

# The Studies on the Residual Accommodation of Koreans

## I. The Residual Accommodation under 1% Atropine and 5% Homatropine Cycloplegia

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### ABSTRACT

This study was conducted to determine how much of a residual accommodation remained one hour after three instillations of atropine or homatropine in 384 eyes of younger Koreans.

The amount of residual accommodation was measured by the blur point method, and the following results were obtained.

1) The average amount of the residual accommodation was 0.96 D under 1% atropine and 1.42 D under 5% homatropine.

2) In comparing the two cycloplegic agents, 1% atropine was found to be more effective than 5% homatropine.

3) Residual accommodation under 1% atropine and 5% homatropine showed gradually decrease in older patients.

4) No sex difference was found.

the accommodation must be put at rest. However, when the cycloplegic drugs are used for cycloplegic refraction, a small residual accommodation remains which cannot be eliminated.

A number of studies have been done elsewhere in the past, but there have been no reports from Korea. These studies are based on measurements made by the blur point or some modification of that method done after the instillation of a cycloplegic agent. However, these results show a considerable variation in the amount of residual accommodation. We think this variation may be due to differences of race, age, the method, or cooperation of the patients.

Our studies of residual accommodation under 1% atropine and 5% homatropine cycloplegia were made on 384 eyes of Koreans.

### INTRODUCTION

Accommodation is a variable force capable of changing the refraction of the eye. In younger persons it is more difficult to inhibit this action but as a person ages and the amplitude of accommodation decreases, it becomes easier to suppress accommodative action. Therefore, if one wishes to measure the static refractive error of the eye of a youth,

### MATERIALS AND METHODS

The survey was made on 384 eyes of 192 subjects, 109 males (218 eyes) and 83 females (166 eyes), whose ages ranged from 6 years to 20 years, who had no refractive error, no change in the anterior segment or retina, and no general disease.

The cycloplegic drug, 1% atropine sulphate for 180 eyes, and 5% homatropine hydrobromide for 204

**Table 1.** Residual accommodation by 1% atropine

Age	No. of Eyes	Near Blur Point	Distance Blur Point	Residual Accommodation	Standard Deviation
6-10	62 { M 40 F 22	25.3cm(3.95 D)	35.2cm(2.84 D)	1.11D { M 1.15 D F 1.07 D	0.477
11-15	68 { M 34 F 34	25.8cm(3.87 D)	34.6cm(2.90 D)	0.97D { M 0.93 D F 1.01 D	0.432
16-20	50 { M 28 F 22	26.9cm(3.72 D)	34.6cm(2.90 D)	0.82D { M 0.84 D F 0.80 D	0.381
	Total	Average	Average	Average	
	180 { M 102 F 78	26.0cm(3.84 D)	34.8cm(2.87 D)	0.96D { M 0.97 D F 0.96 D	

**Table 2.** Residual accommodation by 5% homatropine

Age	No. of Eyes	Near Blur Point	Distance Blur Point	Residual Accommodation	Standard Deviation
6-10	62 { M 30 F 22	22.4cm(4.46 D)	35.3cm(2.83 D)	1.63D { M 1.68 D F 1.58 D	0.843
11-15	78 { M 44 F 34	23.8cm(4.20 D)	34.7cm(2.88 D)	1.32D { M 1.23 D F 1.41 D	0.651
16-20	64 { M 42 F 22	23.3cm(4.29 D)	33.6cm(2.97 D)	1.32D { M 1.20 D F 1.46 D	0.558
	Total	Average	Average	Average	
	204 { M 116 F 88	23.2cm(4.31 D)	34.5cm(2.89 D)	1.42D { M 1.37 D F 1.47 D	

eyes, was instilled into the conjunctival sacs 3 times at 5 minutes intervals, and the residual accommodation was measured by the blur point method 1 hour after the first instillation.

At that time the near vision should be indistinct, so that a +3.00 D lens was placed in front of the eye enabling the patient to see fine print.

Measurements were made by a modified Prince rule which was equipped with a slide on which was mounted one test card. On the test card, there was a fine black vertical line. While the patient was looking at the test card with one eye covered, he was instructed to move the card away from the 33 centimeters point until two blurred lines, instead of one fine black vertical line, were seen on the test card. A record of the far blur point was made when the patient just began to notice blurring. Then he was instructed to move the card toward his eye until blurring of the line occurred. This

position of the card was the near blur point. Each eye was measured separately.

These distances were measured in centimeters from the eye and were converted into diopters by dividing by each measurements. The difference in diopters between the near blur point and far blur point was a value of the residual accommodation.

## RESULTS

Table 1 and 2 demonstrate the data of the amounts of the residual accommodation according to age and sex. The average residual accommodation for 180 eyes under 1% atropine was 0.96 D, and the average residual accommodation for 204 eyes under 5% homatropine was 1.42 D.

## DISCUSSION

Table 3 summarizes several different authors' results of statistical studies on residual accommodation. On the basis of this data it is seen that atropine

**Table 3.** Residual accommodation as reported in the literature

Author	Cycloplegic Agent	Subjects	Age	Residual Accommodation
Marron	1% Atropine	107	15~40	1.90 D
Wolf & Hodge	1% Atropine	16		0.21 D
Our Result	1% Atropine	62	6~10	1.11 D
		68	11~15	0.97 D
		50	16~20	0.82 D
Prangen	2% Homatropine	61	7~45	2.00 D
Marron	5% Homatropine & 1% Paredrine	25	17~57	1.60 D
Thorne & Murphey	2% Homatropine	72	17~35	0.87 D
Milder	5% Homatropine	38(White)	7~48	1.40 D
		12(Negroes)	7~48	3.10 D
Milder	5% Homatropine	6	6~10	2.50 D
		15	11~15	2.60 D
		4	16~20	1.60 D
Wenaas & Associates	1% Homatropine	27	8~35	1.66 D
	2% Homatropine	27	8~45	1.34 D
	5% Homatropine	22	8~35	1.58 D
Yasuna	Homatropine	24	7~16	1.60 D
Wolf & Hodge	1% Homatropine	24		0.55 D
Sudranski	Homatropine & Cocaine	25	18~57	Less than 1.00 D
Weimman & Fralick	Homatropine & Cocaine	150		0.90-1.60 D
Slataper	Homatropine	20		1.42 D
Our Result	5% Homatropine	62	6~10	1.63 D
		78	11~15	1.32 D
		64	16~20	1.32 D

produced the lowest degree of residual accommodation 0.21 D, Wlof and Hodge (1946). The highest degree was 1.90 D, Marron (1940). When homatropine was used, the lowest degree was 0.55 D, Wolf and Hodge, and the highest degree was 3.10 D, Milder (1961). There were considerable variations in the amounts found.

Milder found in negroes that the residual accommodation under homatropine was 3.10 D, which was higher than 1.40 D noted in whites. Also, Gettes et al. (1953, 1954, 1961) established that in the Negro race regardless of the cycloplegic used, inadequate cycloplegia from drugs other than atropine is frequently noted.

Our results 0.96 D by atropine and 1.42 D by homatropine, were relatively in the mid-level as

compared with other authors' results from other countries. However, the average age of the subjects of this survey was far younger than that of subjects of the other authors. Because of this youthfulness of our subjects, we think our results were lower than those of others. Further investigations are needed to determine whether these findings were caused by differences of race, methods, or other factors.

According to Table 1 and 2, for the age group from 6 to 10 years the residual accommodation following atropine was 1.11 D and after homatropine was 1.63 D. The group from 11 to 15 years showed 0.97 and 1.32 D respectively, and the age group from 16 to 20 years dropped to 0.82 and 1.32 D.

With the exception that following homatropine

the residual accommodaton in the two groups, 11-15 years and 16-20 years, remained the same, the data showed a decreasing residual accommodation with age. It is well known fact that the amplitude of accommodation decreases with increasing age because of the physiologic change in the lens. It became apparent from the foregoing that also the residual accommodation decreases with age.

No significant sex differences were found.

The ggestion of what constitutes a satisfactory state of cycloplegia to allow an accurate determination of the refractive error in a young person is of special significance to all ophthalmologists. When a cycloplegic is required, there would be a basic level to which it is necessary to reduce accommodation so that the refractive error can be determined without interference by accommodation. How much need the residual accommodation be reduced in order to find the accurate refractive error?

According to Sudranski and Maxwell, a residual accommodation not exceeding 1.00 D constituted adequate cycloplegia. However Milder and Gettes accepted 2.00 D or less and Prangen (1931) felt that 2.50 D or less constituted adequate cycloplegia. There is general agreement that a residual accommodation not exceeding 2.00 D constitutes a cycloplegia which is satisfactory for the accurate refraction.

Table 4 shows the comparative cycloplegic effectivity of atropine and homatropine not exceeding 1.00 D or 2.00 D. Atropine was more effective than homatropine. Atropine was almost complete cycloplegic in persons over 11 years of age.

**Table 4.** Cycloplegic effectivity of 1% atropine and 5% homatropine

Age	Cycloplegics	Effectivity (Less than 2.0D)	Effectivity (Less than 1.0D)
6-10	1% Atropine	93.5%	44.6%
	5% Homatropine	64.5%	27.4%
11-15	1% Atropine	100.0%	60.7%
	5% Homatropine	84.8%	38.4%
16-20	1% Atropine	100.0%	64.7%
	5% Homatropine	89.0%	40.6%

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