

# Comparison of autokeratometer and radiuscope measurements of base curves of various rigid gas permeable lenses.

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## **Summary**

The Alcon handheld keratometer has proven its use in many clinical settings. This study shows whether or not it can replace a standard radiuscope for the measurement of base curves of hard contact lenses.

## **Introduction**

The radiuscope has traditionally been the gold standard of base curve measurement in many clinical settings (Defazio and Lowther, 1979; Rakow, 1985; Tannehill and Sampson, 1966). Keratometry has traditionally been performed with manual instruments. Numerous studies have proven the effectiveness of autokeratometers, both stand and hand held models, in the measurement of both corneal curvature and on man made surfaces (Pardhan and Douthwaite, 1998; Harvey et al., 1995; Lam, 1995; Douthwaite and Pardhan, 1995, 1997; Tennen et al., 1995; Wassill and Dick, 1995). The purpose of this study is to bridge the gap between these two instruments and test the accuracy of a hand held autokeratometer in comparison to a standard radiuscope.

## **Materials & Methods**

A Reichert Radiuscope and an Alcon hand held autokeratometer were used to measure the base curves of four different fitting sets of trial hard contact lenses. The trial contact lens set were as follows. A set of standard trial lenses (Boston II's) ranging from a marked base curve of 8.20 to 7.40 mm. A set of Toric Base Curve lenses ranging in marked base curves of 8.65/8.03 to 7.85/7.34 mm. A set of low base curve lenses ranging in marked base curve from 6.49 to 5.62 mm. A set of Aspheric Lenses was also included to compare measured values. Marked base curves ranged from 7.20 to 6.70 mm.

Six independent readings of base curve were taken with each instrument and the results averaged and a standard deviation was calculated (Chart #1, #3, #5, and #7). The difference between the two instruments was also calculated for each lens along with a mean difference with its own standard deviation (Chart #2, #4, #6, and #8). Finally, for the non-aspheric lenses (spherical and toric base curves), a total mean difference was calculated with its own standard deviation (Chart #9).

## **Results**

See attached Charts.

## **Discussion**

Discussion will be started with the first three groups of lenses (spherical base curve, toric base curve, and low base curve), followed by the aspheric lens results.

#### Regular Lenses

The results clearly show that the Alcon Keratometer gives measurements very close to that of the Reichert Radiuscope. Chart #9 gives the best overall reading of the result. The mean difference for all of the lenses was 0.00 mm with a standard deviation of 0.019.

Even the individual sets of lenses showed marked similarity in readings. Only the low base curve lenses showed a slight average difference in readings, although the difference was within the calculated standard deviation for the readings. This may however, raise the question of the accuracy of the Alcon Keratometer for reading base curves further from "normal" values. For example, high or low base curve lenses.

#### Aspheric Lenses

Not surprisingly, neither instrument was accurate in measuring the marked base curve of aspheric lenses, although both instruments did show very reliable values for their measurements. It would appear that the radiuscope measures aspheric lenses more accurately than the Alcon Keratometer. This does make sense intuitively, as the

radiuscope measures a very small area of curvature near the center of the lens where the curvature most closely resembles the marked base curve. The Alcon Keratometer uses a larger lens area, on the other hand, and will therefore get more interference from the flatter periphery of the lens.

### **Conclusion**

The Alcon Keratometer is comparable to the Reichert radiuscope in the measurement of base curves of the majority of hard lenses that will be encountered in a contact lens practice. Neither instrument performs well in the measurement of aspheric lenses, but this is to be expected. In short, if a hand held Alcon Keratometer is present in a practice, it can be used as a quick and easy way to verify base curve of hard contact lenses.

## Bibliography

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Chart #1

**Chart comparing the Alcon Keratometer to a Reichert Radiuscope  
for Spherical lenses (Art Optical Boston II's)**

**Alcon Keratometer**

Marked Base Curve (mm)	Reading (mm)						Mean Reading (mm)	Standard Deviation (mm)
	1	2	3	4	5	6		
8.20	8.23	8.23	8.21	8.21	8.23	8.26	8.23	0.0167
8.10	8.10	8.13	8.11	8.11	8.11	8.11	8.11	0.0090
8.00	8.04	8.01	8.04	8.01	8.01	8.01	8.02	0.0141
7.90	7.89	7.89	7.92	7.92	7.90	7.92	7.91	0.0137
7.80	7.81	7.80	7.80	7.83	7.83	7.83	7.82	0.0137
7.70	7.71	7.74	7.71	7.70	7.71	7.74	7.72	0.0157
7.60	7.61	7.61	7.58	7.58	7.61	7.61	7.60	0.0141
7.50	7.50	7.50	7.51	7.52	7.50	7.50	7.51	0.0076
7.40	7.44	7.44	7.44	7.44	7.44	7.44	7.44	0.0000

**Reichert Radiuscope**

Marked Base Curve (mm)	Reading (mm)						Mean Reading (mm)	Standard Deviation (mm)
	1	2	3	4	5	6		
8.20	8.20	8.22	8.22	8.23	8.25	8.24	8.23	0.0160
8.10	8.11	8.10	8.11	8.12	8.14	8.10	8.11	0.0137
8.00	8.00	8.00	8.02	8.02	8.00	8.01	8.01	0.0090
7.90	7.88	7.90	7.90	7.93	7.92	7.90	7.91	0.0161
7.80	7.83	7.82	7.81	7.82	7.82	7.80	7.82	0.0094
7.70	7.70	7.69	7.71	7.70	7.71	7.73	7.71	0.0125
7.60	7.60	7.62	7.62	7.59	7.58	7.60	7.60	0.0146
7.50	7.50	7.52	7.50	7.53	7.50	7.50	7.51	0.0121
7.40	7.40	7.43	7.42	7.44	7.45	7.43	7.43	0.0157

Chart #2

Difference

Alcon Keratometer Reading - Reichert Reading

0.00	Mean Difference
0.00	0.00
0.01	
0.00	Standard Deviation
0.00	0.006316
0.01	
0.00	
0.00	
0.01	

Chart #4

Difference

Alcon Keratometer Reading - Reichert Reading

A	B	Mean Difference	
0.01	-0.04	A	B
0.00	0.02	0.00	0.00
0.00	-0.03		
-0.01	0.01		
-0.01	-0.01		
-0.02	0.04	Standard Deviation	
0.00	0.01	A	B
0.02	0.03	0.016451	0.032933
-0.03	-0.06		



Chart #6

Difference

Alcon Keratometer Reading - Reichert Reading

-0.03	Mean Difference
0.00	-0.01
-0.01	
0.00	Standard Deviation
0.01	0.011785
-0.01	
-0.01	
-0.01	
-0.03	

Chart #8

Difference

Alcon Keratometer Reading - Reichert Reading

0.11	Mean Difference
0.16	0.15
0.15	
0.14	Standard Deviation
0.18	0.026445
0.13	

Chart #9

Total Mean Difference

0.00

Total Standard Deviation

0.019449

5.82	5.80	5.82	5.82	5.84	5.82	5.80	5.82	0.0137
5.72	5.66	5.67	5.69	5.68	5.68	5.71	5.68	0.0157
5.62	5.60	5.60	5.62	5.63	5.64	5.60	5.62	0.0161

Chart #7

**Chart comparing the Alcon Keratometer to a Reichert Radiuscope  
for Aspheric Lenses**

**Alcon Keratometer**

Marked Base Curve (mm)	Reading (mm)						Mean Reading (mm)	Standard Deviation (mm)
	1	2	3	4	5	6		
7.20	7.44	7.46	7.44	7.44	7.44	7.44	7.44	0.0075
7.09	7.24	7.27	7.30	7.26	7.30	7.27	7.27	0.0213
7.01	7.20	7.20	7.20	7.20	7.16	7.16	7.19	0.0189
6.90	7.12	7.12	7.12	7.14	7.13	7.15	7.13	0.0115
6.80	7.01	7.03	7.01	6.99	7.01	7.01	7.01	0.0115
6.70	6.84	6.86	6.85	6.84	6.85	6.85	6.85	0.0069

**Reichert Radiuscope**

Marked Base Curve (mm)	Reading (mm)						Mean Reading (mm)	Standard Deviation (mm)
	1	2	3	4	5	6		
7.20	7.32	7.34	7.34	7.36	7.32	7.33	7.34	0.0138
7.09	7.12	7.09	7.10	7.14	7.11	7.10	7.11	0.0163
7.01	7.04	7.02	7.05	7.03	7.02	7.04	7.03	0.0111
6.90	7.00	6.99	7.00	6.98	6.98	6.98	6.99	0.0090
6.80	6.81	6.82	6.83	6.84	6.83	6.83	6.83	0.0094
6.70	6.72	6.73	6.71	6.74	6.69	6.73	6.72	0.0163

8.03	7.50	8.06	7.48	8.03	7.49	8.03	7.50	8.05	7.50	8.05	7.52	8.06	7.53	8.05	7.50	0.0137	0.0186
7.94	7.42	7.96	7.43	7.98	7.45	7.94	7.36	7.92	7.44	7.94	7.48	7.97	7.42	7.95	7.43	0.0223	0.0400
7.85	7.34	7.86	7.40	7.84	7.40	7.86	7.40	7.84	7.38	7.88	7.38	7.78	7.36	7.84	7.39	0.0344	0.0163

Chart #5

**Chart comparing the Alcon Keratometer to a Reichert Radiuscope  
for Low Base Curve Spherical lenses**

**Alcon Keratometer**

Marked Base Curve (mm)	Reading (mm)						Mean Reading (mm)	Standard Deviation (mm)
	1	2	3	4	5	6		
6.49	6.46	6.47	6.47	6.46	6.46	6.46	6.46	0.0047
6.37	6.37	6.38	6.37	6.38	6.37	6.37	6.37	0.0047
6.37	6.37	6.37	6.38	6.37	6.37	6.36	6.37	0.0058
6.14	6.15	6.15	6.15	6.15	6.15	6.15	6.15	0.0000
6.03	6.03	6.04	6.04	6.04	6.04	6.04	6.04	0.0037
5.92	5.91	5.91	5.91	5.91	5.91	5.91	5.91	0.0000
5.82	5.80	5.80	5.81	5.81	5.81	5.80	5.81	0.0050
5.72	5.67	5.67	5.68	5.67	5.67	5.67	5.67	0.0037
5.62	5.60	5.58	5.58	5.59	5.58	5.59	5.59	0.0075

**Reichert Radiuscope**

Marked Base Curve (mm)	Reading (mm)						Mean Reading (mm)	Standard Deviation (mm)
	1	2	3	4	5	6		
6.49	6.48	6.50	6.49	6.50	6.49	6.49	6.49	0.0069
6.37	6.37	6.37	6.38	6.36	6.39	6.37	6.37	0.0094
6.37	6.36	6.38	6.40	6.38	6.38	6.38	6.38	0.0115
6.14	6.17	6.17	6.15	6.14	6.15	6.14	6.15	0.0125
6.03	6.02	6.06	6.03	6.04	6.03	6.01	6.03	0.0157
5.92	5.92	5.92	5.94	5.91	5.93	5.93	5.93	0.0096

Chart #3

**Chart comparing the Alcon Keratometer to a Reichert Radiuscope  
for Toric Base Curve RGP's**

**Alcon Keratometer**

Marked Base Curve (mm)	Reading (mm)												Mean Reading (mm)	Standard Deviation (mm)			
	1		2		3		4		5		6			A	B		
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
8.65	8.03	8.65	8.04	8.65	8.04	8.65	8.04	8.63	8.04	8.65	8.01	8.65	8.04	8.65	8.04	0.0082	0.0122
8.54	7.94	8.57	7.94	8.60	7.94	8.57	7.96	8.63	7.94	8.60	7.94	8.60	7.94	8.60	7.94	0.0226	0.0082
8.43	7.85	8.49	7.83	8.49	7.83	8.46	7.85	8.44	7.89	8.46	7.87	8.49	7.85	8.47	7.85	0.0214	0.0234
8.33	7.76	8.36	7.78	8.41	7.85	8.39	7.80	8.39	7.78	8.39	7.80	8.41	7.76	8.39	7.80	0.0183	0.0308
8.23	7.67	8.28	7.63	8.28	7.65	8.28	7.65	8.28	7.65	8.28	7.65	8.26	7.65	8.28	7.65	0.0082	0.0082
8.13	7.58	8.18	7.61	8.18	7.61	8.18	7.58	8.18	7.61	8.16	7.61	8.16	7.58	8.17	7.60	0.0103	0.0155
8.03	7.50	8.06	7.52	8.04	7.50	8.06	7.52	8.04	7.52	8.06	7.52	8.04	7.52	8.05	7.52	0.0110	0.0082
7.94	7.42	7.99	7.40	7.94	7.46	7.96	7.46	7.96	7.48	7.96	7.48	7.96	7.46	7.96	7.46	0.0160	0.0294
7.85	7.34	7.89	7.34	7.92	7.32	7.89	7.34	7.89	7.30	7.92	7.32	7.80	7.34	7.89	7.33	0.0442	0.0163

**Reichert Radiuscope**

Marked Base Curve (mm)	Reading (mm)												Mean Reading (mm)	Standard Deviation (mm)			
	1		2		3		4		5		6			A	B		
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
8.65	8.03	8.66	8.04	8.66	8.05	8.58	8.08	8.64	8.08	8.62	8.09	8.65	8.09	8.64	8.07	0.0308	0.0214
8.54	7.94	8.55	7.92	8.54	7.90	8.58	7.97	8.55	7.91	8.55	7.91	8.59	7.94	8.56	7.93	0.0200	0.0259
8.43	7.85	8.44	7.86	8.42	7.86	8.41	7.90	8.40	7.91	8.45	7.89	8.43	7.87	8.43	7.88	0.0187	0.0214
8.33	7.76	8.37	7.82	8.39	7.75	8.39	7.79	8.35	7.80	8.37	7.75	8.38	7.78	8.38	7.78	0.0152	0.0279
8.23	7.67	8.24	7.68	8.24	7.66	8.28	7.60	8.26	7.68	8.23	7.68	8.23	7.65	8.25	7.66	0.0197	0.0313
8.13	7.58	8.20	7.59	8.20	7.54	8.17	7.59	8.15	7.58	8.15	7.54	8.22	7.53	8.18	7.56	0.0293	0.0279