Intra-session repeatability of iridocorneal angle measurements in normal subjects and glaucoma patients using Scheimpflug-Placido disc topographer

Dear Editor,

Quantitative iridocorneal angle (ICA) measurement is essential in planning implantable collamer lens (ICL) surgery and to measure angle widening after laser peripheral iridotomy (LPI) in primary angle-closure glaucoma (PACG). Sirius Scheimpflug-Placido disc topographer (SCHWIND eye-tech-solutions, Kleinostheim, Germany) combines placido corneal topography with rotating Scheimpflug camera to measure ICA.

We assessed intra-session, intra-operator repeatability of ICA measurements in 102 subjects (50 normal and 52 PACG) with Sirius topographer. All scans were performed by a single optometrist between 12:30 pm to 2 p.m. in the same standardized room illumination. Three scans were taken sequentially with a 5-minute interval between each measurement. “Glaucoma summary” output at nasal and temporal meridians (0°, ±10°, ±20°, ±30°) was noted. Images were checked for good-quality indices (centration, coverage >90%) and “good” acquisition quality (green check mark).

Statistical analysis was performed using the SPSS software (version 16; Chicago, USA). Descriptive statistics included median and interquartile range for non-normally distributed variables. Intraclass correlation coefficient (ICC), within-subject standard deviation (Sw), and intra-subject precision were used to assess the intra-session repeatability.

Descriptive analysis for ICA measurements is shown in Table 1. Mean pair-wise comparison showed that the nasal ICA measurements were significantly lower than the corresponding temporal ICA measurements in both normal and PACG (p < 0.0001). ICC ranged from 0.991 (temporal 30°) to 0.916 (nasal 20°) in the normal subjects to 0.986 (temporal 30°) to 0.916 (nasal 10°) in PACG. The best precision of repeatability was approximately 2° (temporal 30°) in normal subjects and 3° (temporal –30°) in glaucoma patients. The Sw was below

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### Table 1: Iridocorneal angle measurements in the different meridians measured with Scheimpflug-Placido disc topographer in normal subjects and glaucoma patients

| Iridocorneal angle meridians | Median (interquartile range: first quartile, third quartile) | Range (minimum–maximum) |
|-----------------------------|-------------------------------------------------------------|--------------------------|
| **Normal subjects**         |                                                             |                          |
| Median age: 37 years (IQR: 23,47) |                                                             |                          |
| Temporal angle –30°         | 46.00 (40.00, 49.33)                                        | 33-64                    |
| Temporal angle –20°         | 46.00 (41.00, 49.17)                                        | 31-54                    |
| Temporal angle –10°         | 47.67 (43.17, 49.50)                                        | 26-56                    |
| Temporal angle 0°           | 48.00 (42.50, 50.33)                                        | 30-59                    |
| Temporal angle 10°          | 46.00 (43.67, 49.83)                                        | 29-60                    |
| Temporal angle 20°          | 47.00 (42.83, 50.67)                                        | 29-57                    |
| Temporal angle 30°          | 48.33 (43.17, 50.50)                                        | 29-65                    |
| Nasal angle –30°            | 39.00 (34.83, 45.00)                                        | 18-55                    |
| Nasal angle –20°            | 41.00 (34.17, 45.00)                                        | 20-56                    |
| Nasal angle –10°            | 38.33 (33.17, 44.50)                                        | 18-53                    |
| Nasal angle 0°              | 40.00 (34.83, 44.67)                                        | 22-51                    |
| Nasal angle 10°             | 40.67 (33.17, 43.83)                                        | 19-56                    |
| Nasal angle 20°             | 40.00 (33.00, 45.17)                                        | 15-53                    |
| Nasal angle 30°             | 42.00 (34.83, 46.50)                                        | 19-56                    |
| **Glaucoma patients**       |                                                             |                          |
| Median age: 53 years (IQR: 48,64) |                                                             |                          |
| Temporal angle –30°         | 39.33 (34.92, 43.17)                                        | 26-58                    |
| Temporal angle –20°         | 39.33 (35.17, 42.42)                                        | 28-57                    |
| Temporal angle –10°         | 40.00 (36.00, 43.17)                                        | 25-56                    |
| Temporal angle 0°           | 40.00 (35.92, 42.67)                                        | 24-61                    |
| Temporal angle 10°          | 39.17 (35.92, 42.25)                                        | 23-57                    |
| Temporal angle 20°          | 39.00 (33.33, 43.42)                                        | 21-60                    |
| Temporal angle 30°          | 38.67 (34.67, 43.08)                                        | 23-60                    |
| Nasal angle –30°            | 33.00 (27.33, 36.00)                                        | 19-53                    |
| Nasal angle –20°            | 32.00 (27.58, 36.33)                                        | 20-51                    |
| Nasal angle –10°            | 31.67 (26.58, 36.83)                                        | 16-52                    |
| Nasal angle 0°              | 31.67 (26.58, 35.58)                                        | 14-52                    |
| Nasal angle 10°             | 31.33 (28.25, 34.08)                                        | 19-51                    |
| Nasal angle 20°             | 30.00 (27.17, 34.92)                                        | 14-50                    |
| Nasal angle 30°             | 32.33 (27.33, 36.42)                                        | 16-49                    |
Table 2: Intra-session, intra-operator repeatability of iridocorneal angle in different meridians measured with Scheimpflug-Placido disc topographer in normal subjects and glaucoma patients

| Iridocorneal angle meridians | Intraclass correlation coefficient (ICC) (95% Confidence Interval (lower bound–upper bound)) | Intra-subject standard deviation (Sw) (°) | Intra-subject Precision (°) | Intra-subject repeatability |
|-----------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------|--------------------------|
| **Normal subjects**         |                                                                                                 |                                        |                                |                          |
| Temporal angle –30°         | 0.984 (0.971-0.992)                                                                              | 1.645                                  | 3.224                          | 4.557                    |
| Temporal angle –20°         | 0.919 (0.852-0.958)                                                                              | 2.323                                  | 4.357                          | 6.434                    |
| Temporal angle –10°         | 0.983 (0.969-0.991)                                                                              | 2.000                                  | 3.92                           | 5.54                     |
| Temporal angle 0°           | 0.988 (0.978-0.994)                                                                              | 1.731                                  | 3.393                          | 4.795                    |
| Temporal angle 10°          | 0.983 (0.970-0.991)                                                                              | 2.376                                  | 4.657                          | 6.581                    |
| Temporal angle 20°          | 0.988 (0.978-0.994)                                                                              | 1.548                                  | 3.034                          | 4.288                    |
| Temporal angle 30°          | 0.991 (0.983-0.995)                                                                              | 1.054                                  | 2.066                          | 2.919                    |
| Nasal angle –30°            | 0.964 (0.935-0.981)                                                                              | 7.376                                  | 14.457                         | 20.431                   |
| Nasal angle –20°            | 0.966 (0.938-0.982)                                                                              | 3.538                                  | 6.934                          | 9.302                    |
| Nasal angle –10°            | 0.960 (0.927-0.979)                                                                              | 7.140                                  | 13.994                         | 19.778                   |
| Nasal angle 0°              | 0.966 (0.939-0.983)                                                                              | 5.828                                  | 11.423                         | 16.143                   |
| Nasal angle 10°             | 0.966 (0.938-0.982)                                                                              | 6.742                                  | 13.214                         | 18.675                   |
| Nasal angle 20°             | 0.916 (0.866-0.949)                                                                              | 6.215                                  | 12.181                         | 17.215                   |
| Nasal angle 30°             | 0.972 (0.949-0.985)                                                                              | 4.581                                  | 8.066                          | 12.689                   |
| **Glaucoma patients**       |                                                                                                 |                                        |                                |                          |
| Temporal angle –30°         | 0.981 (0.970-0.989)                                                                              | 1.582                                  | 3.101                          | 4.382                    |
| Temporal angle –20°         | 0.918 (0.911-0.932)                                                                              | 2.163                                  | 4.239                          | 5.991                    |
| Temporal angle –10°         | 0.955 (0.929-0.973)                                                                              | 3.268                                  | 6.405                          | 9.052                    |
| Temporal angle 0°           | 0.958 (0.933-0.975)                                                                              | 3.954                                  | 7.750                          | 10.952                   |
| Temporal angle 10°          | 0.974 (0.959-0.984)                                                                              | 2.542                                  | 4.982                          | 7.041                    |
| Temporal angle 20°          | 0.983 (0.972-0.990)                                                                              | 2.150                                  | 4.214                          | 5.955                    |
| Temporal angle 30°          | 0.986 (0.978-0.992)                                                                              | 1.810                                  | 3.548                          | 5.013                    |
| Nasal angle –30°            | 0.950 (0.921-0.970)                                                                              | 4.778                                  | 9.365                          | 13.235                   |
| Nasal angle –20°            | 0.949 (0.919-0.969)                                                                              | 4.595                                  | 9.006                          | 12.728                   |
| Nasal angle –10°            | 0.956 (0.931-0.974)                                                                              | 5.980                                  | 11.721                         | 16.565                   |
| Nasal angle 0°              | 0.954 (0.927-0.972)                                                                              | 5.209                                  | 10.209                         | 14.429                   |
| Nasal angle 10°             | 0.916 (0.866-0.949)                                                                              | 7.209                                  | 14.13                          | 19.969                   |
| Nasal angle 20°             | 0.948 (0.918-0.969)                                                                              | 5.438                                  | 10.658                         | 15.063                   |
| Nasal angle 30°             | 0.957 (0.932-0.974)                                                                              | 5.752                                  | 11.274                         | 15.933                   |

2.4° (temporal) and 7.4° (nasal) in normal subjects and below 4° (temporal) and below 7.2° (nasal) in PACG [Table 2].

Ruiz-Belda et al.[11] have demonstrated high repeatability for the ICA measurements in normal subjects using the Sirius topographer. Repeatability of ICA measurements with Sirius topographer in glaucoma has not been reported. We found that the Sirius topographer provides excellent repeatability of nasal and temporal ICA measurements in normal subjects and PACG, but there was a regional and sector variation, with all the nasal ICA being significantly lower than the temporal ICA in both the groups. This could be due to the fact that the nasal ICA measurements are affected by the nose shadow, resulting in lower repeatability. As pupil-size variation can influence angle configuration and its measurement, we obtained all the scans in standardized lighting condition to minimize the pupillary response to variation of light and accommodation. In our study, the intra-session ICC was high for both the nasal and temporal ICA measurements. The excellent repeatability was also reflected by the high precision. The temporal 30° ICA precision was found to be 2.066, which means that the true value measured in this meridian would be expected to be less than 2.1° for 95% of the observations.

One of the limitations of the Sirius topographer is that it can measure only nasal and temporal meridians, as the built-in software produces ICA measurement from 7/25 slit frames, in nasal and temporal meridian only.

In conclusion, Sirius topographer demonstrated reliable ICA measurements with good repeatability and would prove useful in PACG and in patients undergoing ICL implantation.

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Conflicts of interest
There are no conflicts of interest.

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Reference

1. Ruiz-Belda C, Piñero DP, Ruiz-Fortes P, Soto-Negro R, Moya M, Pérez-Cambrodí RJ, et al. Intra-session repeatability of iridocorneal angle measurements provided by a Scheimpflug photography-based system in healthy eyes. Graefes Arch Clin Exp Ophthalmol 2016;254:169-75.

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