Nationwide multicentre comparison of preoperative biometry and predictability of cataract surgery in Japan

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ABSTRACT

Aim To compare the preoperative biometric data and the refractive accuracy of cataract surgery among major surgical sites in a nationwide multicentre study.

Methods We prospectively obtained the preoperative biometric data of 2143 eyes of 2143 consecutive patients undergoing standard cataract surgery at major 12 facilities and compared the preoperative biometry as well as the postoperative refractive accuracy among them.

Results We found significant differences in most preoperative variables, such as axial length (one-way analysis of variance, p=0.003), anterior chamber depth (p<0.001), lens thickness (p<0.001) and central corneal thickness (p<0.001), except for mean keratometry (p=0.587) and corneal astigmatism (p=0.304), among the 12 surgical sites. The prediction error using the Sanders-Retzlaff-Kraff/Theoretical (SRK/T formula was significantly more hyperopic than that using the Barrett Universal II formula (paired t-test, p<0.001). The absolute error using the SRK/T formula was significantly larger than that using the Barrett Universal II formula (p=0.016). The prediction error using the SRK/T formula was significantly more hyperopic than that using the Barrett Universal II formula at 10 of 12 institutions, but significantly more myopic at one institution. The absolute error using the SRK/T formula was significantly larger than that using the Barrett Universal II formula at 4 of 12 institutions but significantly smaller at two institutions.

Conclusions Regional divergences of the preoperative biometry were not necessarily negligible, and the optimised intraocular lens power calculation formula was individually different among the 12 facilities. Our findings highlight the importance of individual optimisation of these formulas at each facility, especially in consideration of these biometric variations.

Trial registration number
Clinical Trial Registry; 000039976.

INTRODUCTION

Modern cataract surgery has been acknowledged as one of the effective means for the treatment of refractive errors by implanting an intraocular lens (IOL) with a proper refractive power. Not only meticulous preoperative biometry but also precise IOL power calculation is necessary in order to further obtain the precise refraction and to maximise the subsequent patient satisfaction after cataract surgery. Although the refractive accuracy of modern cataract surgery has been considerably refined by the introduction of the optical biometry and the newest-generation IOL power calculation formulas, regional dissimilarities of the preoperative biometry may contribute to the variances not only in the optimised IOL power calculation formula but also in the surgical complexity of cataract cases at an individual surgical site.

Local differences in the preoperative biometry, such as keratometry, axial length, anterior chamber depth, lens thickness, corneal thickness and corneal astigmatism, may influence the optimised selection of IOL power calculation formulas as well as the subsequent refractive precision of cataract surgery. There have so far been several comparative studies on the preoperative biometry for cataract surgery.[1–5] However, most studies have simply focused on the biometric comparison based on the ethnicities of patients with cataract. Therefore, neither a detailed direct comparison of the preoperative biometric distributions, nor the refractive correctness of cataract surgery, has yet been fully understood, in patients with cataract in various regions. It may give us intrinsic insights into understanding the biometric distribution among a cataract population and selecting the optimised IOL power calculation formula in different areas in daily practice. The goal of the present multicenter study is to prospectively compare the preoperative biometry, and the refractive precision of cataract surgery, among 12 nationwide major surgical facilities in Japan.

MATERIALS AND METHODS

Study population

We registered this study protocol with the University Hospital Medical Information Network Clinical Trial Registry. This multicentre study was held under the auspices of the Data Analysis Committee of the Japanese Society of Cataract and Refractive Surgery (JSCRS). This prospective observational study comprised a total of 2143 eyes of 2143 consecutive patients who underwent standard phacoemulsification with monofocal IOL implantation, with high-quality data of a swept source optical coherence tomography-based optical biometer (IOLMaster 700, Carl Zeiss Meditec, AG, Jena, Germany or OA-2000, Tomey Corporation, Aichi, Japan), at the 12 major surgical sites (Eguchi Eye Hospital, Hokkaido; Sato Yuya Eye Clinic,

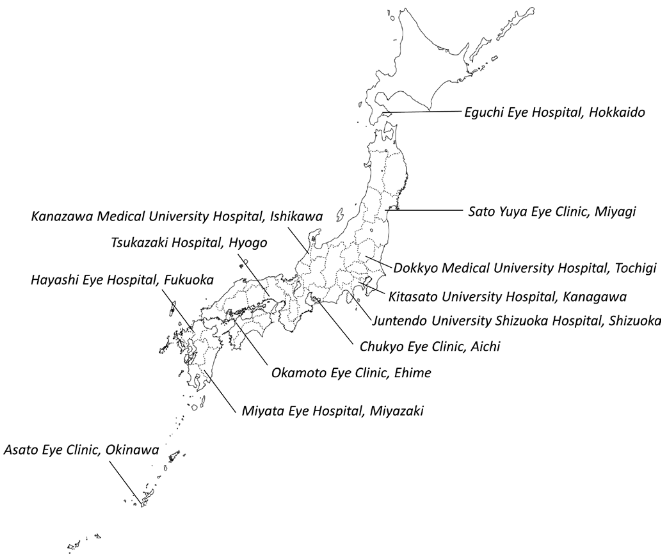

Figure 1 A graph showing the locations of the 12 institutions in Japan. These institutions were located in all regions of Japan (Hokkaido, Tohoku, Kanto, Tokai, Hokuriku, Kansai, Chugoku-Shikoku, Kyushu and Okinawa).

Miyagi; Dokkyo Medical University Hospital, Tochigi; Kitasato University Hospital, Kanagawa; Juntendo University Shizuoka Hospital, Shizuoka; Chukyo Eye Clinic, Aichi; Kanazawa Medical University Hospital, Ishikawa; Tsukazaki Hospital, Hyogo; Okamoto Eye Clinic, Ehime; Hayashi Eye Hospital, Fukuoka; Miyata Eye Hospital, Miyazaki and Asato Eye Clinic, Okinawa), between June 2019 and August 2020. These surgical sites were located in all regions of Japan (Hokkaido, Tohoku, Kanto, Tokai, Hokuriku, Kansai, Chugoku-Shikoku, Kyushu and Okinawa) (figure 1). The inclusion criteria were 20 ≤age <95 years, corneal astigmatism ≤3.0 D, no symptoms of lens dislocation or subluxation, no concomitant eye diseases such as severe dry eye, progressive corneal degeneration, severe glaucoma, uveitis and retinal disease and no history of ocular surgery. The exclusion criteria were eyes with postoperative best-corrected visual acuity ≥0.15 logMAR, eyes with out of the capsular bag fixation, eyes requiring sutures to the wound or eyes developing any intraoperative or postoperative complications that could affect refractive outcomes. Only one eye was randomly selected for statistical analysis, when bilateral cataract surgery was performed. The targeted sample size was set at 200 eyes of 200 patients at each facility. Written informed consent for cataract surgery was obtained from all patients. This prospective observational study was approved by the Institutional Review Board at Kitasato University Hospital (B18-290) and followed the tenets of the Declaration of Helsinki.

Assessment of refractive error

IOL power was calculated by the SRK/T formula[6] and by the Barrett Universal II formula,[7] using keratometric readings, axial length and anterior chamber depth (only for the Barrett Universal II formula), measured with an optical biometer. We optimised the A-constants for both IOL power calculations at each facility. We determined the prediction errors, which was calculated by subtracting the postoperative manifest spherical equivalent refraction 1 month postoperatively from the predicted refraction, these absolute values, and the percentages of eyes within ±0.25, 0.5 and 1.0 diopter (D) of the targeted refraction.

Statistical analysis

The variance of the biometric data among all institutions was checked by using one-way analysis of variance (ANOVA), when the data were normally distributed. Otherwise, it was checked by the Kruskal-Wallis test. The paired t-test was used to compare the biometric data, the prediction error and the absolute error, using the SRK/T and the Barrett Universal II formulas. The McNemar test was used to compare the percentages of eyes within ±0.25, 0.5 and 1.0 D of the targeted correction. We expressed the results as mean±SD, and a value of $p<0.05$ was considered statistically significant.

RESULTS

Table 1 shows the preoperative demographics of the whole study population. We found significant differences in most preoperative metrics, such as axial length (one-way ANOVA, $p=0.003$), anterior chamber depth ($p<0.001$), lens thickness ($p<0.001$) and central corneal thickness ($p<0.001$), except for mean keratometry ($p=0.587$) and corneal astigmatism ($p=0.304$), among the 12 surgical institutions (figures 2–7). Multiple comparison analyses were shown as the heat maps in online supplemental files 1–6.

Table 2 shows the prediction error and the absolute error of the targeted refraction, when using the SRK/T and the Barrett Universal II formulas. In the entire population, the prediction error (0.01±0.54 D) using the SRK/T formula was significantly more hyperopic than that (−0.11±0.49 D) using Barrett Universal II formula (paired t-test, $p<0.001$). The absolute error (0.39±0.37 D) using the SRK/T formula was significantly larger than that (0.36±0.34 D) using the Barrett Universal II formula ($p=0.016$).

Based on the classification of the axial length (short; <22 mm, middle; ≤22, <26 mm, long; ≤26 mm), the prediction error using the SRK/T formula was significantly more hyperopic than that using the Barrett Universal II formula, in the short and middle axial length groups ($p<0.001$) but not in the long axial length group ($p=0.362$). The absolute error using the SRK/T formula was significantly larger than that using the Barrett Universal II formula in the long axial length group ($p<0.001$), significantly smaller in the short axial length group ($p<0.001$) and not significantly different in the middle axial length group ($p=0.097$).

The prediction error using the SRK/T formula was significantly more hyperopic than that using the Barrett Universal II formula at 10 of 12 institutions, significantly more myopic at one institution, and not significantly different at one institution. The absolute error using the SRK/T formula was significantly larger than that using the Barrett Universal II formula at 4 of 12 institutions, significantly smaller at two institutions and not significantly different at six institutions.

Table 3 shows the percentages within ±0.25, 0.5 and 1.0 D of the targeted refraction. In the entire population, there were no significant differences in the percentages within ±0.25, 0.5 and 1.0 D using the two formulas (McNemar test, $p=0.353$, $p=1.000$ and $p=0.188$, respectively). The percentages within ±0.25 and 0.5 D using the Barrett Universal II formula were significantly higher than that when using the SRK/T formula at 1 of 12 institutions and significantly smaller at one institution. Otherwise, the percentages of eyes within ±0.25, 0.5 or 1.0 D were not significantly different between the two groups at any institution.

DISCUSSION

In the current study, our nationwide multicentre study showed that there were significant variances in most preoperative

Table 1 Preoperative demographics of the study population undergoing cataract surgery

		Eyes	Age (years)	Gender (male: female)	Mean keratometric readings (D)	Axial length (mm)	Anterior chamber depth (mm)	Lens thickness (mm)	Central corneal thickness (mm)	Corneal astigmatism (D)
Total		2143	72.83±8.26	897:1246	44.32±1.50	24.02±1.59	3.13±0.42	4.56±0.45	0.54±0.04	0.91±0.65
95% CI			56.64 to 89.03		41.38 to 47.25	20.89 to 27.14	2.3 to 3.97	3.68 to 5.43	0.46 to 0.61	−0.37 to 2.19
Eguchi Eye Hospital	Hokkaido	175	75.33±7.88	61:114	44.16±1.55	23.79±1.64	3.17±0.44	4.59±0.47	0.52±0.05	0.93±0.83
OA-2000			59.87 to 90.78		41.13 to 47.19	20.56 to 27.01	2.31 to 4.03	3.67 to 5.50	0.43 to 0.62	−0.70 to 2.55
Sato Yuya Eye Clinic	Miyagi	200	72.61±8.15	88:112	44.37±1.33	24.22±1.49	3.25±0.44	4.42±0.47	0.55±0.03	0.83±0.58
IOLMaster 700			56.63 to 88.58		41.76 to 46.98	21.3 to 27.14	2.39 to 4.10	3.51 to 5.34	0.48 to 0.61	−0.31 to 1.98
Dokkyo Medical University	Tochigi	130	72.39±8.03	58:72	44.27±1.38	24.02±1.70	3.18±0.47	4.62±0.45	0.51±0.04	0.88±0.59
OA-2000			56.65 to 88.14		41.56 to 46.98	20.68 to 27.36	2.25 to 4.11	3.74 to 5.51	0.45 to 0.58	−0.28 to 2.04
Kitasato University	Kanagawa	143	73.61±8.22	65:78	44.2±1.48	24.28±1.75	3.07±0.46	4.61±0.43	0.55±0.03	0.84±0.53
IOLMaster 700			57.5 to 89.72		41.3 to 47.11	20.85 to 27.72	2.18 to 3.97	3.77 to 5.44	0.48 to 0.61	−0.20 to 1.88
Juntendo University Shizuoka	Shizuoka	164	75.83±7.49	61:103	44.46±1.44	23.76±1.33	3.15±0.39	4.55±0.40	0.54±0.03	0.89±0.60
IOLMaster 700			61.14 to 90.51		41.64 to 47.27	21.15 to 26.37	2.39 to 3.91	3.77 to 5.33	0.48 to 0.60	−0.27 to 2.06
Chukyo Eye Clinic	Aichi	200	73.41±8.49	93:107	44.43±1.56	24.12±1.48	3.16±0.44	4.55±0.50	0.55±0.04	0.93±0.61
IOLMaster 700			56.78 to 90.04		41.38 to 47.47	21.21 to 27.02	2.30 to 4.02	3.58 to 5.52	0.48 to 0.62	−0.26 to 2.13
Kanazawa Medical University	Ishikawa	200	71.88±8.6	89:111	44.18±1.64	24.20±2.03	3.12±0.42	4.53±0.45	0.54±0.04	0.88±0.69
IOLMaster 700			55.02 to 88.73		40.97 to 47.39	20.21 to 28.18	2.29 to 3.94	3.64 to 5.41	0.47 to 0.61	−0.46 to 2.23
Tsukazaki Hospital	Hyogo	200	72.58±7.89	93:107	44.35±1.53	23.90±1.40	3.09±0.41	4.56±0.45	0.54±0.03	0.93±0.54
IOLMaster 700			57.11 to 88.04		41.35 to 47.35	21.17 to 26.64	2.29 to 3.89	3.67 to 5.45	0.47 to 0.60	−0.13 to 1.99
Okamoto Eye Clinic	Ehime	131	74.5±7.79	53:78	44.31±1.60	24.24±1.90	3.10±0.44	4.56±0.44	0.54±0.03	0.98±0.76
IOLMaster 700			59.23 to 89.76		41.16 to 47.45	20.51 to 27.97	2.24 to 3.95	3.71 to 5.42	0.48 to 0.61	−0.52 to 2.48
Hayashi Eye Hospital	Fukuoka	200	71.17±8.03	83:117	44.31±1.60	24.08±1.58	3.11±0.42	4.55±0.39	0.54±0.03	0.92±0.59
IOLMaster 700			55.45 to 86.9		41.18 to 47.44	20.97 to 27.18	2.28 to 3.94	3.79 to 5.32	0.47 to 0.60	−0.24 to 2.07
Miyata Eye Hospital	Miyazaki	200	72.18±8.58	89:111	44.29±1.42	23.80±1.29	3.15±0.40	4.56±0.48	0.52±0.04	1.02±0.81
OA-2000			55.36 to 88.99		41.51 to 47.07	21.26 to 26.34	2.37 to 3.94	3.63 to 5.49	0.45 to 0.59	−0.57 to 2.61
Asato Eye Clinic	Okinawa	200	70.03±8.05	64:136	44.46±1.41	23.86±1.42	3.05±0.37	4.61±0.40	0.54±0.03	0.86±0.62
IOLMaster 700			54.25 to 85.81		41.71 to 47.22	21.08 to 26.64	2.32 to 3.78	3.83 to 5.40	0.48 to 0.61	−0.36 to 2.07
P value	P value		<0.001	0.056	0.587	0.003	<0.001	<0.001	<0.001	0.304

D, diopter.

biometric parameters such as axial length, anterior chamber depth, lens thickness and central corneal thickness, among all surgical facilities, even in a single country. It is suggested that these local differences in the preoperative biometric distributions were existent to a certain degree and were not necessarily negligible in a clinical setting, especially in order to select the optimised IOL power calculation. These biometric variations can also influence the complexity of cataract surgery. Overall, the anterior chamber depth in the southern part of Japan, especially in Okinawa, tended to be smaller than other areas, which was in line with a previous finding of a population-based cohort study.[8 9] Considering that anterior chamber depth may play some role in the surgical complexity, especially in consideration of the damage of corneal endothelial cells in a clinical setting, we should be aware that the complexity of cataract surgery might be different among the regions and might increase especially in the southern part of Japan. We believe that this information is simple, but clinically helpful, for understanding biometric characteristics, especially in terms of mean keratometry, anterior chamber depth, axial length and lens thickness, since these variations may have implications for the awareness of the difficulty of cataract surgery at each surgical facility.

Our findings also showed that the use of the Barrett Universal II formula tended to provide a better predictability than that of the SRK/T formula in the whole population. However, it should be noted that the SRK/T formula still provided a significantly better predictability than the Barrett Universal II formula, in terms of the absolute error at two institutions, and the percentages of eyes within ±0.25 and 0.5 D at 1 of 12 institutions, namely, the Barrett Universal II formula was not always superior

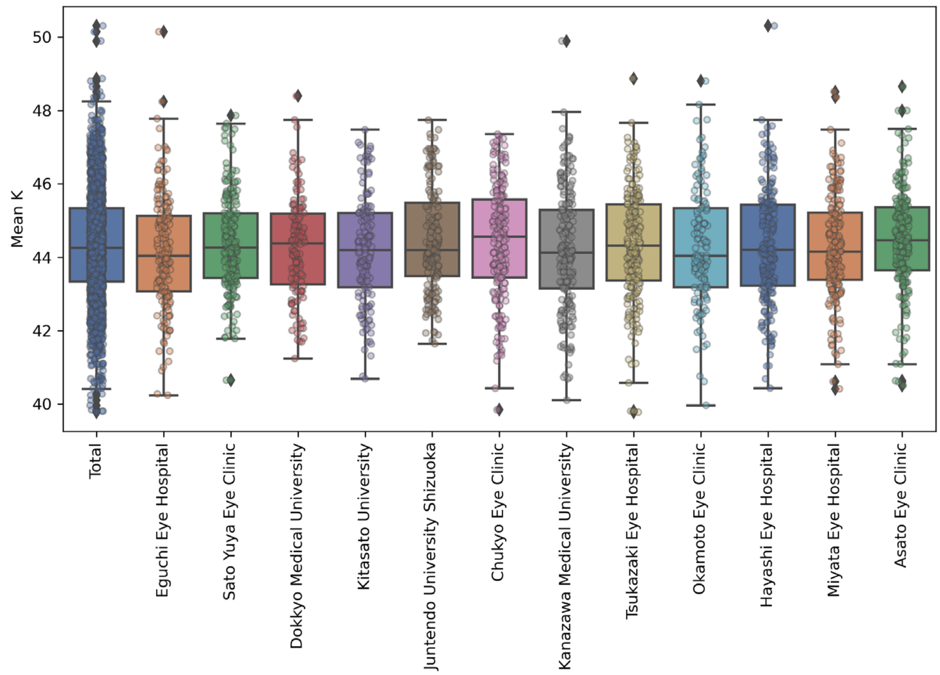

Figure 2 A graph showing distributions in mean keratometric readings at each facility. We found no significant difference in mean keratometric readings among the 12 institutions (one-way analysisof variance, p=0.587).

to the SRK/T formula in terms of the predictability outcomes at all institutions, and the optimised IOL power calculation formula was individually different among these surgical sites. Unfortunately, we found no obvious characteristics in preoperative biometric data at these institutions. It is suggested that there are still no established absolute IOL power formulas to accurately predict IOL power, and that we should independently optimise these existing IOL formulas at each surgical site, especially in consideration of these biometric divergences.

There have so far been several studies comparing preoperative biometric data of cataract surgery.[1–5] Wang and Yuwen[1] described that the lens thickness of the Kazakh population was significantly thinner than that of the Han population in patients with cataract. Trivedi and Wilson[2] stated that the African-American

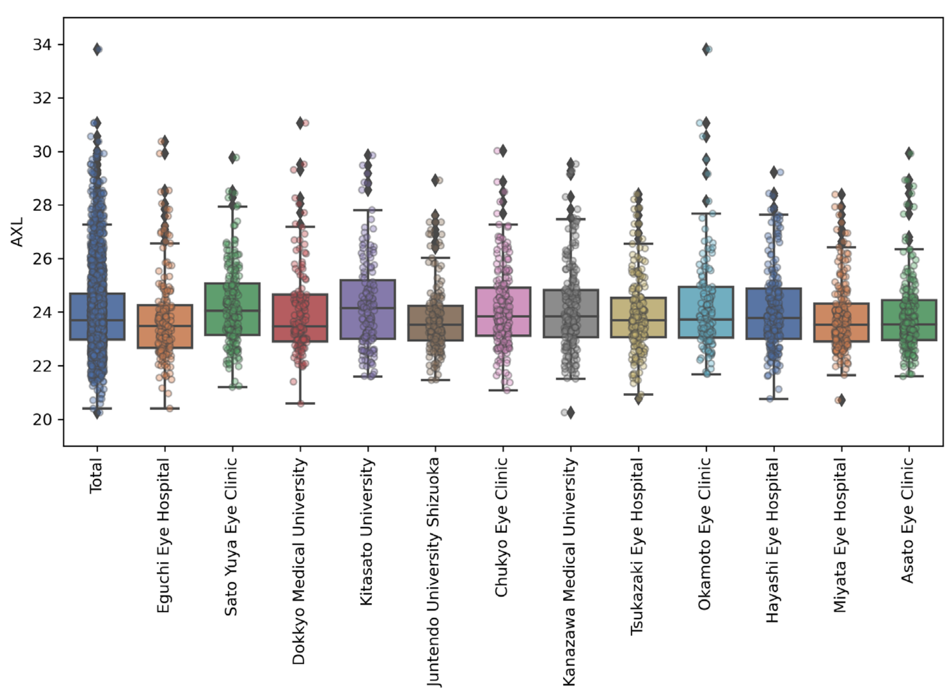

Figure 3 A graph showing distributions in axial length at each facility. We found a significant difference in axial length among the 12 institutions (one-way analysisof variance, p<0.001).

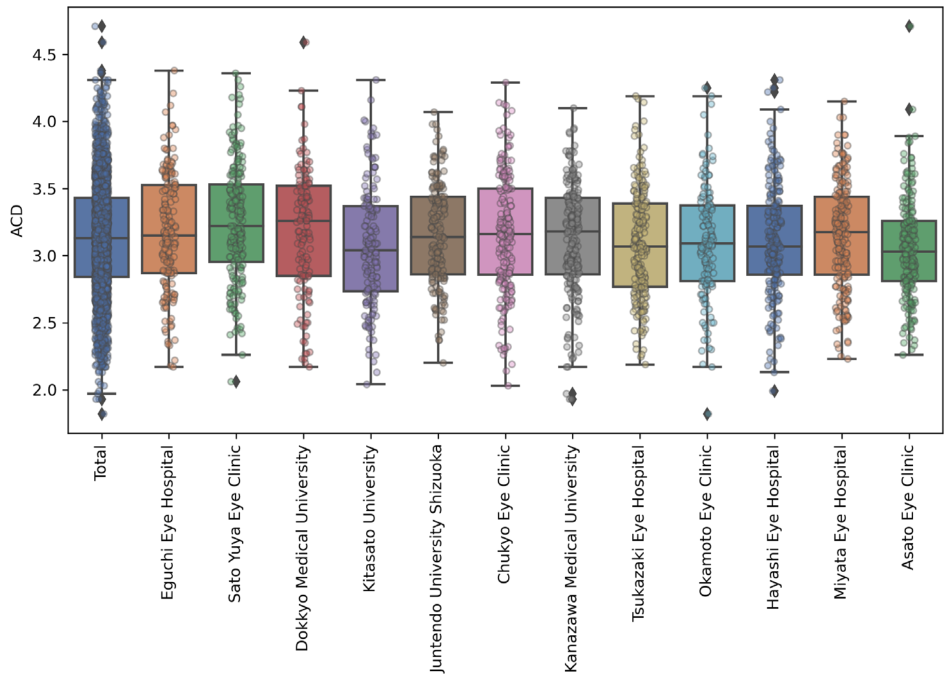

Figure 4 A graph showing distributions in anterior chamber depth at each facility. We found a significant difference in anterior chamber depth among the 12 institutions (one-way analysis of variance, p<0.001). ACD, anterior chamber depth.

subjects had significantly longer axial length than did the Caucasians in paediatric cataract population. Yoon *et al*[3] mentioned that axial length was longest in Asian eyes, and that anterior chamber depth in eyes of Pacific people was significantly larger than that of Caucasians and Asians. Wang *et al*[4] demonstrated significant differences while comparing Asians with Whites, and Asians with African-Americans between ethnic groups. We also demonstrated significant differences in mean keratometric readings, anterior chamber depth, axial length and lens thickness, by approximately 0.3 D, 0.3 mm, 0.6 mm and 0.3 mm, respectively, between two domestic facilities.[5] To the best of our knowledge, this is the first study to prospectively and directly compare detailed ocular biometric parameters in a large cohort of cataract population among the multiple nationwide institutions. In the present study, most eyes in the study population were essentially composed of Asian ethnicity, but there are several

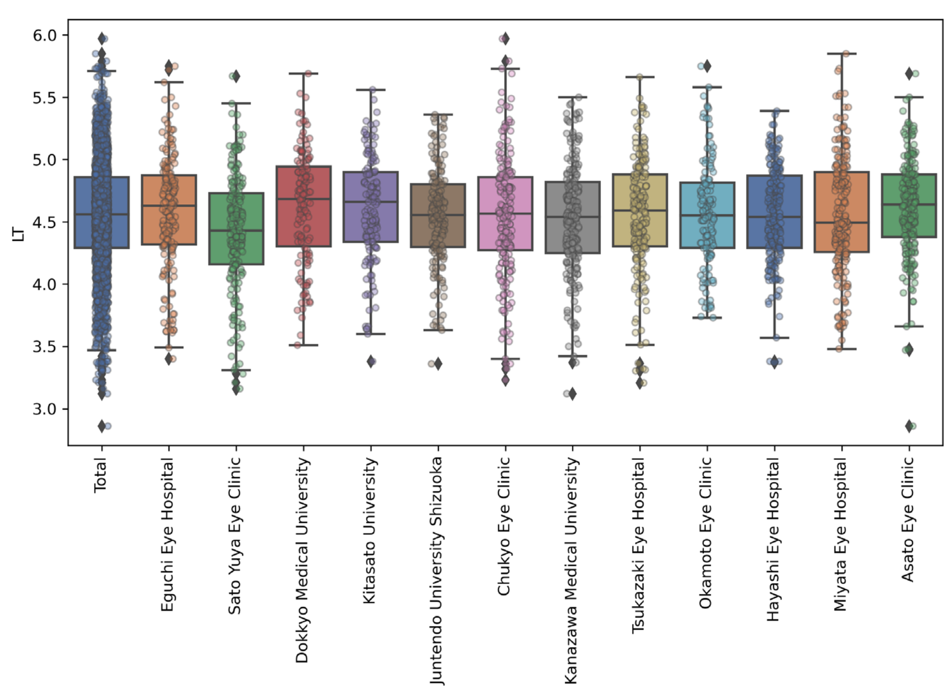

Figure 5 A graph showing distributions in lens thickness at each facility. We found a significant difference in lens thickness among the 12 institutions (one-way analysisof variance, p<0.001).

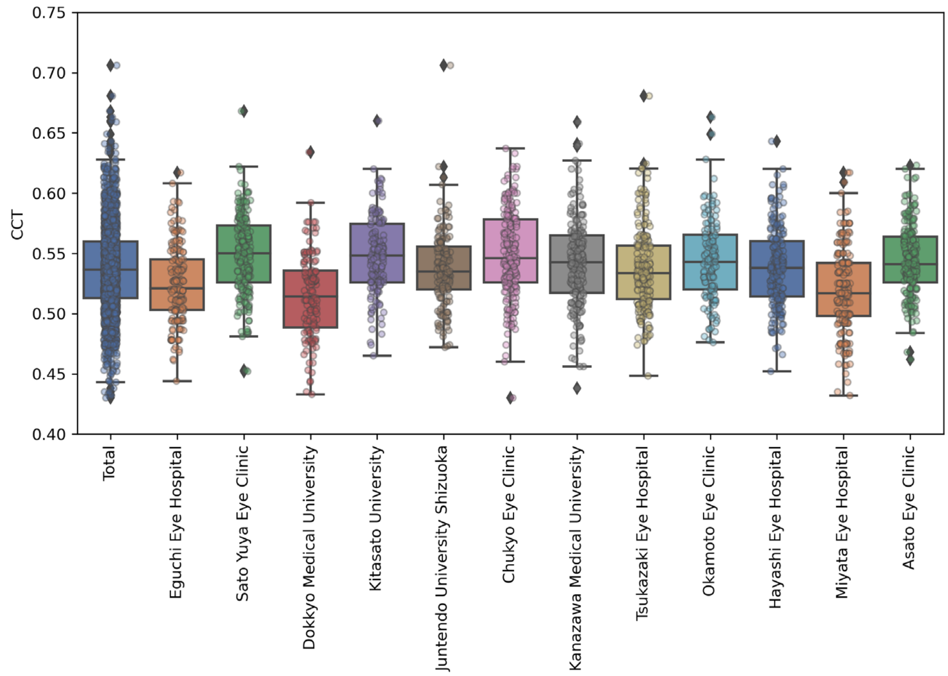

Figure 6 A graph showing distributions in central corneal thickness at each facility. We found a significant difference in central corneal thickness among the 12 institutions (one-way analysisof variance, p<0.001).

variations in the patient backgrounds among the 12 institutions (Yamato people, Ryukyuan people native to the Ryukyu Islands vs Ainu people native to northern Japan, rural area, suburban area vs urban area and private clinic, private hospital vs university hospital). Although we did not investigate the ethnicity in all eyes in this study, we assume that the biometric differences might be attributed to the racial, regional and institutional diversities in this cataract population.

We have several limitations to this study. First, we simply compared the biometric distributions at the 12 surgical sites. Therefore, we cannot conclude that racial and regional differences in the biometry certainly exist in various areas of Japan. However, these regional differences in the preoperative biometric distributions highlight the importance of the optimisation of IOL power calculation at each surgical site. Second, patient age and gender were not matched among the 12 institutions and

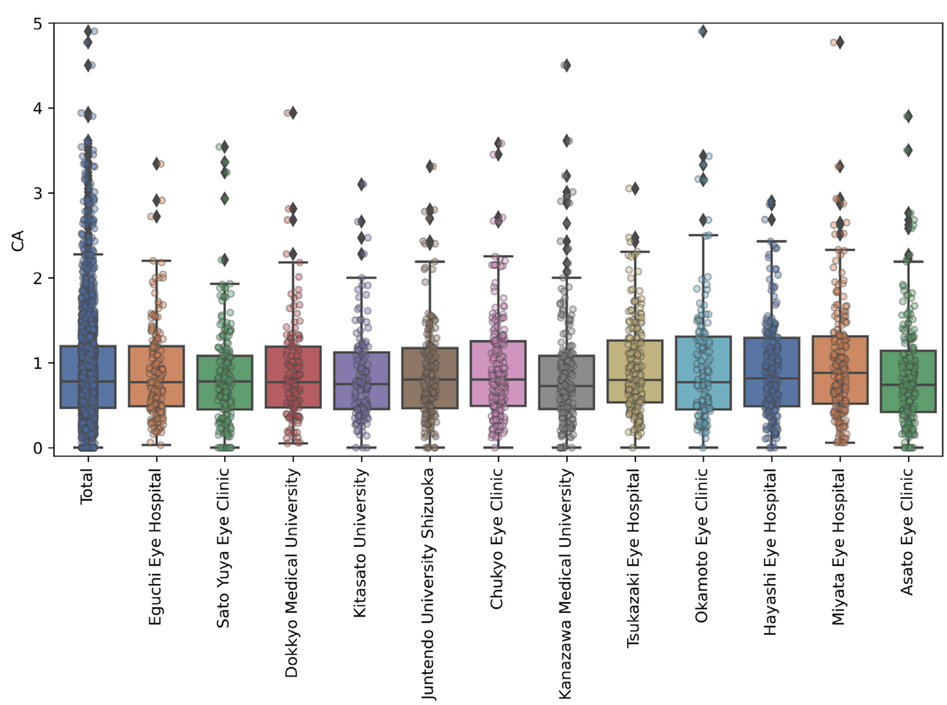

Figure 7 A graph showing distributions in corneal astigmatism at each facility. We found no significant difference in corneal astigmatism among the 12 institutions (one-way ANOVA, p=0.304). ANOVA, analysis of variance; D, diopter; IOL, intraocular lens.

Table 2 Prediction error and absolute error of targeted refraction using the SRK/T and the Barrett Universal II formulas

		SRK/T formula			Barrett Universal II formula		
		Prediction error (D)	Absolute error (D)	Median absolute error (D)	Prediction error (D)	Absolute error (D)	Median absolute error (D)
Total		0.01±0.54	0.39±0.37	0.30	−0.11±0.49	0.36±0.34	0.27
95% CI		−1.05 to 1.06	−0.33 to 1.11		−1.07 to 0.85	−0.31 to 1.04	
Short axial length		−0.06±0.55	0.39±0.39	0.30	−0.18±0.60	0.44±0.45	0.38
95% CI		−1.14 to 1.03	−0.37 to 1.16		−1.36 to 1.00	−0.44 to 1.32	
Middle axial length		−0.02±0.55	0.38±0.40	0.29	−0.15±0.50	0.37±0.37	0.28
95% CI		−1.1 to 1.06	−0.4 to 1.16		−1.14 to 0.83	−0.36 to 1.10	
Long axial length		−0.13±0.54	0.42±0.36	0.32	−0.11±0.46	0.36±0.31	0.29
95% CI		−1.18 to 0.93	−0.29 to 1.13		−1.01 to 0.80	−0.25 to 0.97	
Eguchi Eye Hospital	Hokkaido	−0.05±0.60	0.46±0.38	0.36	−0.00±0.55	0.42±0.35	0.34
		−1.22 to 1.13	−0.28 to 1.21		−1.08 to 1.07	−0.26 to 1.11	
Sato Yuya Eye Clinic	Miyagi	0.05±0.39	0.30±0.25	0.24	−0.13±0.38	0.29±0.27	0.20
		−0.71 to 0.82	−0.20 to 0.80		−0.86 to 0.61	−0.23 to 0.82	
Dokkyo Medical University	Tochigi	0.01±0.59	0.46±0.37	0.40	−0.06±0.55	0.44±0.32	0.41
		−1.15 to 1.17	−0.26 to 1.18		−1.13 to 1.01	−0.20 to 1.08	
Kitasato University	Kanagawa	0.15±0.47	0.34±0.35	0.25	−0.04±0.36	0.25±0.26	0.17
		−0.77 to 1.06	−0.33 to 1.02		−0.75 to 0.67	−0.27 to 0.77	
Juntendo University Shizuoka	Shizuoka	0.41±0.47	0.44±0.44	0.32	0.27±0.39	0.29±0.37	0.17
		−0.50 to 1.33	−0.42 to 1.30		−0.49 to 1.02	−0.43 to 1.01	
Chukyo Eye Clinic	Aichi	0.02±0.56	0.39±0.40	0.31	−0.13±0.5	0.36±0.37	0.27
		−1.08 to 1.13	−0.40 to 1.18		−1.11 to 0.84	−0.37 to 1.08	
Kanazawa Medical University	Ishikawa	−0.03±0.59	0.42±0.42	0.34	−0.03±0.61	0.43±0.43	0.36
		−1.19 to 1.12	−0.40 to 1.23		−1.23 to 1.17	−0.42 to 1.28	
Tsukazaki Hospital	Hyogo	−0.06±0.46	0.34±0.32	0.26	−0.23±0.42	0.37±0.31	0.32
		−0.97 to 0.85	−0.29 to 0.97		−1.06 to 0.60	−0.24 to 0.98	
Okamoto Eye Clinic	Ehime	−0.06±0.56	0.43±0.37	0.32	−0.17±0.5	0.38±0.37	0.29
		−1.17 to 1.04	−0.29 to 1.15		−1.15 to 0.82	−0.33 to 1.10	
Hayashi Eye Hospital	Fukuoka	0.01±0.61	0.41±0.46	0.27	−0.18±0.45	0.36±0.32	0.26
		−1.19 to 1.21	−0.49 to 1.30		−1.05 to 0.70	−0.28 to 0.99	
Miyata Eye Hospital	Miyazaki	−0.21±0.47	0.40±0.33	0.31	−0.34±0.46	0.45±0.35	0.40
		−1.14 to 0.72	−0.24 to 1.04		−1.24 to 0.55	−0.24 to 1.14	
Asato Eye Clinic	Okinawa	−0.06±0.43	0.34±0.27	0.29	−0.19±0.40	0.33±0.30	0.27
		−0.90 to 0.78	−0.20 to 0.87		−0.97 to 0.60	−0.25 to 0.91	

D, diopter; SRK/T, Sanders-Retzlaff-Kraff/theoretical .

might be biased in the current study. However, we believe that this study reflects the actual status of the preoperative biometry in daily practice. Third, we only applied the SRK/T and the Barrett Universal II formulas, since these two formulas are most commonly used for IOL power calculation in Japan. According to the 2020 JSCRS clinical survey, the SRK/T formula was still most preferred (82.5%), followed by the Barrett Universal II formula (57.1%), the Haigis formula (37.0%), the Holladay II formula (9.3%), the SRK 2 formula (9.3%), the ray tracing method (5.9%), the Hoffer Q formula (5.1%) and the Hill RBF method (4.0%), in Japan (multiple answers allowed).[10] It has been demonstrated that eyes with longer axial length and flatter keratometry showed more hyperopic outcomes, when the SRK/T formula was applied without adjustments,[11–13] and that the latest generation formulas, such as the Barrett Universal II formula, the Hill RBF V.2 method and the Kane formula, were less subjected to biometrical variations in the axial length and the keratometric readings.[14–17] A further study using these new generation formulas is required to clarify this point. Fourth, we used two different optical biometers (IOLMaster 700 at nine institutions and OA-2000 at three institutions) for this evaluation, since there are some variations in optical biometers for clinical use in Japan. Liao *et al* recently showed that the 95% limits of agreement between the two biometers ranged from −0.03 to 0.03 mm for axial length, −0.08 to 0.07 mm for anterior chamber depth, −0.18 to 0.18 D for mean keratometry.[18] It is suggested that the two devices have excellent agreement on ocular biometric measurements, especially in terms of axial length and anterior chamber depth, both of which are considered to be key parameters for IOL power calculation, possibly due to the employment of swept-source optical coherence tomography and fixation monitoring system. We accept that the use of a single optical biometer would be ideal to confirm our multicentre findings.

In summary, our nationwide multicentre study revealed significant differences in anterior chamber depth, axial length, lens thickness, central corneal thickness, and the optimised IOL power calculation formula was different among the 12 institutions in Japan. These findings may support the view that regional dissimilarities in a cataract population did exist to some degree, and that IOL power calculation should be optimised to further improve the refractive accuracy at each facility, even in the same country, especially in consideration of these biometric variations.

Table 3 Percentages within ±0.25, 0.5 and 1.0 D of the targeted refraction

		SRK/T formula			Barrett Universal II formula			P value		
		Within ±0.25 D	Within ±0.5 D	Within ±1.0 D	Within ±0.25 D	Within ±0.5 D	Within ±1.0 D	±0.25 D	±0.5 D	±1.0 D
Total		43.9%	73.0%	94.5%	47.2%	74.8%	95.5%	0.353	1.000	0.188
Short axial length		44.0%	76.2%	95.2%	39.3%	69.0%	91.7%	0.572	0.18	0.375
Middle axial length		44.7%	74.6%	95.5%	45.4%	73.5%	96.1%	0.572	0.285	0.169
Long axial length		39.3%	66.7%	93.6%	45.3%	77.4%	95.3%	0.087	<0.001	0.388
Eguchi Eye Hospital	Hokkaido	35.4%	64.6%	93.7%	38.3%	65.7%	93.7%	0.511	0.864	1.000
Sato Yuya Eye Clinic	Miyagi	53.0%	82.0%	97.5%	60.0%	82.0%	98.0%	0.072	1.000	0.625
Dokkyo Medical University	Tochigi	34.6%	63.1%	90.8%	38.5%	60.8%	94.6%	0.541	0.503	0.180
Kitasato University	Kanagawa	51.7%	77.6%	96.5%	63.6%	88.1%	98.6%	0.036	0.008	0.375
Juntendo University Shizuoka	Shizuoka	40.9%	68.3%	90.9%	65.2%	87.8%	92.7%	0.350	0.405	0.500
Chukyo Eye Clinic	Aichi	42.0%	75.0%	95.5%	47.5%	77.5%	96.0%	0.207	0.487	1.000
Kanazawa Medical University	Ishikawa	41.5%	66.5%	95.5%	40.0%	68.0%	93.0%	0.711	0.701	0.125
Tsukazaki Hospital	Hyogo	50.0%	79.5%	94.5%	42.0%	75.5%	95.5%	0.072	0.243	0.625
Okamoto Eye Clinic	Ehime	40.5%	67.9%	93.1%	43.5%	72.5%	95.4%	0.473	0.265	0.508
Hayashi Eye Hospital	Fukuoka	47.0%	75.5%	93.0%	48.5%	76.0%	96.0%	0.820	1.000	0.065
Miyata Eye Hospital	Miyazaki	43.0%	70.0%	94.5%	33.0%	62.5%	92.5%	0.010	0.024	0.219
Asato Eye Clinic	Okinawa	43.0%	80.5%	99.0%	49.0%	80.0%	99.0%	0.161	1.000	1.000

D, diopter; SRK/T, Sanders-Retzlaff-Kraff/Theoretical .

We assume that it will be helpful for understanding the regional variations in the preoperative biometry and the importance of an optimised IOL power calculation at each facility in a clinical setting.

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