0 value measured with subjective refraction and the objective methods: Spearman's Rho resulted 0.66, 0.77, and 0.72 ($p < 0.001$), for the relations subjective-CFA, subjective-OFA, and subjective-OFAUTO respectively. Also, for the Non-presbyopic group a significant correlation was found between the J0 value measured with subjective refraction and the objective methods: Spearman's Rho resulted 0.81, 0.70, and 0.80 (all $p < 0.001$), for the relations subjective-CFA, subjective-OFA, and subjective-OFAUTO respectively.

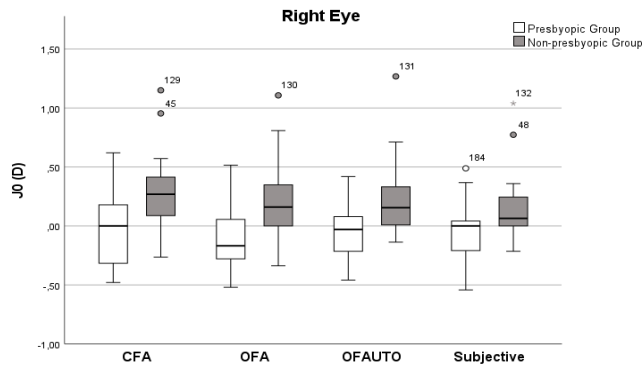
In the right eye, Bland–Altman plots showed a proportional bias for the relationship between difference and mean of J0 values achieved by subjective refraction and CFA in the Presbyopic group (r of Pearson=0.60; $p=0.003$) ([Figure S3a](#)) and for the relationship between difference and mean of subjective refraction and OFA in the Non-presbyopic group (Spearman Rho=0.53; $p=0.004$) ([Figure S3e](#)). No

proportional bias was found in the remaining comparisons (Figure S3b, c, d, and f).

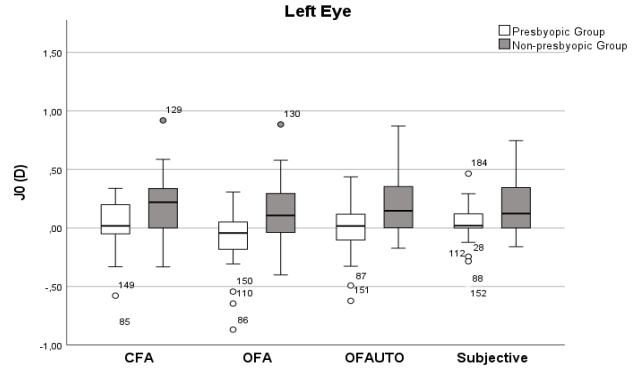
In the left eye, no Bland–Altman plots for the relationship between difference and mean of J0 values achieved by subjective refraction and the objective procedures (CFA, OFA, and OFAUTO) showed a proportional bias both for the Presbyopic group and the Non-presbyopic group (Figure S4).

Table S1. Mean, standard deviation (SD), median, and interquartile range (IQR) of J0 values obtained for the right and left eye across the four procedures (with OFA and OFAUTO evaluated under both monocular and binocular conditions) for Presbyopic group (n = 23), and Non-presbyopic group (n = 27). For CFA, OFA and OFAUTO, three repeated measurements and their average are reported, whereas in the case of subjective refraction only the final measure is included.

	Presbyopic group (n=23)				Non-presbyopic Group (n=27)			
	First Reading Mean $\pm$ SD; Median (IQ Range) (D)	Second Reading Mean $\pm$ SD; Median (IQ Range) (D)	Third Reading Mean $\pm$ SD; Median (IQ Range) (D)	Average Reading Mean $\pm$ SD; Median (IQ Range) (D)	First Reading Mean $\pm$ SD; Median (IQ Range) (D)	Second Reading Mean $\pm$ SD; Median (IQ Range) (D)	Third Reading Mean $\pm$ SD; Median (IQ Range) (D)	Average Reading Mean $\pm$ SD; Median (IQ Range) (D)
Right eye								
CFA	-0.02 $\pm$ 0.33; 0.00 (0.55)	-0.03 $\pm$ 0.32; 0.00 (0.53)	-0.02 $\pm$ 0.33; 0.00 (0.54)	-0.02 $\pm$ 0.32; 0.00 (0.52)	0.29 $\pm$ 0.30; 0.26 (0.41)	0.29 $\pm$ 0.34; 0.23 (0.38)	0.26 $\pm$ 0.32; 0.28 (0.43)	0.28 $\pm$ 0.30; 0.27 (0.39)
OFA (Mono)	-0.11 $\pm$ 0.29; -0.17 (0.41)	-0.12 $\pm$ 0.28; -0.17 (0.39)	-0.13 $\pm$ 0.29; -0.17 (0.34)	-0.12 $\pm$ 0.29; -0.17 (0.37)	0.20 $\pm$ 0.30; 0.15 (0.34)	0.20 $\pm$ 0.30; 0.17 (0.38)	0.20 $\pm$ 0.30; 0.16 (0.34)	0.20 $\pm$ 0.30; 0.16 (0.36)
OFA (Bino)	-0.13 $\pm$ 0.31; -0.17 (0.39)	-0.13 $\pm$ 0.30; -0.17 (0.35)	-0.13 $\pm$ 0.30; -0.17 (0.38)	-0.13 $\pm$ 0.30; -0.17 (0.38)	0.21 $\pm$ 0.30; 0.20 (0.40)	0.23 $\pm$ 0.31; 0.23 (0.36)	0.23 $\pm$ 0.30; 0.22 (0.43)	0.23 $\pm$ 0.30; 0.23 (0.38)
OFAUTO (Mono)	-0.02 $\pm$ 0.24; -0.03 (0.32)	-0.07 $\pm$ 0.24; -0.03 (0.29)	-0.06 $\pm$ 0.27; -0.07 (0.29)	-0.05 $\pm$ 0.24; -0.03 (0.31)	0.20 $\pm$ 0.30; 0.13 (0.37)	0.21 $\pm$ 0.29; 0.15 (0.37)	0.22 $\pm$ 0.31; 0.16 (0.31)	0.21 $\pm$ 0.30; 0.16 (0.36)
OFAUTO (Bino)	-0.07 $\pm$ 0.28; -0.06 (0.45)	-0.07 $\pm$ 0.29; -0.03 (0.47)	-0.06 $\pm$ 0.27; -0.02 (0.31)	-0.07 $\pm$ 0.28; -0.03 (0.36)	0.20 $\pm$ 0.29; 0.16 (0.29)	0.20 $\pm$ 0.27; 0.15 (0.36)	0.21 $\pm$ 0.28; 0.13 (0.32)	0.21 $\pm$ 0.28; 0.13 (0.30)
Subjective Procedure	_____	_____	_____	-0.05 $\pm$ 0.25; 0.00 (0.30)	_____	_____	_____	0.16 $\pm$ 0.26; 0.06 (0.25)
Left eye								
CFA	0.00 $\pm$ 0.30; 0.07 (0.26)	0.00 $\pm$ 0.28; 0.00 (0.27)	0.00 $\pm$ 0.28; 0.01 (0.27)	0.00 $\pm$ 0.29; 0.02 (0.29)	0.18 $\pm$ 0.27; 0.21 (0.37)	0.20 $\pm$ 0.27; 0.23 (0.36)	0.18 $\pm$ 0.27; 0.22 (0.36)	0.19 $\pm$ 0.27; 0.22 (0.36)
OFA (Mono)	-0.12 $\pm$ 0.30; -0.01 (0.26)	-0.11 $\pm$ 0.25; -0.05 (0.26)	-0.11 $\pm$ 0.27; -0.04 (0.29)	-0.11 $\pm$ 0.27; -0.04 (0.26)	0.10 $\pm$ 0.30; 0.00 (0.38)	0.12 $\pm$ 0.29; 0.13 (0.40)	0.12 $\pm$ 0.29; 0.13 (0.38)	0.11 $\pm$ 0.29; 0.11 (0.39)
OFA (Bino)	-0.08 $\pm$ 0.25; 0.00 (0.29)	-0.09 $\pm$ 0.26; 0.00 (0.30)	-0.09 $\pm$ 0.26; 0.00 (0.28)	-0.09 $\pm$ 0.26; 0.00 (0.29)	0.14 $\pm$ 0.31; 0.17 (0.48)	0.15 $\pm$ 0.31; 0.16 (0.39)	0.14 $\pm$ 0.30; 0.13 (0.45)	0.14 $\pm$ 0.30; 0.17 (0.44)
OFAUTO (Mono)	-0.02 $\pm$ 0.30; 0.02 (0.28)	-0.02 $\pm$ 0.25; 0.00 (0.23)	0.00 $\pm$ 0.22; 0.00 (0.30)	-0.01 $\pm$ 0.25; 0.02 (0.27)	0.18 $\pm$ 0.25; 0.16 (0.36)	0.18 $\pm$ 0.23; 0.14 (0.35)	0.21 $\pm$ 0.24; 0.18 (0.34)	0.19 $\pm$ 0.24; 0.15 (0.36)
OFAUTO (Bino)	-0.02 $\pm$ 0.31; 0.02 (0.34)	-0.02 $\pm$ 0.31; 0.01 (0.35)	-0.04 $\pm$ 0.30; 0.00 (0.38)	-0.03 $\pm$ 0.30; 0.01 (0.35)	0.21 $\pm$ 0.26; 0.17 (0.33)	0.20 $\pm$ 0.26; 0.18 (0.34)	0.20 $\pm$ 0.27; 0.16 (0.30)	0.21 $\pm$ 0.26; 0.17 (0.28)
Subjective Procedure	_____	_____	_____	0.00 $\pm$ 0.24; 0.02 (0.12)	_____	_____	_____	0.19 $\pm$ 0.24; 0.12 (0.35)

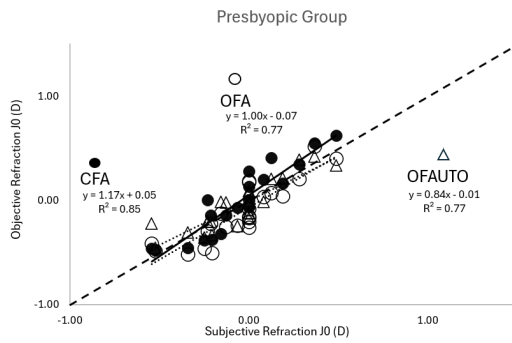


a)

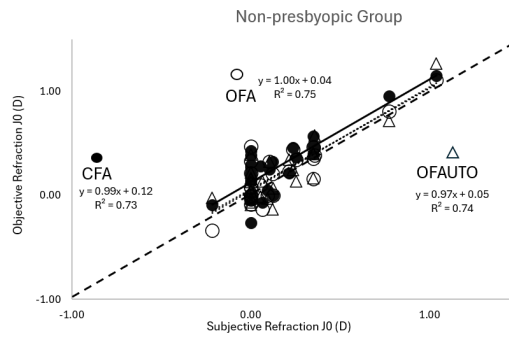


b)

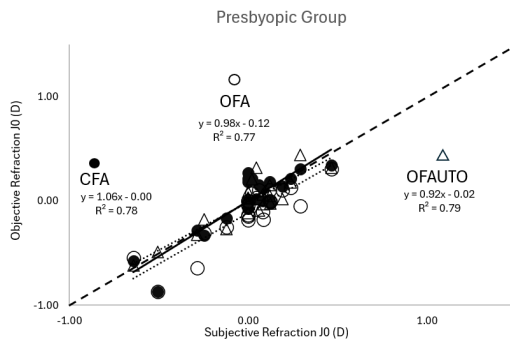
Figure S1: Box and whisker plots of the J0 values for the right eye (a) and left eye (b) obtained using the four procedures in the Presbyopic Group (n = 23), and the Non-presbyopic Group (n = 27) respectively. CFA: Closed-field aberrometer; OFA: Open-field aberrometer; OFAUTO: Open-field autorefractor; Subjective: subjective refraction.



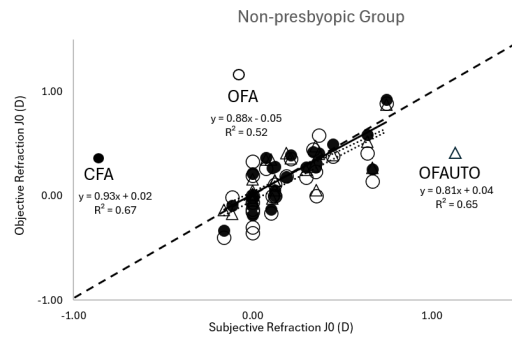
a)



b)



c)



d)

Figure S2: scatterplot of J0 values obtained with subjective refraction versus objective procedures. Panels show data for the right eye in the Presbyopic Group (a) and Non-presbyopic Group (b), and for the left eye in the Presbyopic Group (c) and the Non-presbyopic Group (d) respectively.

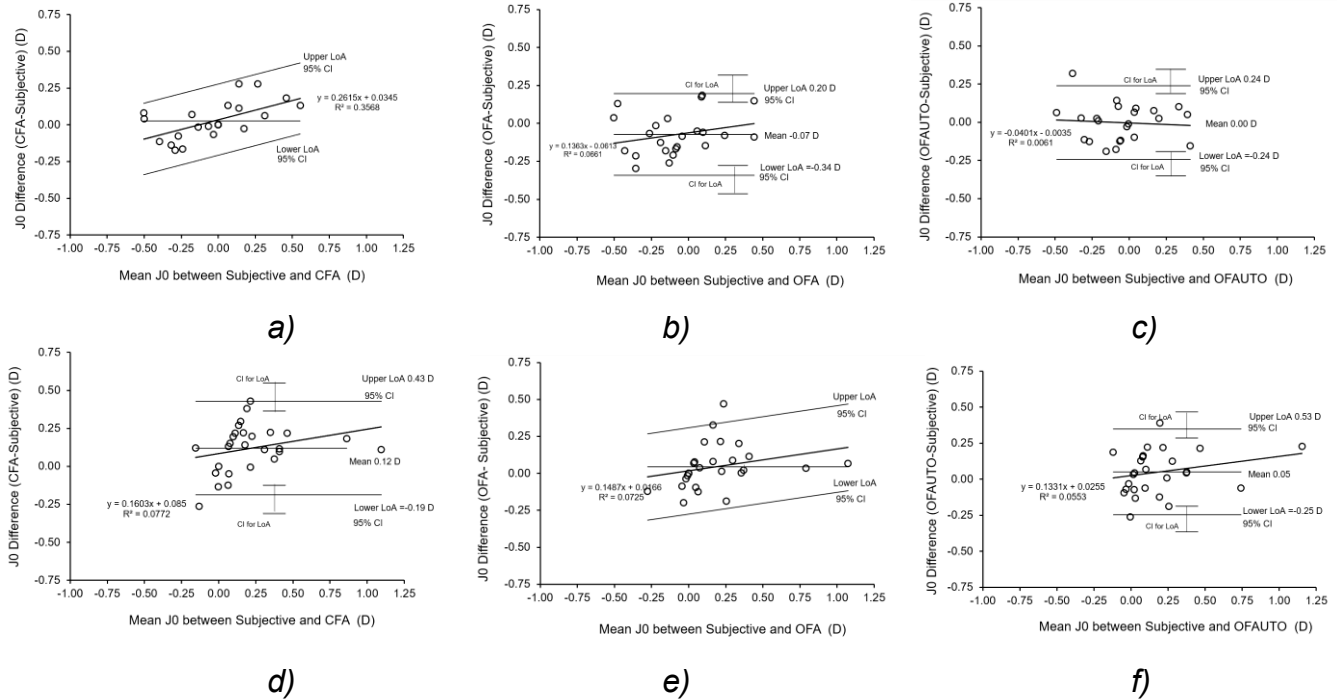


Figure S3: Bland–Altman plots illustrating the relationship between the mean of the J0 values obtained through subjective refraction and objective procedures and the difference between them for the right eye of the Presbyopic Group [CFA (a), OFA (b), and OFAUTO (c)] and the Non-presbyopic group [CFA (d), OFA (e), and OFAUTO (f)]. In the Presbyopic group, Correlation between the difference of J0 values achieved with subjective refraction and CFA and their mean was significant (r of Pearson=0.60; $p=0.03$), whereas it was not significant in the case of OFA (r of Pearson=0.26; $p=n.s.$), and OFAUTO (r of Pearson=-0.08; $p=n.s.$). In the Non-presbyopic group, correlation between the difference and the mean of J0 values achieved with subjective refraction and CFA, and subjective refraction OFAUTO was not significant (Spearman Rho=0.36 and Spearman Rho =0.33 respectively). Correlation between the difference of J0 values achieved with subjective refraction and OFA and their mean was significant (Spearman Rho =0.53; $p=0.004$). Limits of agreement (LoA) were calculated as the mean difference $\pm 1.96 \times$ standard deviation (SD) of the differences.

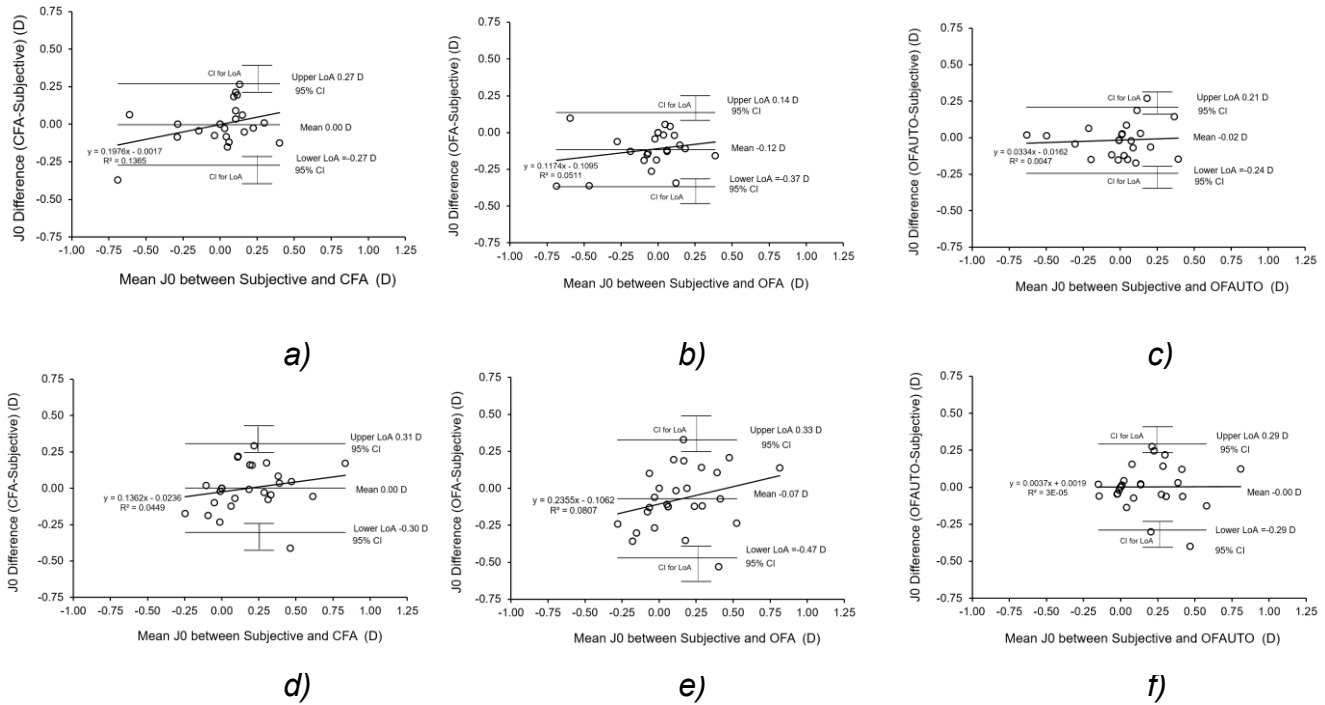


Figure S4: Bland–Altman plots illustrating the relationship between the mean of the J0 values obtained through subjective refraction and objective procedures and the difference between them for the left eye of the Presbyopic Group [CFA (a), OFA (b), and OFAUTO (c)] and the Non-presbyopic group [CFA (d), OFA (e), and OFAUTO (f)]. In the Presbyopic group, Correlation (Spearman Rho) between the difference and the mean of J0 values achieved with subjective refraction and objective refraction resulted 0.30, 0.21, and 0.12 for CFA, OFA and OFAUTO respectively (all n.s.). In the Non-presbyopic group, the correlation (r of Pearson) between the difference and the mean of J0 values achieved with subjective refraction and objective refraction resulted 0.21, 0.28, and -0.01 for CFA, OFA and OFAUTO respectively (all n.s.). Limits of agreement (LoA) were calculated as the mean difference $\pm 1.96 \times$ standard deviation (SD) of the differences.

Table S2. Bland-Altman plot information for the relationship between the mean of the J0 values obtained through objective refraction procedures (CFA, OFA, and OFAUTO) and subjective refraction and the difference between them: mean and SD of difference, limits of agreement (LoA) confidence intervals (CI) (95%) for the mean bias, CI calculated for LoA; the proportion of participants within ± 0.25 D and ± 0.50 D of subjective refraction (S). Information is reported for the right eye and left eye in the Presbyopic group and the Non-presbyopic group.

	Presbyopic group					Non-presbyopic group				
Relationship	Mean, SD of difference	LoA	CI for the mean bias	CI for LoA: outer limits / inner limits	Proportion of participants within ± 0.25 D and ± 0.50 D of S	Mean, SD of difference	LoA	CI for the mean bias	CI for LoA: outer limits / inner limits	Proportion of participants within ± 0.25 D and ± 0.50 D of S
	Right Eye									
CFA- Subjective	0.03, 0.12	-0.22 / 0.27	-0.03 / 0.08	0.22 / 0.38 -0.17 / -0.33	0.91 / 1.00	0.12, 0.16	-0.19 / 0.43	0.06 / 0.18	0.37 / 0.55 -0.13 / -0.31	0.82 / 1.00
OFA -Subjective	-0.07, 0.14	-0.34 / 0.20	-0.02 / -0.13	0.14 / 0.32 -0.28 / -0.46	0.91 / 1.00	0.04, 0.15	-0.25 / 0.34	-0.01 / 0.10	0.28 / 0.45 -0.19 / -0.37	0.93 / 1.00
OFAUTO- Subjective	0.00, 0.12	-0.24 / 0.24	-0.05 / 0.05	0.19 / 0.35 -0.19 / 0.31	0.96 / 1.00	0.05, 0.15	-0.25 / 0.35	-0.01 / 0.11	0.29 / 0.45 -0.19 / -0.37	0.93 / 1.00
	Left Eye									
CFA- Subjective	0.00, 0.14	-0.27 / 0.27	-0.06 / 0.05	0.21 / 0.39 -0.25 / -0.39	0.91 / 1.00	0.00, 0.16	-0.30 / 0.31	-0.06 / 0.06	0.25 / 0.43 -0.24 / -0.43	0.93 / 1.00
OFA -Subjective	-0.12, 0.13	-0.37 / 0.14	-0.17 / -0.06	0.08 / 0.25 -0.31 / -0.48	0.87 / 1.00	-0.07, 0.20	-0.47 / 0.33	-0.15 / 0.01	0.25 / 0.49 -0.39 / -0.63	0.78 / 0.96
OFAUTO- Subjective	-0.02, 0.12	-0.24 / 0.21	-0.06 / 0.03	0.16 / 0.31 -0.20 / -0.35	0.96 / 1.00	0.00, 0.15	-0.29 / 0.29	-0.05 / 0.06	0.23 / 0.41 -0.23 / -0.40	0.89 / 1.00

Mono vs Bino: J0 component

No statistically significant difference was found between monocular and binocular measurements of J0 component for OFA and OFAUTO in the right eye of Presbyopic group and the Non-presbyopic group (Wilcoxon test; all $p = \text{n.s.}$). The same results were found for the left eye (paired t test; all n.s.).

Table S3. Descriptive statistics (Mean $\pm$ SD; Median and Interquartile Range [IQ]) of J0 component achieved in monocular and binocular condition both for OFA e OFAUTO and the Presbyopic group (n = 23), and the Non-presbyopic group (n = 27). Differences between binocular and monocular conditions are reported as mean $\pm$ SD; Median and IQ, and 95% of Limits of Agreement (LoA). Reported p-values are unadjusted for multiple comparisons. The Bonferroni-corrected significance level is $\alpha = 0.025$. Significant values are highlighted in bold. The proportion of participants with a difference between monocular and binocular conditions within ± 0.25 D and ± 0.50 D are also reported.

Presbyopic group (n=23)				Non-presbyopic group (n=27)			
Average Reading (D) Mean $\pm$ SD; Median, (IQ Range)	Difference (D) Mean $\pm$ SD; Median, (IQ Range); 95% LoA	p-value (paired test); Correlation coefficient, value, p- value	Proportion of participants with a difference within ± 0.25 D; and ± 0.50 D	Average Reading (D) Mean $\pm$ SD; Median, (IQ Range)	Difference (D) Mean $\pm$ SD; Median, (IQ Range); 95% LoA	p-value (paired test); Correlation coefficient, value and p- value	Proportion of participants with a difference within ± 0.25 D; and ± 0.50 D

Right eye

OFA (Mono)	-0.12 $\pm$ 0.29; -0.17 (0.37)	-0.01 $\pm$ 0.09; -0.01 (0.14) -0.18 / 0.16	0.62 (t-test); r Pearson, 0.96, <0.001	1.00; 1.00	0.20 $\pm$ 0.30; 0.16 (0.36)	0.02 $\pm$ 0.09; 0.00 (0.13) -0.16 / 0.21	0.34 (Wilcoxon); Spearman Rho, 0.88, <0.001	0.96; 1.00
OFA (Bino)	-0.13 $\pm$ 0.30; -0.17 (0.38)				0.23 $\pm$ 0.30; 0.23 (0.38)			
OFAUTO (Mono)	-0.05 $\pm$ 0.24; -0.03 (0.31)	-0.02 $\pm$ 0.15; -0.03 (0.18) -0.30 / 0.27	0.59 (t-test); r Pearson, 0.85, <0.001	0.87; 1.00	0.21 $\pm$ 0.30; 0.16 (0.36)	0.00 $\pm$ 0.15; 0.00 (0.21) -0.31 / 0.30	0.94 (Wilcoxon); Spearman Rho, 0.65, <0.001	0.93; 1.00
OFAUTO (Bino)	-0.07 $\pm$ 0.28; -0.03 (0.36)				0.21 $\pm$ 0.28; 0.13 (0.30)			

Left eye

OFA (Mono)	-0.11 $\pm$ 0.27; -0.04 (0.26)	0.02 $\pm$ 0.11; 0.01 (0.05) -0.19 / 0.24	0.36 (Wilcoxon); Spearman Rho, 0.85, <0.001	0.96; 1.00	0.11 $\pm$ 0.29; 0.11 (0.39)	0.03 $\pm$ 0.09; 0.03 (0.09) -0.15 / 0.21	0.13 (t-test); r Pearson, 0.95, <0.001	1.00; 1.00
OFA (Bino)	-0.09 $\pm$ 0.26; 0.00 (0.29)				0.14 $\pm$ 0.30; 0.17 (0.44)			
OFAUTO (Mono)	-0.01 $\pm$ 0.25; 0.02 (0.27)	-0.02 $\pm$ 0.20; -0.01 (0.12) -0.40 / 0.37	0.71 (t-test); r Pearson, 0.77, <0.001	0.91; 0.96	0.19 $\pm$ 0.24; 0.15 (0.36)	0.02 $\pm$ 0.11; 0.02 (0.12) -0.20 / 0.24	0.40 (t-test); r Pearson, 0.91, <0.001	0.87; 1.00
OFAUTO (Bino)	-0.03 $\pm$ 0.30; 0.01 (0.35)				0.21 $\pm$ 0.26; 0.17 (0.28)			

Reliability of the different refraction procedures: J0 component

In [Tables S3](#) are shown the CP, CR, and ICC calculated for the value J0 achieved in the three repeated measures for each procedure, separately for Presbyopic and the Non-presbyopic group in the right and left eye respectively. All the reliability coefficients worked out for all procedures were extraordinarily high.

Table S4. CP, CR, and ICC calculated for the J0 values obtained from the three repeated measures for each procedure, separately for the right and left eye in the Presbyopic group (n = 23), and Non-presbyopic group (n = 27). * <0.001, **<0.01

	Presbyopic group (n=23)			Non-presbyopic Group (n=27)		
	CP (95% CI)	CR (95% CI)	ICC (95% CI)	CP (95% CI)	CR (95% CI)	ICC (95% CI)
Right Eye						
CFA	0.04 (0.04-0.05)	0.06 (0.05-0.08)	0.995* (0.991-0.998)	0.11 (0.09-0.14)	0.16 (0.13-0.19)	0.966* (0.937-0.983)
OFA (Mono)	0.05 (0.05-0.07)	0.08 (0.06-0.10)	0.990* (0.981-0.996)	0.05 (0.04-0.06)	0.07 (0.06-0.08)	0.994* (0.988-0.997)
OFA (Bino)	0.03 (0.03-0.04)	0.05 (0.04-0.06)	0.997* (0.994-0.999)	0.07 (0.06-0.09)	0.11 (0.09-0.13)	0.984* (0.970-0.992)
OFAUTO (Mono)	0.14 (0.12-0.18)	0.20 (0.17-0.25)	0.914* (0.837-0.960)	0.11 (0.10-0.14)	0.16 (0.14-0.20)	0.962* (0.930-0.981)
OFAUTO (Bino)	0.10 (0.08-0.13)	0.14 (0.12-0.18)	0.965* (0.933-0.984)	0.10 (0.09-0.13)	0.15 (0.12-0.18)	0.964** (0.933-0.982)
Left Eye						
CFA	0.07 (0.06-0.09)	0.10 (0.08-0.12)	0.986* (0.972-0.994)	0.06 (0.05-0.08)	0.09 (0.07-0.11)	0.986* (0.974-0.993)
OFA (Mono)	0.13 (0.11-0.17)	0.19 (0.16-0.24)	0.938* (0.88-0.971)	0.07 (0.06-0.08)	0.10 (0.08-0.12)	0.986* (0.973-0.993)
OFA (Bino)	0.05 (0.04-0.06)	0.07 (0.05-0.08)	0.992* (0.983-0.996)	0.06 (0.05-0.08)	0.09 (0.08-0.11)	0.988* (0.978-0.994)
OFAUTO (Mono)	0.18 (0.15-0.22)	0.25 (0.21-0.31)	0.880* (0.778-0.943)	0.11 (0.10-0.14)	0.16 (0.14-0.20)	0.943* (0.986-0.972)
OFAUTO (Bino)	0.08 (0.06-0.10)	0.11 (0.09-0.14)	0.984* (0.968-0.993)	0.09 (0.07-0.11)	0.12 (0.11-0.15)	0.971* (0.947-0.986)

Agreement among the different refraction procedures: J45 component

Descriptive statistics for J45 are reported in [Table S3](#). The comparison between the instruments was performed on the J45 mean data of CFA, OFA monocular, OFAUTO monocular and Subjective procedure for right eye and left eye separately.

On the right eye, the mean data sets for J45 resulted not normally distributed only in the case of Subjective refraction for the Presbyopic group and for CFA, OFA, and Subjective refraction in the Non-presbyopic group (Shapiro–Wilk test; $p < 0.005$). On the left eye, the mean data sets for J45 resulted not normally distributed only in the case OFAUTO and Subjective refraction for Presbyopic groups (Shapiro–Wilk test; $p < 0.005$).

The two-way ANOVA, run for J45 component ([Figure S5a](#)) in the right eye, showed a significant effect of procedure (within the subjects) ($F_{(3,144)} = 4.11$; Greenhouse-Geisser correction: $p = 0.01$) and interaction ($F_{(3,144)} = 3.13$; Greenhouse-Geisser

correction: $p = 0.03$), without a significant effect of group. Separate post-hoc analyses (with Bonferroni correction) for the right eye showed a significant difference for comparisons between the CFA and OFA (mean paired difference = -0.06 D, 95%CI = -0.11 to -0.01 D, adjusted p -value = 0.02), between CFA and Subjective (mean paired difference = -0.10 D, 95%CI = -0.15 to -0.05 D, adjusted p -value < 0.001), and between OFAUTO and Subjective (mean paired difference = -0.10 D, 95%CI = -0.14 to -0.05 D, adjusted p -value < 0.001) all in the Presbyopic group.

In the case of J45 for the left eye ([Figure S5b](#)), the main effect of procedure (within the subjects), the interaction and the effect of group were not significant.

In [Figures S6 a and b](#) are reported the scatterplots between right eye J45 values achieved with Subjective refraction versus objective procedures for the Presbyopic group and the Non-presbyopic group respectively. In [Figures S6 c and d](#) are reported the scatterplots between left eye J45 values achieved with Subjective refraction versus objective procedures in the Presbyopic group and the Non-presbyopic group respectively.

In the right eye, Bland–Altman plots showed a proportional bias for the relationship between difference and mean of J45 values achieved by subjective refraction and OFA in the Presbyopic group (r of Pearson= 0.54 ; $p=0.008$) ([Figure S7b](#)) and for the relationship between difference and mean of subjective refraction and CFA (Spearman $Rho=0.45$; $p=0.02$), OFA (Spearman $Rho=0.51$; $p=0.006$), and OFAUTO (Spearman $Rho=0.58$; $p=0.002$) in the Non-presbyopic group ([Figure S7 d, e, and f](#)). No proportional bias was found in the remaining comparisons ([Figures S7a and c](#)). In the left eye, Bland–Altman plots showed a proportional bias for the relationship between difference and mean of J45 values achieved by subjective refraction and CFA (Spearman $Rho=0.50$; $p=0.001$) and subjective refraction and OFA (Spearman $Rho=0.45$; $p=0.03$), both in the Presbyopic group ([Figures S8a and b](#)). No proportional bias was found in the remaining comparisons ([Figures S8c, d, e, and f](#)).

Table S5. Mean, standard deviation (SD), median, and interquartile range (IQR) of J45 values obtained for the right and left eye across the four procedures (with OFA and OFAUTO evaluated under both monocular and binocular conditions) for Presbyopic group (n = 23), and Non-presbyopic group (n = 27). For CFA, OFA and OFAUTO, three repeated measurements and their average are reported, whereas in the case of subjective refraction only the final measure is included.

	Presbyopic group (n=23)				Non-presbyopic Group (n=27)			
	First Reading Mean $\pm$ SD; Median (IQ Range) (D)	Second Reading Mean $\pm$ SD; Median (IQ Range) (D)	Third Reading Mean $\pm$ SD; Median (IQ Range) (D)	Average Reading Mean $\pm$ SD; Median (IQ Range) (D)	First Reading Mean $\pm$ SD; Median (IQ Range) (D)	Second Reading Mean $\pm$ SD; Median (IQ Range) (D)	Third Reading Mean $\pm$ SD; Median (IQ Range) (D)	Average Reading Mean $\pm$ SD; Median (IQ Range) (D)
Right eye								
CFA	-0.07 $\pm$ 0.17; 0.00 (0.25)	-0.06 $\pm$ 0.17; -0.01 (0.31)	-0.07 $\pm$ 0.17; 0.00 (0.26)	-0.07 $\pm$ 0.17; -0.01 (0.28)	-0.01 $\pm$ 0.14; -0.01 (0.19)	-0.01 $\pm$ 0.13; -0.04 (0.17)	-0.01 $\pm$ 0.14; 0.00 (0.19)	-0.01 $\pm$ 0.13; -0.03 (0.19)
OFA (Mono)	-0.02 $\pm$ 0.20; -0.08 (0.34)	0.00 $\pm$ 0.21; -0.02 (0.35)	-0.01 $\pm$ 0.20; -0.04 (0.32)	-0.01 $\pm$ 0.21; -0.07 (0.32)	-0.03 $\pm$ 0.16; -0.02 (0.14)	-0.02 $\pm$ 0.15; -0.03 (0.12)	-0.03 $\pm$ 0.16; -0.03 (0.14)	-0.03 $\pm$ 0.16; -0.02 (0.12)
OFA (Bino)	-0.03 $\pm$ 0.19; -0.07 (0.31)	-0.02 $\pm$ 0.18; -0.01 (0.24)	-0.03 $\pm$ 0.19; -0.10 (0.27)	-0.03 $\pm$ 0.18; -0.10 (0.28)	-0.03 $\pm$ 0.17; -0.04 (0.13)	-0.04 $\pm$ 0.17; -0.03 (0.14)	-0.04 $\pm$ 0.16; -0.03 (0.17)	-0.04 $\pm$ 0.16; -0.05 (0.15)
OFAUTO (Mono)	-0.06 $\pm$ 0.18; -0.11 (0.18)	-0.05 $\pm$ 0.17; -0.11 (0.14)	-0.08 $\pm$ 0.18; -0.11 (0.20)	-0.06 $\pm$ 0.17; -0.12 (0.16)	0.01 $\pm$ 0.19; -0.03 (0.21)	0.00 $\pm$ 0.15; -0.02 (0.19)	-0.01 $\pm$ 0.14; -0.02 (0.17)	0.00 $\pm$ 0.16; -0.03 (0.19)
OFAUTO (Bino)	-0.11 $\pm$ 0.20; -0.13 (0.28)	-0.10 $\pm$ 0.19; -0.11 (0.24)	-0.09 $\pm$ 0.19; -0.07 (0.26)	-0.10 $\pm$ 0.19; -0.09 (0.24)	-0.02 $\pm$ 0.22; -0.03 (0.22)	-0.01 $\pm$ 0.17; -0.02 (0.14)	0.02 $\pm$ 0.18; -0.04 (0.21)	0.02 $\pm$ 0.18; -0.04 (0.16)
Subjective Procedure	_____	_____	_____	0.03 $\pm$ 0.15; 0.00 (0.07)	_____	_____	_____	0.01 $\pm$ 0.11; 0.00 (0.06)
Left eye								
CFA	-0.03 $\pm$ 0.22; 0.00 (0.19)	-0.03 $\pm$ 0.23; 0.00 (0.18)	-0.03 $\pm$ 0.23; 0.00 (0.23)	-0.03 $\pm$ 0.22; 0.00 (0.19)	-0.02 $\pm$ 0.14; 0.00 (0.17)	-0.01 $\pm$ 0.15; 0.00 (0.21)	-0.01 $\pm$ 0.13; 0.00 (0.18)	-0.01 $\pm$ 0.14; 0.00 (0.18)
OFA (Mono)	0.01 $\pm$ 0.19; 0.00 (0.24)	0.02 $\pm$ 0.18; 0.02 (0.20)	0.01 $\pm$ 0.19; 0.03 (0.28)	0.01 $\pm$ 0.19; 0.02 (0.24)	-0.01 $\pm$ 0.13; 0.00 (0.19)	-0.01 $\pm$ 0.13; 0.00 (0.20)	-0.01 $\pm$ 0.13; 0.00 (0.22)	-0.01 $\pm$ 0.13; 0.00 (0.20)
OFA (Bino)	0.03 $\pm$ 0.19; 0.04 (0.12)	0.03 $\pm$ 0.19; 0.05 (0.10)	0.03 $\pm$ 0.19; 0.05 (0.10)	0.03 $\pm$ 0.19; 0.04 (0.10)	0.03 $\pm$ 0.13; 0.00 (0.17)	0.02 $\pm$ 0.13; 0.00 (0.19)	0.03 $\pm$ 0.13; 0.00 (0.22)	0.03 $\pm$ 0.13; 0.01 (0.17)
OFAUTO (Mono)	-0.01 $\pm$ 0.19; 0.00 (0.26)	-0.03 $\pm$ 0.21; -0.04 (0.28)	-0.03 $\pm$ 0.20; -0.03 (0.28)	-0.03 $\pm$ 0.19; -0.06 (0.25)	-0.04 $\pm$ 0.16; -0.02 (0.13)	-0.05 $\pm$ 0.16; -0.02 (0.17)	-0.05 $\pm$ 0.17; -0.03 (0.12)	-0.05 $\pm$ 0.16; -0.02 (0.15)
OFAUTO (Bino)	0.02 $\pm$ 0.18; 0.01 (0.24)	0.02 $\pm$ 0.19; 0.00 (0.22)	0.00 $\pm$ 0.20; 0.00 (0.19)	0.01 $\pm$ 0.18; 0.01 (0.21)	-0.02 $\pm$ 0.18; -0.03 (0.18)	-0.01 $\pm$ 0.18; -0.02 (0.15)	-0.01 $\pm$ 0.18; 0.00 (0.17)	-0.01 $\pm$ 0.18; 0.00 (0.17)
Subjective Procedure	_____	_____	_____	-0.03 $\pm$ 0.13; 0.00 (0.09)	_____	_____	_____	-0.03 $\pm$ 0.15; 0.00 (0.13)

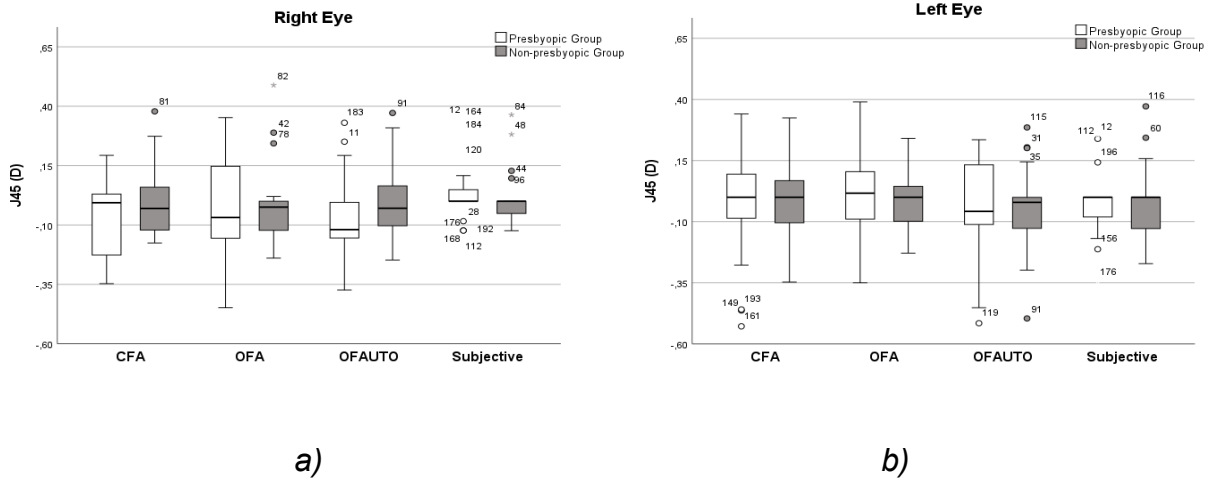


Figure S5: Box and whisker plots of the J45 values for the right eye (a) and left eye (b) obtained using the four procedures in the Presbyopic Group (n = 23), and the Non-presbyopic Group (n = 27) respectively. CFA: Closed-field aberrometer; OFA: Open-field aberrometer; OFAUTO: Open-field autorefractor; Subjective: subjective refraction.

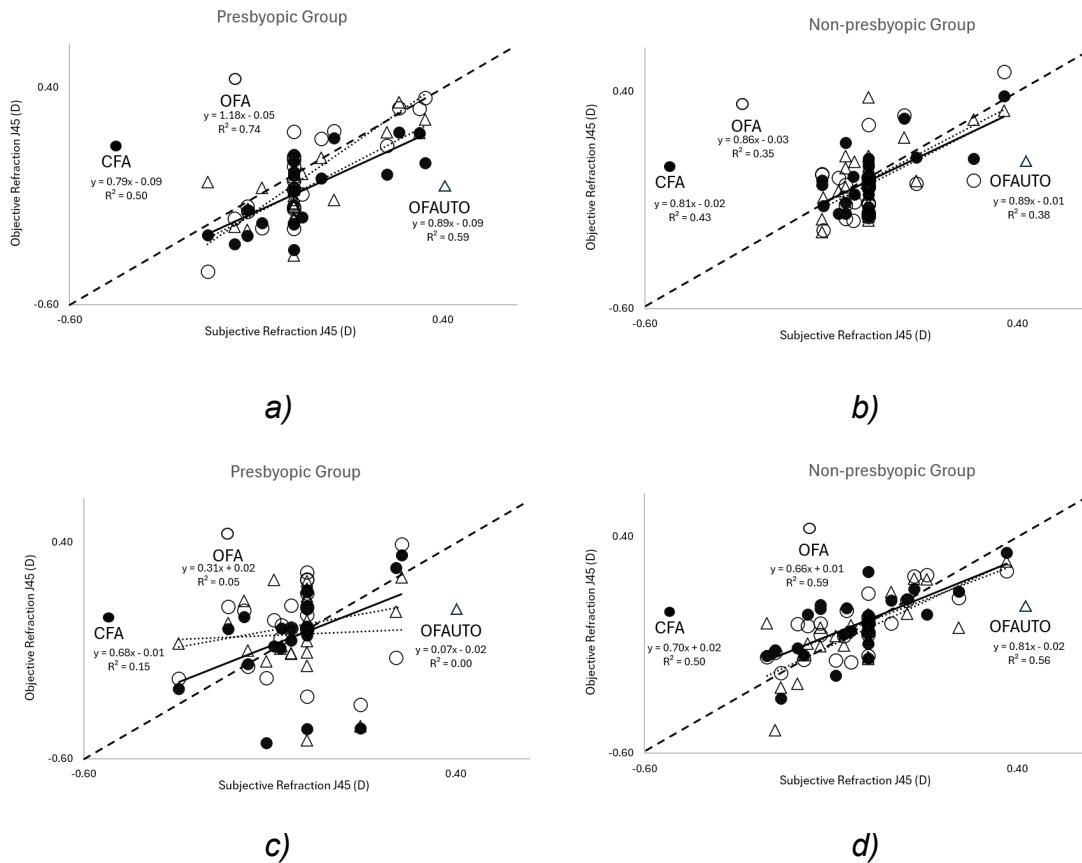


Figure S6: scatterplot of J45 values obtained with subjective refraction versus objective procedures. Panels show data for the right eye in the Presbyopic Group (a) and Non-presbyopic

Group (b), and for the left eye in the Presbyopic Group (c) and the Non-presbyopic Group (d) respectively.

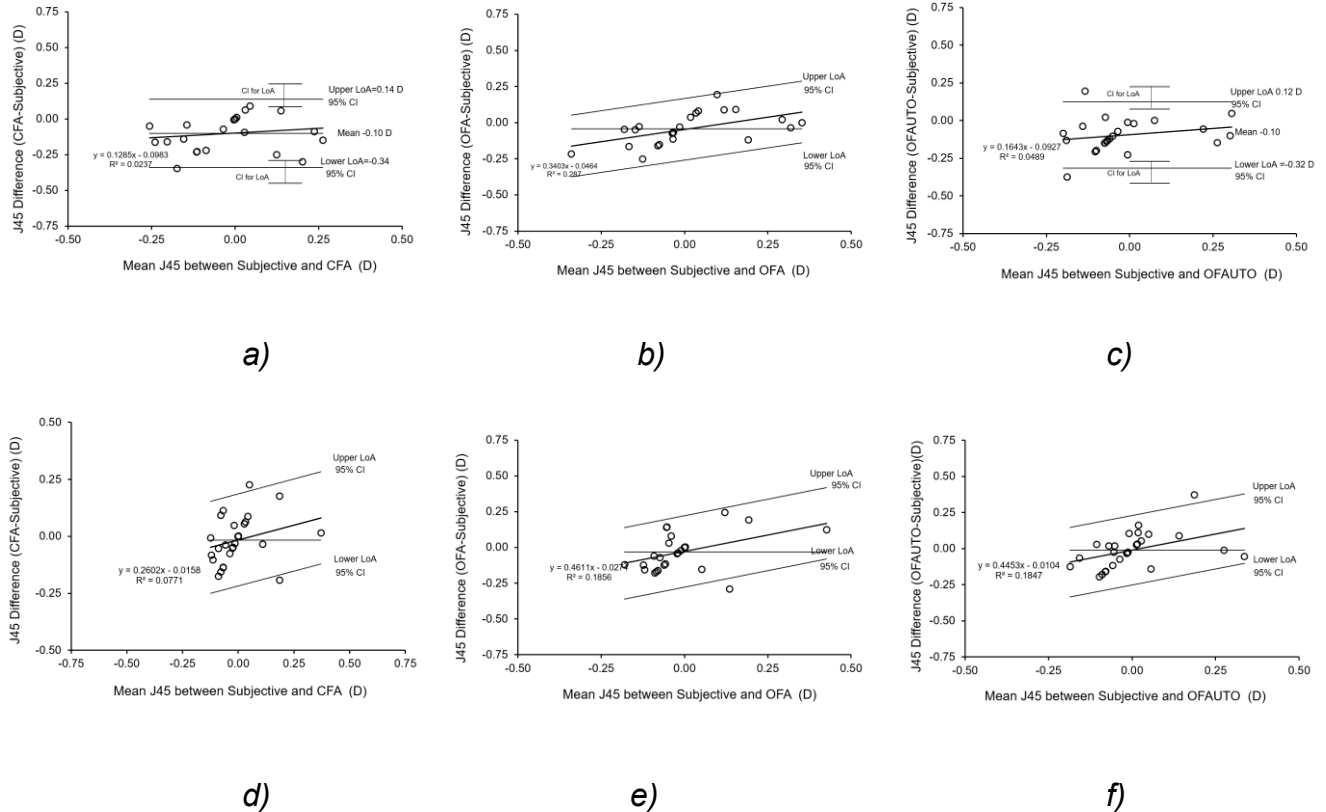


Figure S7: Bland–Altman plots illustrating the relationship between the mean of the J45 values obtained through subjective refraction and objective procedures and the difference between them for the right eye of the Presbyopic Group [CFA (a), OFA (b), and OFAUTO (c)] and the Non-presbyopic group [CFA (d), OFA (e), and OFAUTO (f)]. Correlation between the mean and the difference of J45 values achieved with Subjective refraction and OFA (b) was significant (r of Pearson = 0.54; $p=0.008$). Correlation was not significant for CFA (r of Pearson=0.15; n.s) and OFAUTO (Spearman Rho=0.30; n.s.). In the Non-presbyopic group, correlation between the mean and the difference of J45 values achieved with Subjective refraction and objective procedure were all significant: Spearman rho coefficients were 0.45 ($p=0.02$), 0.51 ($p=0.006$), and 0.58 ($p=0.002$) for CFA, OFA and OFAUTO respectively. Limits of agreement (LoA) were calculated as the mean difference $\pm 1.96 \times$ standard deviation (SD) of the differences.

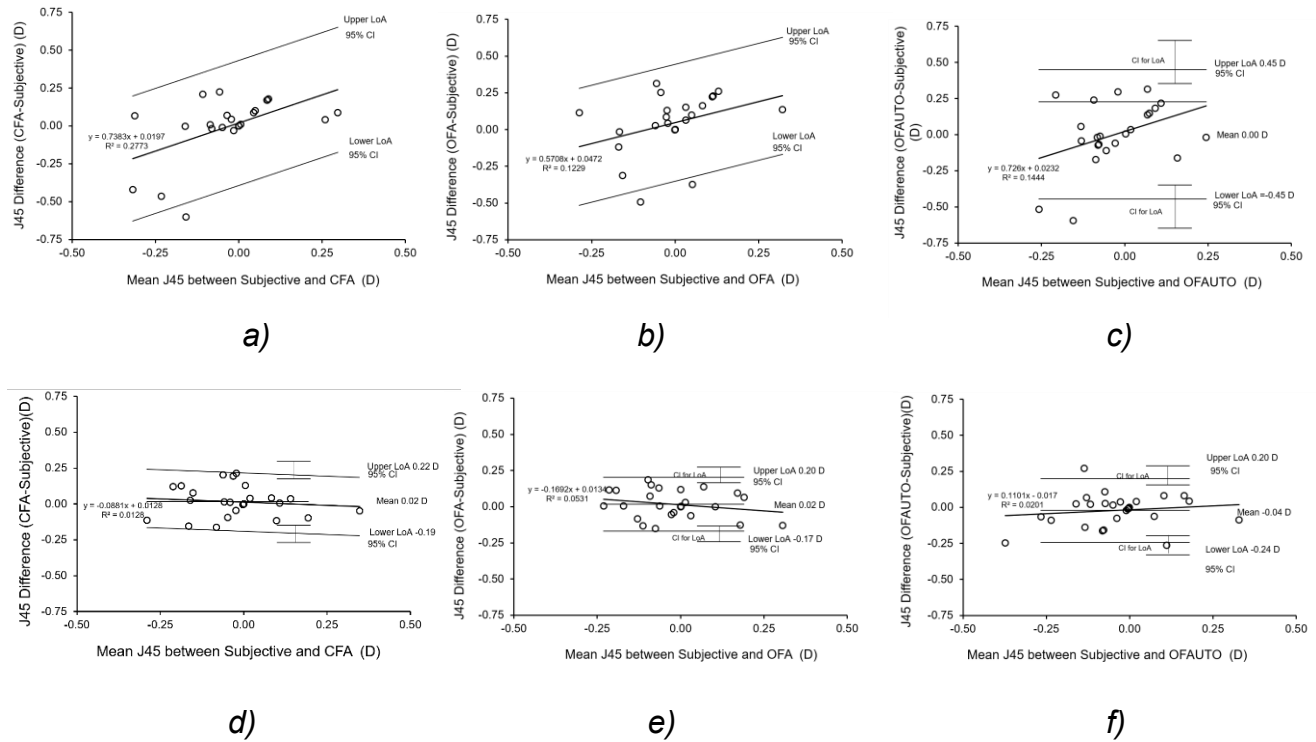


Figure S8: Bland–Altman plots illustrating the relationship between the mean of the J45 values obtained through subjective refraction and objective procedures and the difference between them for the left eye of the Presbyopic Group [CFA (a), OFA (b), and OFAUTO (c)] and the Non-presbyopic group [CFA (d), OFA (e), and OFAUTO (f)]. In the Presbyopic group, Correlation between the mean and the difference of J45 values achieved with Subjective refraction and objective procedure were significant for CFA (Spearman Rho=0.50; p=0.001) and OFA (0.45; p=0.03). In the case of OFAUTO correlation was not significant (Spearman Rho=0.31; n.s.). In the Non-presbyopic group, Correlation between the mean and the difference of J45 values achieved with Subjective and objective procedure was for all the comparisons not significant: Pearson correlation coefficient resulted -0.11, -0.23, and 0.14 for CFA, OFA and OFAUTO respectively (all p n.s). Limits of agreement (LoA) were calculated as the mean difference $\pm 1.96 \times$ standard deviation (SD) of the differences.

Table S6. Bland-Altman plot information for the relationship between the mean of the J45 values obtained through objective refraction procedures (CFA, OFA, and OFAUTO) and subjective refraction and the difference between them: mean and SD of difference, limits of agreement (LoA) confidence intervals (CI) (95%) for the mean bias, CI calculated for LoA; the proportion of participants within ± 0.25 D and ± 0.50 D of subjective refraction (S). Information is reported for the right eye and left eye in the Presbyopic group and the Non-presbyopic group.

	Presbyopic group					Non-presbyopic group				
Relationship	Mean, SD of difference	LoA	CI for the mean bias	CI for LoA: outer limits / inner limits	Proportion of participants within ± 0.25 D and ± 0.50 D of S	Mean, SD of difference	LoA	CI for the mean bias	CI for LoA: outer limits / inner limits	Proportion of participants within ± 0.25 D and ± 0.50 D of S
	Right Eye									
CFA- Subjective	-0.10, 0.12	-0.34 / 0.14	-0.05 / -0.15	0.09 / 0.25 -0.29 / -0.45	0.91 / 1.00	-0.02, 0.10	-0.22 / 0.19	-0.06 / 0.02	0.15 / 0.27 -0.18 / -0.30	1.00 / 1.00
OFA -Subjective	-0.04, 0.11	-0.26 / 0.17	0.00 / -0.09	0.12 / 0.26 -0.21 / -0.35	0.96 / 1.00	-0.03, 0.13	-0.28 / 0.22	-0.08 / 0.02	0.17 / 0.32 -0.23 / -0.38	0.96 / 1.00
OFAUTO- Subjective	-0.10, 0.11	-0.32 / 0.12	-0.05 / -0.17	0.08 / 0.22 -0.27 / -0.42	0.96 / 1.00	-0.01, 0.12	-0.25 / 0.23	-0.06 / 0.04	0.18 / 0.33 -0.20 / -0.35	0.96 / 1.00
	Left Eye									
CFA- Subjective	0.00, 0.21	-0.42 / 0.41	-0.09 / 0.08	0.32 / 0.60 -0.33 / -0.60	0.87 / 0.96	0.01, 0.10	-0.19 / 0.22	-0.02 / 0.05	0.18 / 0.30 -0.15 / -0.27	1.00 / 1.00
OFA -Subjective	0.04, 0.20	-0.36 / 0.44	-0.04 / 0.13	0.36 / 0.62 -0.27 / 0.53	0.74 / 1.00	0.02, 0.09	-0.17 / 0.20	-0.02 / 0.05	0.17 / 0.27 -0.13 / -0.24	1.00 / 1.00
OFAUTO- Subjective	0.00, 0.23	-0.45 / 0.45	-0.09 / 0.10	0.35 / 0.65 -0.35 / -0.65	0.78 / 0.91	-0.02, 0.11	-0.24 / 0.20	-0.06 / 0.02	0.15 / 0.29 -0.20 / -0.33	0.93 / 1.00

Mono vs Bino: J45 component

No statistical difference was found between monocular and binocular measurements of J45 for OFA and OFAUTO in both eyes of Presbyopic group and Non-presbyopic group (Wilcoxon test; all n.s.).

Table S7. Descriptive statistics (Mean $\pm$ SD; Median and Interquartile Range [IQ]) of J45 component achieved in monocular and binocular condition both for OFA e OFAUTO and the Presbyopic group (n = 23), and the Non-presbyopic group (n = 27). Differences between binocular and monocular conditions are reported as mean $\pm$ SD; Median and IQ, and 95% of Limits of Agreement (LoA). Reported p-values are unadjusted for multiple comparisons. The Bonferroni-corrected significance level is $\alpha = 0.025$. Significant values are highlighted in bold. The proportion of participants with a difference between monocular and binocular conditions within ± 0.25 D and ± 0.50 D are also reported.

Presbyopic group (n=23)				Non-presbyopic group (n=27)			
Average Reading (D) Mean $\pm$ SD; Median, (IQ Range)	Difference (D) Mean $\pm$ SD; Median, (IQ Range); 95% LoA	p-value (paired test); Spearman Rho and p- value	Proportion of participants with a difference within ± 0.25 D; and ± 0.50 D	Average Reading (D) Mean $\pm$ SD; Median, (IQ Range)	Difference (D) Mean $\pm$ SD; Median, (IQ Range); 95% LoA	p-value (paired test); Spearman Rho and p- value	Proportion of participants with a difference within ± 0.25 D; and ± 0.50 D

Right eye

OFA (Mono)	-0.01 $\pm$ 0.21; -0.07 (0.32)	-0.02 $\pm$ 0.09; -0.02 (0.10) -0.19 / 0.15	0.33 (t-test); r Pearson, 0.91, <0.001	1.00; 1.00	-0.03 $\pm$ 0.16; -0.02 (0.12)	-0.01 $\pm$ 0.03; 0.00 (0.08) -0.17 / 0.15	0.77 (Wilcoxon); Spearman Rho, 0.83, <0.001	1.00; 1.00
OFA (Bino)	-0.03 $\pm$ 0.18; -0.10 (0.28)				-0.04 $\pm$ 0.16; -0.05 (0.15)			
OFAUTO (Mono)	-0.06 $\pm$ 0.17; -0.12 (0.16)	-0.03 $\pm$ 0.11; -0.02 (0.17) -0.24 / 0.18	0.15 (t-test); r Pearson, 0.83, <0.001	1.00; 1.00	0.00 $\pm$ 0.16; -0.03 (0.19)	-0.01 $\pm$ 0.11; -0.01 (0.19) -0.24 / 0.21	0.54 (t-test); r Pearson, 0.77, <0.001	1.00; 1.00
OFAUTO (Bino)	-0.10 $\pm$ 0.19; -0.09 (0.24)				0.02 $\pm$ 0.18; -0.04 (0.16)			

Left eye

OFA (Mono)	0.01 $\pm$ 0.19; 0.02 (0.24)	0.02 $\pm$ 0.09; 0.01 (0.08) -0.16 / 0.20	0.31 (t-test); r Pearson, 0.88, <0.001	0.96; 1.00	-0.01 $\pm$ 0.13; 0.00 (0.20)	0.04 $\pm$ 0.09; 0.03 (0.09) -0.14 / 0.22	0.04 (t-test); r Pearson, 0.74, <0.001	0.96; 1.00
OFA (Bino)	0.03 $\pm$ 0.19; 0.04 (0.10)				0.03 $\pm$ 0.13; 0.01 (0.17)			
OFAUTO (Mono)	-0.03 $\pm$ 0.19; -0.06 (0.25)	0.04 $\pm$ 0.18; 0.03 (0.17) -0.31 / 0.39	0.32 (Wilcoxon); Spearman Rho, 0.66, <0.001	0.91; 0.96	-0.05 $\pm$ 0.16; -0.02 (0.15)	0.03 $\pm$ 0.12; 0.02 (0.08) -0.20 / 0.27	0.14 (t-test); r Pearson, 0.77, <0.001	0.93; 1.00
OFAUTO (Bino)	0.01 $\pm$ 0.18; 0.01 (0.21)				-0.01 $\pm$ 0.18; 0.00 (0.17)			

Reliability of the different refraction procedures: J45 component

In [Tables S4](#) are shown the CP, CR, and ICC calculated for the value J45 achieved in the three repeated measures for each procedure, separately for Presbyopic and the Non-presbyopic group in the right and left eye respectively. All the reliability coefficients worked out for all procedures were extraordinarily high.

Table S8. CP, CR, and ICC calculated for the J45 values obtained from the three repeated measures for each procedure, separately for the right and left eye in the Presbyopic group (n = 23), and Non Presbyopic (n = 27). * <0.001, **<0.01

	Presbyopic group (n=23)			Non-presbyopic group (n=27)		
	CP (95% CI)	CR (95% CI)	ICC (95% CI)	CP (95% CI)	CR (95% CI)	ICC (95% CI)
Right Eye						
CFA	0.05 (0.04-0.06)	0.07 (0.05-0.08)	0.980* (0.961-0.991)	0.06 (0.05-0.08)	0.09 (0.07-0.11)	0.948* (0.904-0.974)
OFA (Mono)	0.06 (0.05-0.08)	0.09 (0.07-0.11)	0.976* (0.952-0.989)	0.04 (0.03-0.04)	0.05 (0.04-0.06)	0.987* (0.975-0.994)
OFA (Bino)	0.04 (0.04-0.06)	0.06 (0.05-0.08)	0.985* (0.970-0.993)	0.06 (0.05-0.07)	0.08 (0.07-0.10)	0.969* (0.943-0.985)
OFAUTO (Mono)	0.10 (0.08-0.12)	0.14 (0.11-0.17)	0.924* (0.854-0.964)	0.09 (0.08-0.11)	0.13 (0.11-0.16)	0.914* (0.846-0.957)
OFAUTO (Bino)	0.09 (0.07-0.11)	0.12 (0.10-0.15)	0.947* (0.898-0.975)	0.08 (0.07-0.10)	0.11 (0.09-0.14)	0.950* (0.909-0.975)
Left Eye						
CFA	0.03 (0.03-0.04)	0.04 (0.04-0.06)	0.995* (0.990-0.998)	0.05 (0.04-0.06)	0.07 (0.06-0.09)	0.966* (0.938-0.983)
OFA (Mono)	0.03 (0.02-0.03)	0.04 (0.03-0.05)	0.994* (0.989-0.997)	0.04 (0.03-0.05)	0.05 (0.05-0.07)	0.976* (0.956-0.988)
OFA (Bino)	0.05 (0.05-0.07)	0.08 (0.06-0.10)	0.978* (0.958-0.990)	0.06 (0.05-0.08)	0.09 (0.07-0.11)	0.944* (0.898-0.972)
OFAUTO (Mono)	0.11 (0.10-0.14)	0.16 (0.14-0.20)	0.914* (0.839-0.959)	0.08 (0.07-0.10)	0.11 (0.09-0.13)	0.943* (0.896-0.972)
OFAUTO (Bino)	0.10 (0.08-0.13)	0.14 (0.12-0.18)	0.927* (0.861-0.966)	0.08 (0.06-0.09)	0.11 (0.09-0.13)	0.953* (0.914-0.977)