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The effect of 1.0% tropicamide/2.5% phenylephrine and Paremyd on pupil diameter, accomodative amplitude and intraocular pressure

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Results: Analysis revealed that Paremyd™ had a slightly less mydriatic and cycloplegic effect than the standard drug regimen. There was also a difference in efficacy when segregating participants due to irides' color with both dilation methods having a greater mydriatic effect on non-brown eyed vs. brown eyed subjects. The reverse was true when cycloplegic effect was analyzed.

Conclusions: It is difficult to assess which regimen should be the drug or drugs of choice with regard to pupil dilation. Paremyd™ proves to be an effective, milder mydriatic agent. Although in brown eyed individuals, one drop of Paremyd™ may fall slightly short of the desired 7 mm dilated pupil.

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Kenneth Eakland

Keywords

Mydiasis, cycloplegia, accommodative amplitude, intraocular pressure, pupillary dilation

Subject Categories

Optometry

THE EFFECT OF 1.0% TROPICAMIDE/2.5% PHENYLEPHRINE AND PAREMYD™ ON PUPIL DIAMETER, ACCOMMODATIVE AMPLITUDE AND INTRAOCULAR PRESSURE

BY

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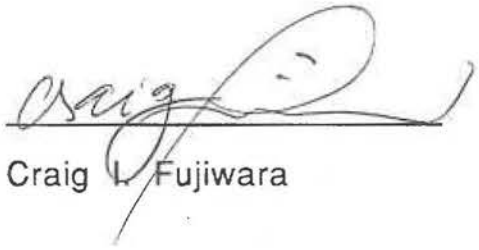
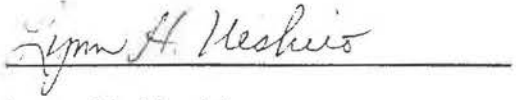


Craig I. Fujiwara



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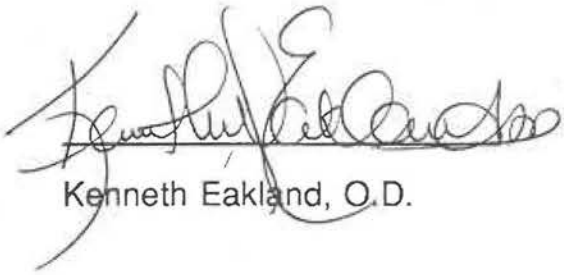

Kenneth Eakland, O.D.

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Craig I. Fujiwara and Lynn H. Ueshiro

It is April 25, 1995 . . . Lynn just finished her Strabismus and Amblyopia final and thus is not able to provide a biographical sketch at this very moment, so I will have to improvise. We were both born in Honolulu, Hawaii. I was born on June 15, 1970 and Lynn was born on February 6, 1966 (I think). We are both products of the Hawaii public school system and damn proud of it.

We both attended the University of Hawaii at Manoa, and acutally was enrolled in the same Microbiology, and Human Anatomy and Physiology classes and never even knew it. Lynn earned a B.S. in mathematics (I think) and worked in the "real world" for a few years. I fullfilled my pre-requisite requirements and was excepted into the Pacific University College of Optometry, Class of 1995. At this time, I received a B.S. in Visual Science (some good this will do me if I change my profession). One year later, Lynn entered the Class of 1996 and was assigned to me as my little sibling.

Eventually, we decided to do this project together and believe it or not, amazingly we're still friends. It's been a very long process and we hated every second of it, but here it is--our thesis . . .

ACKNOWLEDGEMENTS

We would like to thank everyone who was nice enough to sit for our project--we realize that sitting for 4 hours for a thesis is not an ideal way to spend an afternoon. And special thanks to our advisers for being there just in case we killed someone, caused a corneal abrasion with the pulsair or closed an angle.

ABSTRACT

Background: The demand for a milder, yet effective dilation drop prompted Allergan to introduce Paremyd™ to the eye care community in 1993. This study sought to form clinical comparisons between Paremyd™ and the standard drug regimen for dilation of 1% tropicamide/2.5% phenylephrine.

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Results: Analysis revealed that Paremyd™ had a slightly less mydriatic and cycloplegic effect than the standard drug regimen. There was also a difference in efficacy when segregating participants due to irides' color with both dilation methods having a greater mydriatic effect on non-brown eyed vs. brown eyed subjects. The reverse was true when cycloplegic effect was analyzed.

Conclusions: It is difficult to assess which regimen should be the drug or drugs of choice with regard to pupil dilation. Paremyd™ proves to be an effective, milder mydriatic agent. Although in brown eyed individuals, one drop of Paremyd™ may fall slightly short of the desired 7 mm dilated pupil.

KEY WORDS

Mydiasis, cycloplegia, accommodative amplitude, intraocular pressure, pupillary dilation.

Introduction

With the trend toward the increased use of diagnostic and therapeutic drugs and the current standard of care in the optometric profession[1], it is now not so much a question of whether or not a dilated fundus evaluation will be integrated into a routine vision examination; but rather, which drug or combination of drugs will be the most effective and least debilitating for the patient while enhancing the view of the internal structures of the eye. In the late 1800s, homatropine and cocaine[2] were the drugs of choice for observation of the fundus. Now almost 200 years later, there are other more suitable and less "stimulating" options out on the market. Among the more popular of these options is the drug combination of 1.0% tropicamide and 2.5% phenylephrine, and Paremyd™ (0.25% tropicamide and 1.0% hydroxyamphetamine hydrobromide).

Tropicamide is a parasympatholytic agent which blocks cholinergic stimulation at the muscarinic receptor sites in both the ciliary body and the iris sphincter. The anticholinergic activity of this agent effectively causes mydriasis and cycloplegia by competing with acetylcholine at these effector sites[3]. The efficacy of tropicamide depends somewhat on the concentration and the intent of the practitioner (whether it is utilized for the purpose of dilation or to inhibit accommodation). It has been proven that there is not a significant difference in maximum mydriasis between concentrations of 0.25% to 1.0%[4]; however, this consistency between the differing concentrations remains untrue when cycloplegia is taken into account. It has been shown that there is a direct increase in the dioptric value

of residual accommodation with a decrease in the concentration of the drug[5]. The maximum mydriatic effect of tropicamide, regardless of irides' color, typically occurs within 30 minutes following drug instillation, whereas the maximum cycloplegic effect usually is evident 30-35 minutes post-instillation. Another possible reaction secondary to the use of tropicamide is a slight increase in intraocular pressure in patients with open angle glaucoma, although the pressure elevation is usually minimal and involves absolutely no risk to the patient[5].

Phenylephrine and hydroxyamphetamine hydrobromide are both sympathomimetic agents which cause contraction of the iris dilator muscle. This specificity of action results in mydriasis with little or no effect on accommodation. Phenylephrine acts directly as an alpha receptor agonist, whereas hydroxyamphetamine follows a more indirect approach by stimulating the release of norepinephrine. Both agents have been proven to be similar in their efficacy in producing mydriasis, with 2.5% phenylephrine requiring 70.2 minutes and 1.0% hydroxyamphetamine requiring 64.8 minutes to accomplish maximum dilation[6]. It has been speculated that phenylephrine may result in a decrease in IOP; while on the other hand, hydroxyamphetamine typically has little or no effect on IOP[5].

Methodology

The study population consisted of 23 volunteers, 5 males and 17 females, who ranged in age from 23 to 29 years of age. There were 13 subjects with brown irides and 10 subjects with non-brown irides. All subjects were free of ocular and systemic disease, and received comprehensive vision examinations from the Pacific University College of Optometry Family Vision Center prior to participation in this study. Volunteers were excluded from the study for the following reasons: (1) contact lens wear during the investigation; (2) allergies to any of the components in Ophthetic™, tropicamide, phenylephrine and Paremyd™; (3) hypertension, diabetes, pregnancy, cardiac or thyroid disease; (4) current use of tricyclic antidepressants, beta adrenergic blocking drugs or monoamine oxidase inhibitors; (5) corneal disruption or narrow anterior chamber angles; (6) a history of angle closure or open angle glaucoma; (7) pupillary defects; (8) presbyopia. All subjects read and signed a written informed consent prior to entering the study.

The first pre-instillation test was a pupil screening to assess normal direct, consensual and accommodative responses; as well as to rule out an afferent pupillary defect. Evaluation was completed under dim illumination. Following this initial screening, two baseline pupil diameter measurements were taken. This was accomplished using an entopic pupillary diameter technique. Black 2" x 5" poster board with pinholes spaced 3 mm to 11 mm apart in 1 mm step increments was positioned by the subject in front of the pupil being evaluated. The card was placed in front of the participant's eye, with the measurement

device just clearing their eyelashes. Pupillary diameters were then measured by matching the corresponding millimeter separation in which the subject reported that the two circles were just touching. The pinhole separation thus indicates the pupillary diameter. Measurements were taken in standard room illumination and in dim illumination with the BIO light shone in the eye not being evaluated (via a high powered condensing lens) to provide us with a consensual response. This consensual response was used as the indication of the degree of inhibition of the pupillary light reflex. The need to be able to maintain pupillary dilation under intense illumination, as experienced during a BIO examination, mandates the need for ellimination of this pupillary light reflex.

Once this information was collected, monocular accommodative amplitudes were measured using the 0.50 M print size on a standard Donder's near point card. The participant, wearing their best corrected distance prescription, used the push-up technique and was instructed to bring the card towards them until the letters of this paragraph became too blurry to read. Equal effort was exerted between the two eyes and for all further measurements. A corneal health assessment and anterior chamber angle estimation using the Van Herick technique was completed at this time. The final pre-instillation test was an IOP measurement using the Keeler pulsair. Two measurements within three mmHg were mandatory for each eye.

One drop each of Alcaine™ (0.5% proparacaine), 1% tropicamide and 2.5% phenylephrine was instilled in the right eye, while one drop each of Alcaine™ and Paremyd™ was placed in the left eye. All drops were spaced one minute apart, with tropicamide being the first drop

instilled one minute after the anesthetic was placed in both eyes. Phenylephrine and Paremyd™ were the final group of drops administered. Punctal occlusion was performed after instillation of each drop.

Pupil diameters and accommodative amplitudes were taken 10, 20, 30, 45, 60, 90, 120, 150 and 180 minutes post instillation, while IOPs were taken at the 30, 60, 120 and 180 minute mark.

RESULTS

Despite the initial variability in the accommodative abilities between the subjects' right and left eyes, there was still a statistically significant difference between the tropicamide/phenylephrine eye and the Paremyd™ eye at all measurement intervals (figure 1-1). The maximum cycloplegic effect of the tropicamide/phenylephrine combination occurred at 30 minutes post-instillation with a residual accommodation of 21.96% of the initial amplitude, whereas Paremyd's™ maximal effect was evident at the 45 minute mark with a residual value of 32.22% (figure 1-2). Recovery time with Paremyd™ showed a 50% recovery value at approximately 120 minutes vs. 150-180 minutes for the two drug combination.

However, tropicamide/phenylephrine produced a greater mydriatic effect than Paremyd™ at each of the measured intervals (figure 1-3). There was a 15 minute difference in peak mydriasis between the two eyes with the tropicamide/phenylephrine eye, producing a 7.57 mm

pupil diameter at the 45 minute point and the Paremyd™ eye dilating to 7.11 mm at the 60 minute mark.

Intraocular pressure decreased with the use of tropicamide/phenylephrine with a 180 minute reading that was slightly lower than the pre-instillation value. However, Paremyd's™ effect on IOPs was somewhat more inconsistent, resulting in a final value 0.12 mmHg higher than the original (figure 1-4).

When differentiating between irides' color in the study population, both drug regimens affect the accommodative performance of subjects with brown irides to a greater extent and more rapidly than those with non-brown (and hazel) irides (figures 2-1 and 2-2). Upon comparison of recovery percentages, the brown eyed subjects recovered 40.7% of initial accommodative ability at the 180 minute reading when tropicamide/phenylephrine was utilized, while with the use of Paremyd™, 53.9% of initial amplitude was restored. However, in the non-brown eyed subjects, 82.2% of the original value was restored at the final measurement with the two drug combination, while only 69.0% of the initial amplitude was recovered when Paremyd™ was utilized.

With regard to pupil dilation, greater drug efficacy is seen on non-brown eyed individuals (figures 2-3 and 2-4) with tropicamide/phenylephrine reaching a maximum value of 8.10 mm at 45 minutes post-instillation and Paremyd™ attaining a 7.55 mm dilation at 60 minutes. The brown eyed individuals reached a plateau of approximately 7.15 mm from 45-90 minutes with the two drug combo and 6.77 mm from 45-60 minutes with Paremyd™.

Intraocular pressures were markedly stable in brown eyed subjects with the dilation process raising the IOPs in both conditions;

however, there was quite a bit of variability among the non-brown eyed subjects (figures 2-5 and 2-6) with a 180 minute reading that was significantly lower than the initial measurement. Upon comparison of their initial and final readings, tropicamide/phenylephrine lowered pressures an average of 3 mmHg and Paremyd™ decreased values an average of 2.5 mmHg.

DISCUSSION

Paremyd's™ claim of being a milder dilation drop seems to be well substantiated. The foremost goal of this study was to create an environment in which results would be applicable and relevant to the optometric community. To provide this realistic situation, the BIO light and the high plus condensing lens were employed to simulate actual pupil responses during a dilated fundus evaluation. With a 7 mm pupil diameter as the goal to provide an adequate fundus examination, eye care practitioners using 1.0% tropicamide and 2.5% phenylephrine can expect to wait 20 minutes for dilation of this magnitude to occur, whereas those using Paremyd™ would require more than twice the amount of time to reach a diameter of this size. The greater tropicamide concentration appears to be the factor in the quicker dilation of the pupil when comparing the two dilation methods.

Another true to life method that was employed was the use of printed material in measuring the accommodative ability. Although this technique may not be quite as precise and "clean" as other unorthodox procedures, this provided the most useful information and

allowed the application of this data to real life accommodative performance. With the assumption that 5 diopters of accommodative ability is required to read comfortably at 40 centimeters, patients who are dilated with Paremyd™ can expect to resume near work at 60 minutes following drop instillation; however, those dilated with tropicamide/phenylephrine will be debilitated for at least 120 minutes. At the 180 minute point, the Paremyd™ eye recovered 60.18% of their original amplitude, while the tropicamide/phenylephrine subjects were at 54.94% of their initial ability. Once maximum cycloplegia was achieved, the drug combo lagged behind approximately 30 minutes with regard to accommodative recovery.

When segregated according to irides' color, the data seems to indicate that when the drugs' potential mydriatic effects are considered, brown eyes are less susceptible to dilation than non-brown eyes. This is contradictory to cycloplegic effects with the darker irides being affected quicker and to a greater extent than lighter colored irides. However, it remains somewhat suspicious that the subjects with non-brown eyes recovered their accommodative ability over time at a greater value when tropicamide/phenylephrine was used vs. Paremyd™. This may be due to human error on the part of the participant or the examiner. Also of special note, there seems to be quite a bit of variability of initial accommodative amplitude measurements between the two eyes of those with non-brown irides (a 2.88D difference). However, those with brown irides were much more internally consistent (0.51D difference). This variability could well be the cause for the somewhat unexpected finding.

Figure 1-4 may be somewhat misleading due to the small increments utilized to compare the mmHg changes over time. Upon precise examination, the variability is not quite as extensive as may first appear. It may be of interest to note that the eye in which phenylephrine was instilled, which has been considered to have a possible decreasing effect on IOP[5], followed suit and supported previous speculations. With further investigation, it appears that IOP fluctuation over time seems to be influenced by iris color. Could it be theorized that the decrease in iris fibers and pigment play a role in this variability? Further study is required to form concrete conclusions on this matter.

CONCLUSIONS

After much analysis, there is still some uncertainty as to which drug regimen is the best choice. In all circumstances, it appears that Paremyd™ will provide most eye care practitioners with an adequate dilation while leaving the patient with enough accommodative ability to continue with their daily activities. When comparing the significant cycloplegic effect and the rapid onset of tropicamide/phenylephrine vs. the relatively milder effect of Paremyd™, patients will most likely not be quite as aware of their decreased vision if the latter drug is used. If this adverse effect can be minimized, the negativity associated with being dilated may be somewhat diminished. Ultimately, the key factor is time. Can we, as eye care providers, wait an extra 20 minutes for Paremyd™ to dilate those extra-tough dark brown irides? What kind of effect will 2 drops of Paremyd™ have on this population? As other

pertinent questions arise, it still remains evident that in the battle of the mydriatic drugs, there is no clear cut winner.

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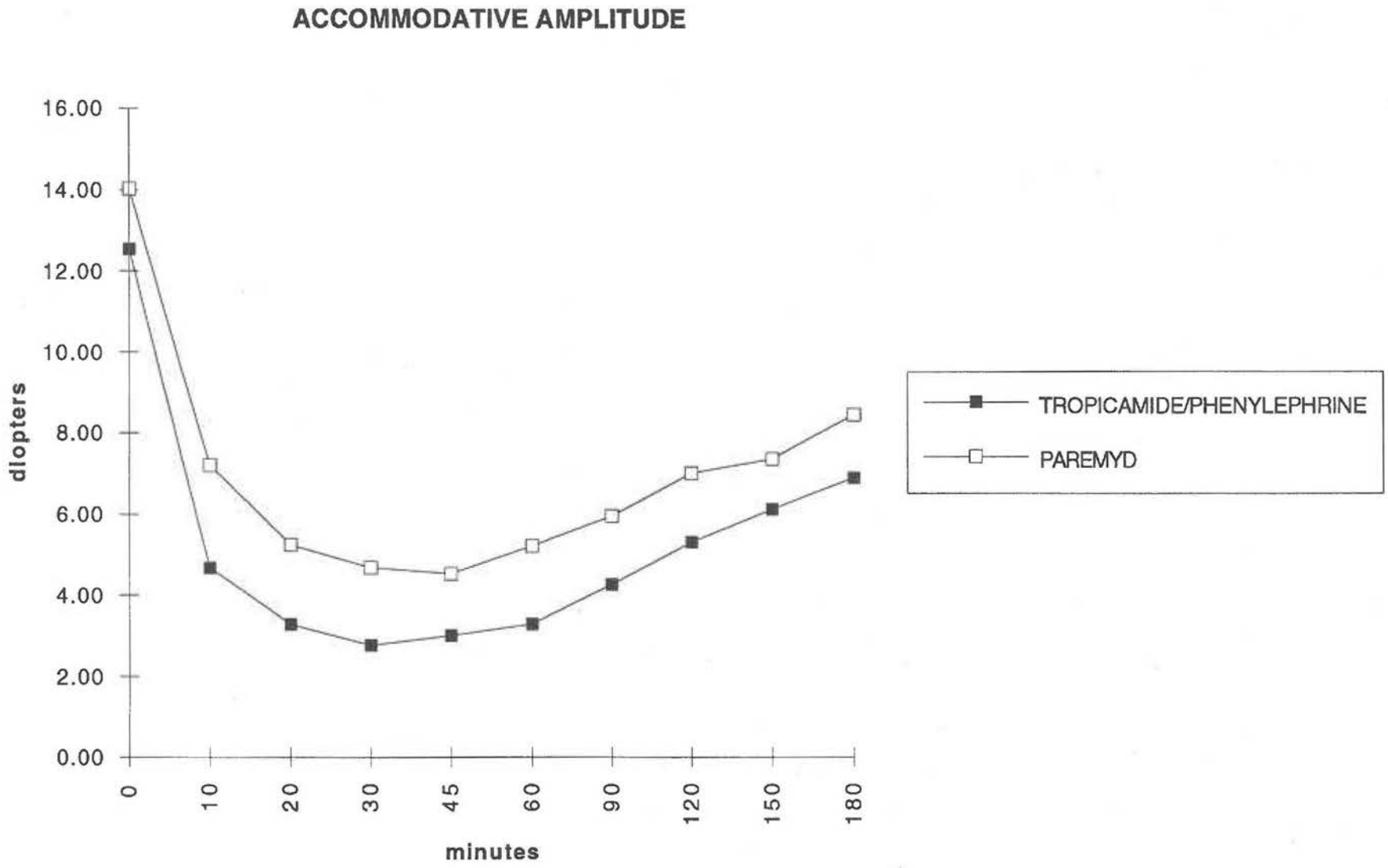

Figure 1-1: Accommodative Amplitude vs. Time following instillation of 1.0% tropicamide/2.5% phenylephrine and Paremyd

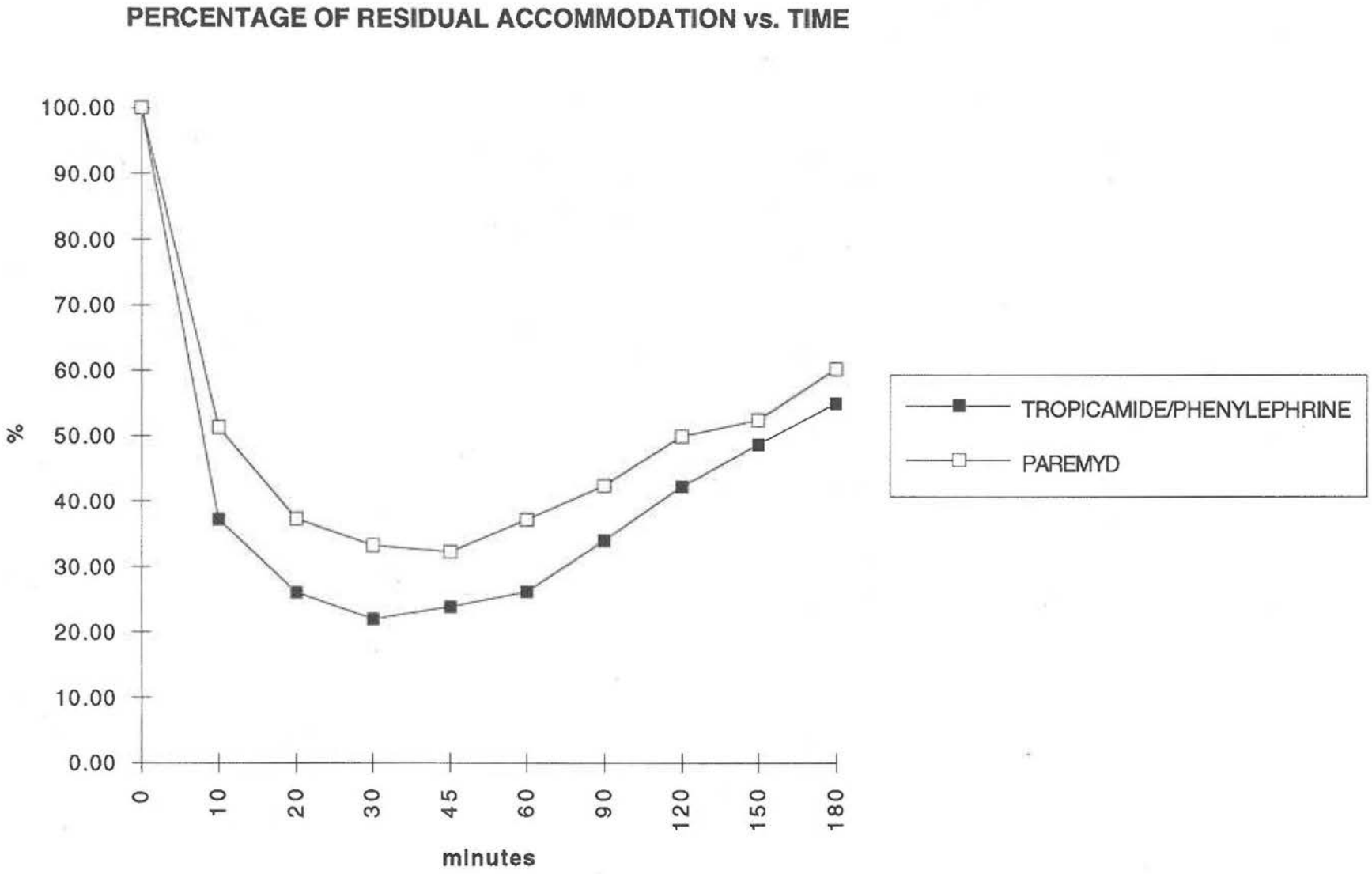

Figure 1-2: Percentage of Residual Accommodative Amplitude vs. Time following instillation of 1.0% tropicamide/2.5% phenylephrine and Paremyd

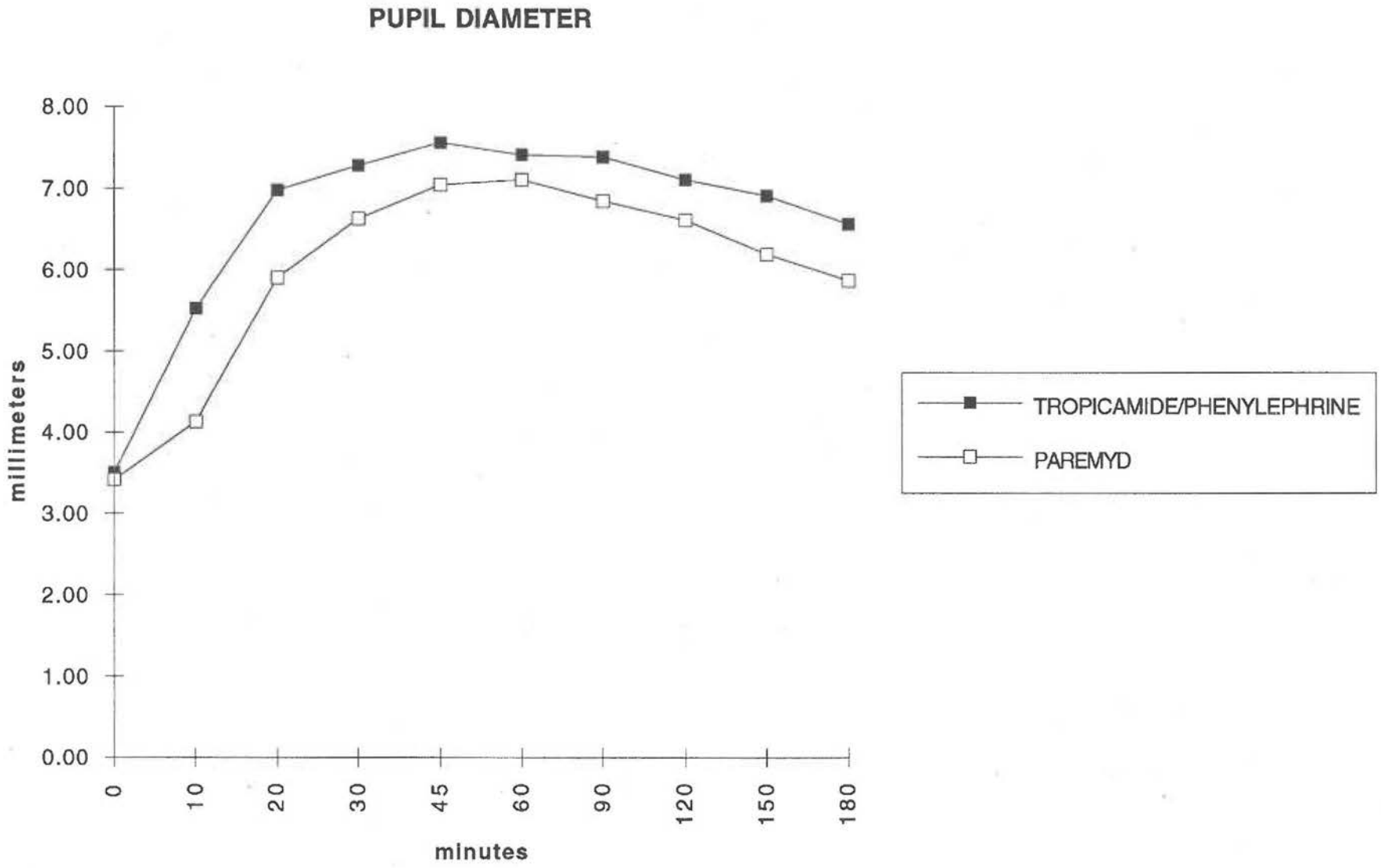

Figure 1-3: Pupil Diameter vs. Time following instillation of 1.0% tropicamide/2.5% phenylephrine and Paremyd

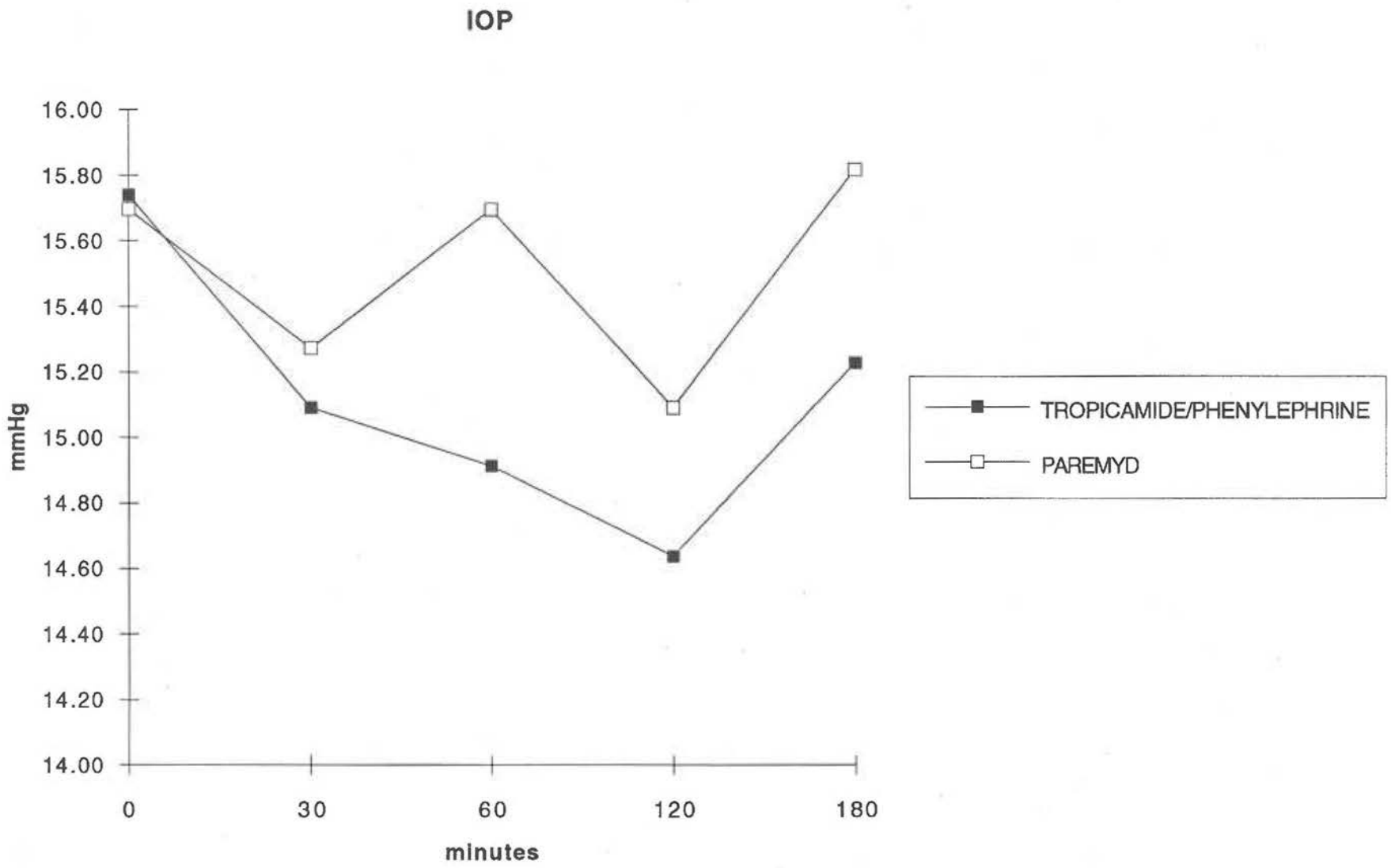

Figure 1-4: IOP vs. Time following instillation of 1.0% tropicamide/2.5% phenylephrine and Paremyd

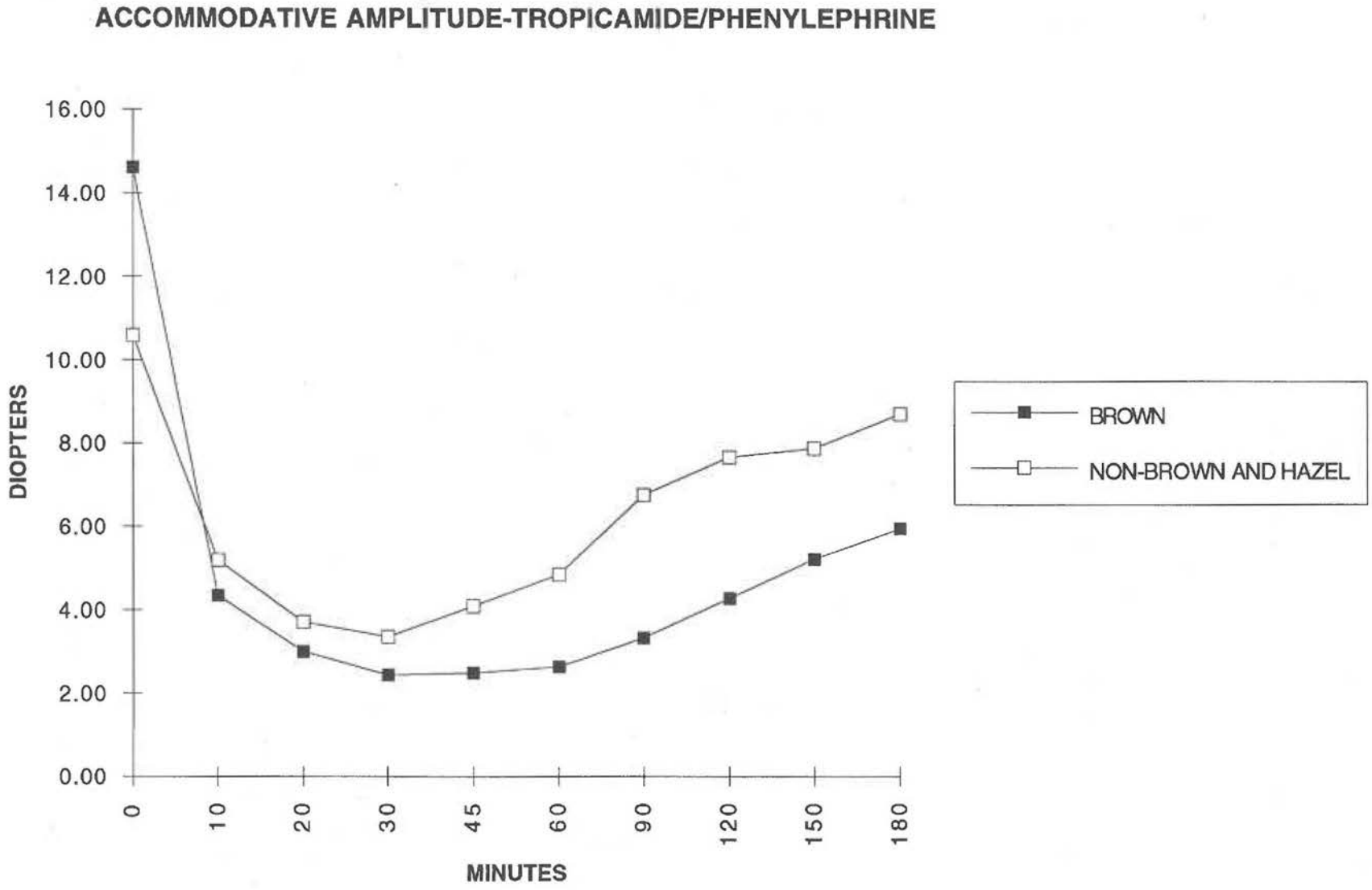

Figure 2-1: Accommodative Amplitude vs. Time post instillation of 1.0% tropicamide/2.5% phenylephrine

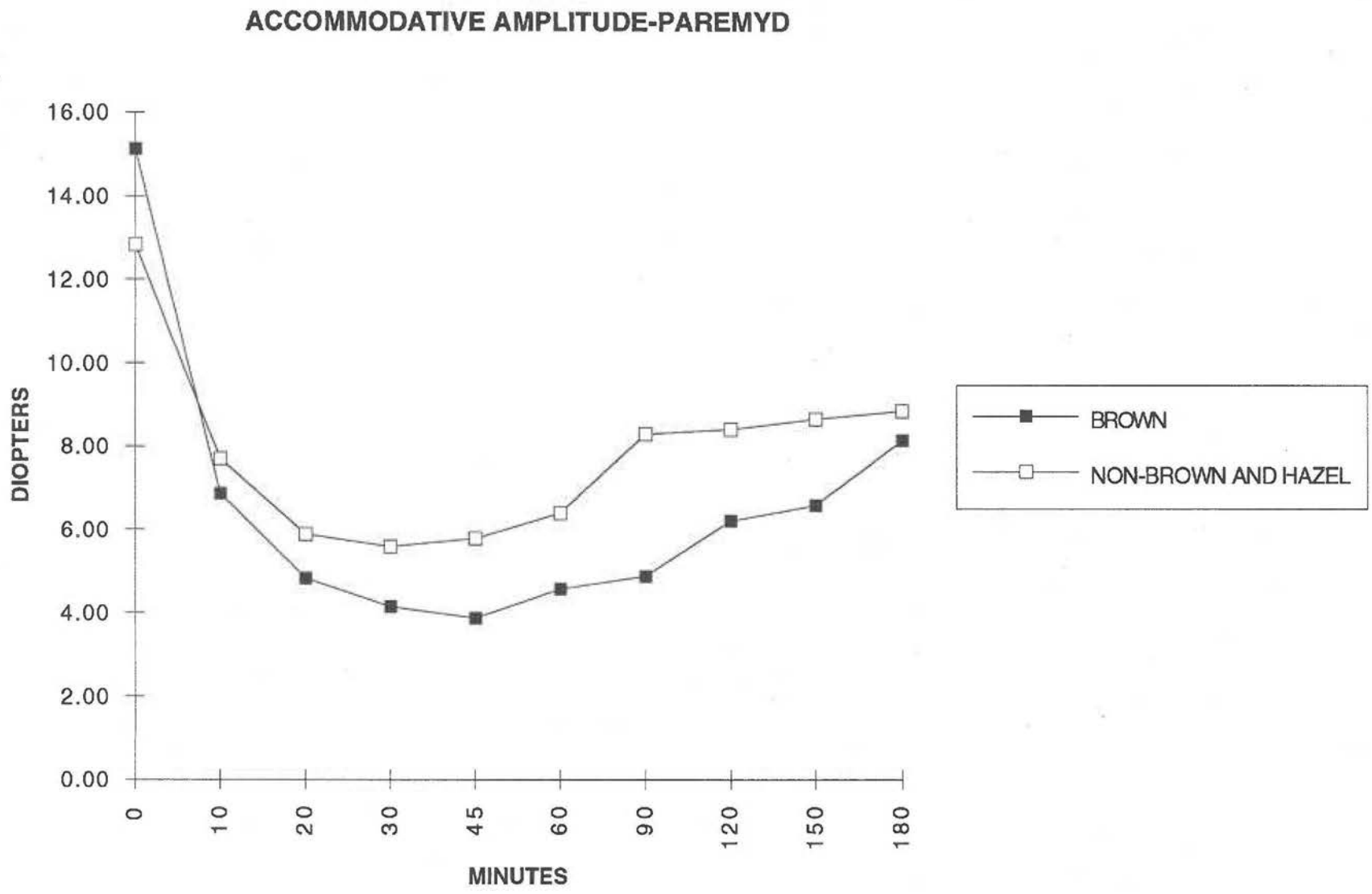

Figure 2-2: Accommodative Amplitude vs. Time post-instillation of Paremyd

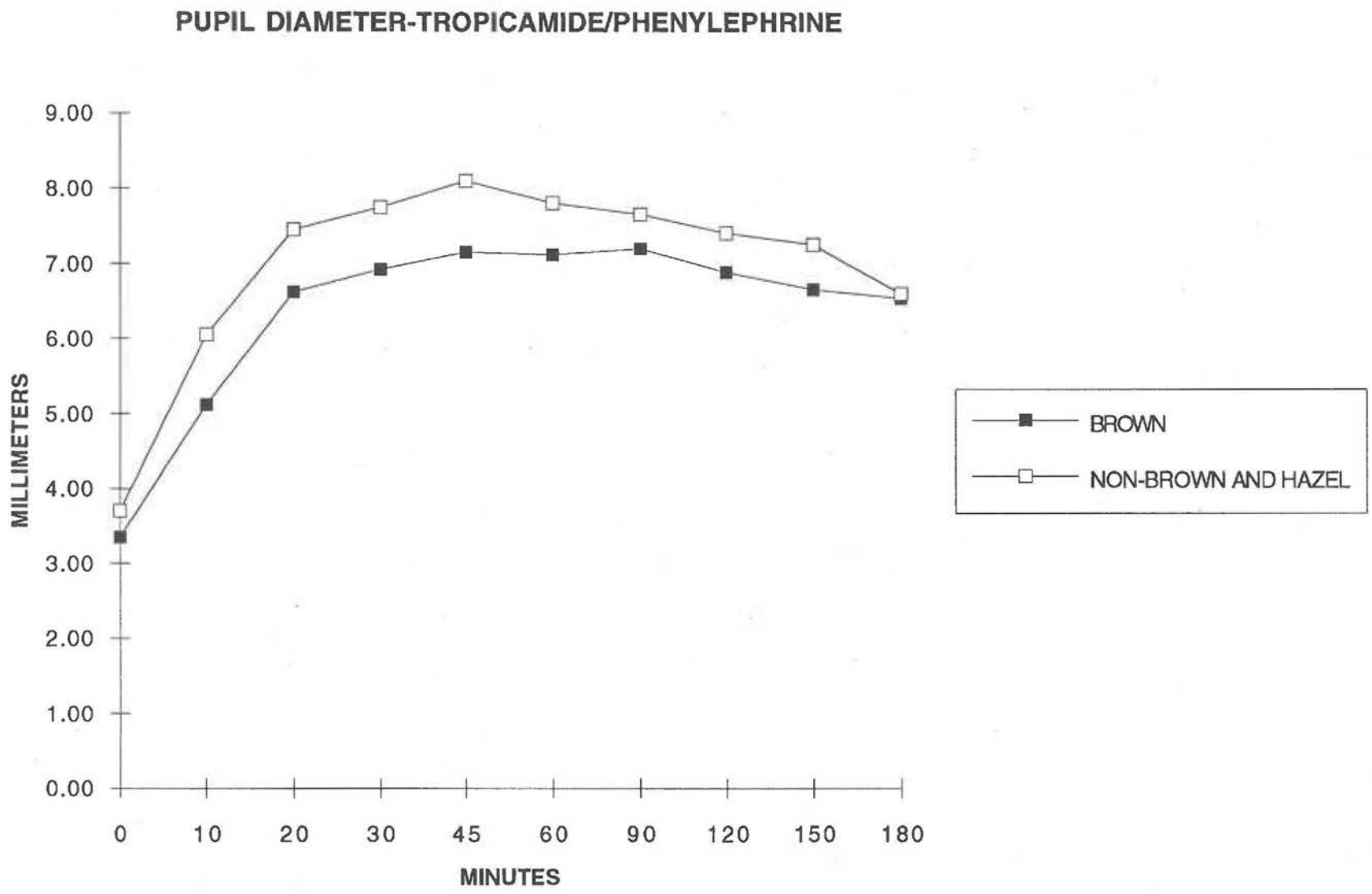

Figure 2-3: Pupil Diameter vs. Time post instillation of 1.0% tropicamide/2.5% phenylephrine

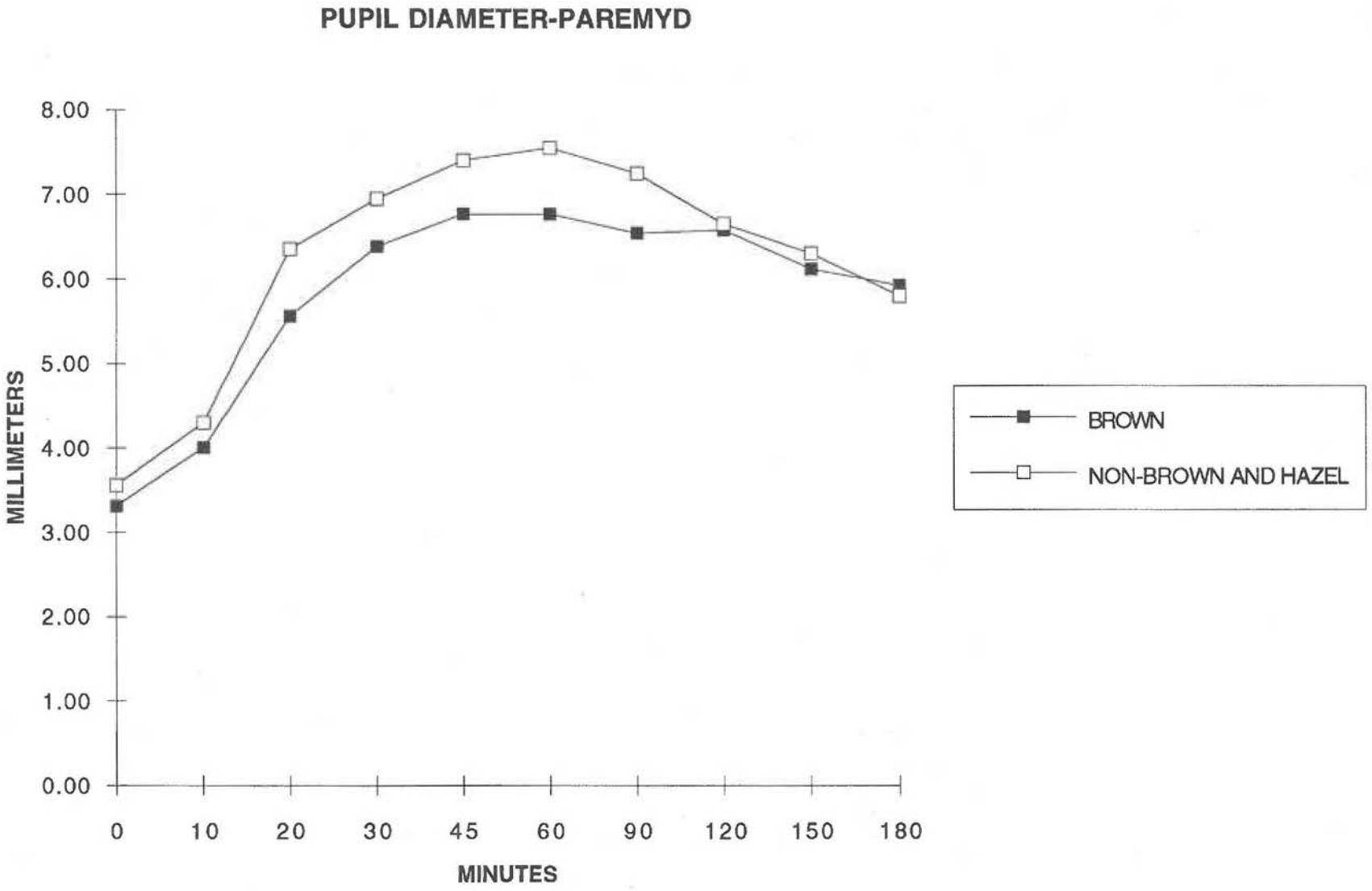

Figure 2-4: Pupil Diameter vs. Time post instillation of Paremyd

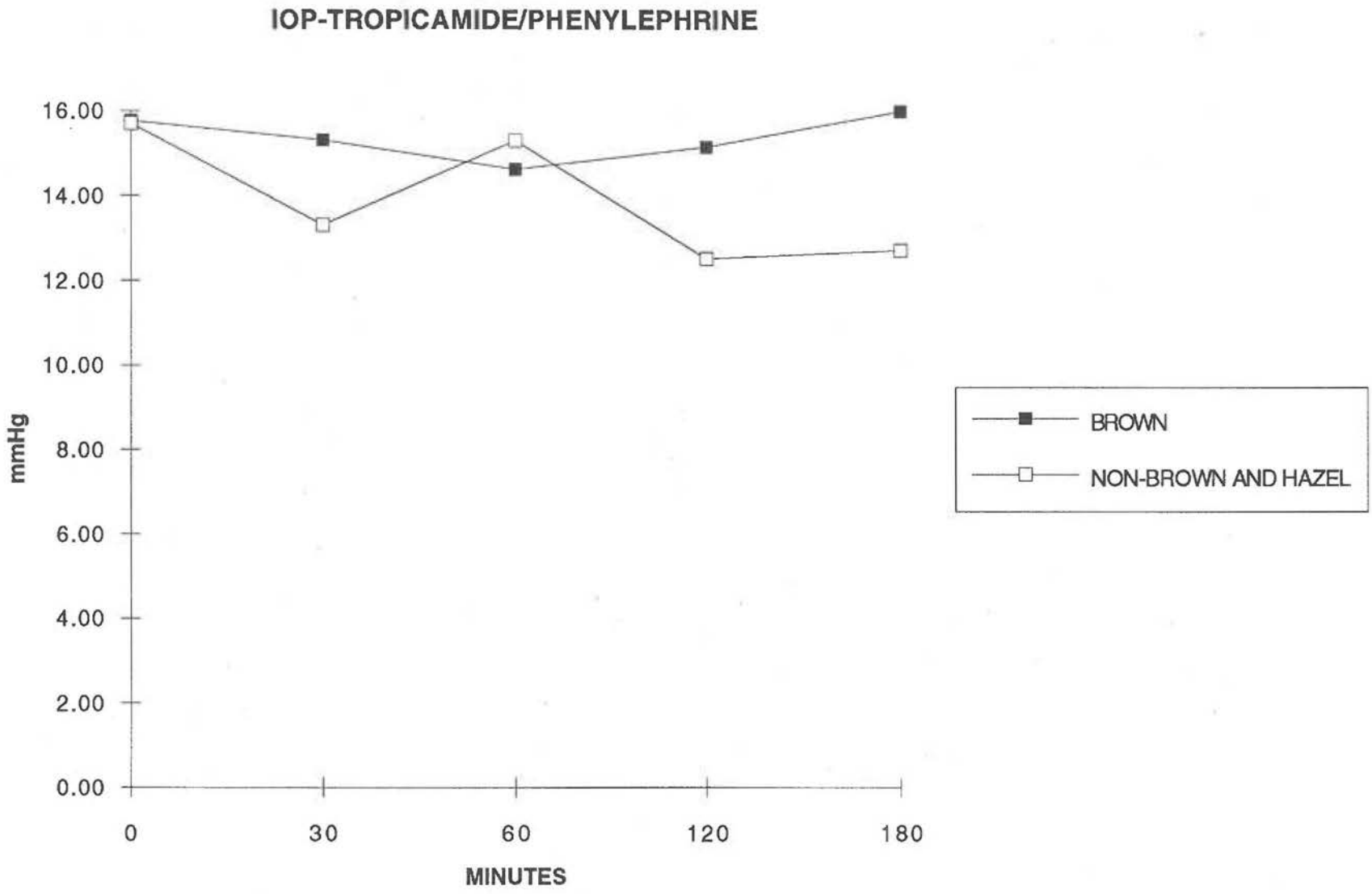

Figure 2-5: IOP vs. Time post instillation of 1.0% tropicamide/2.5% phenylephrine

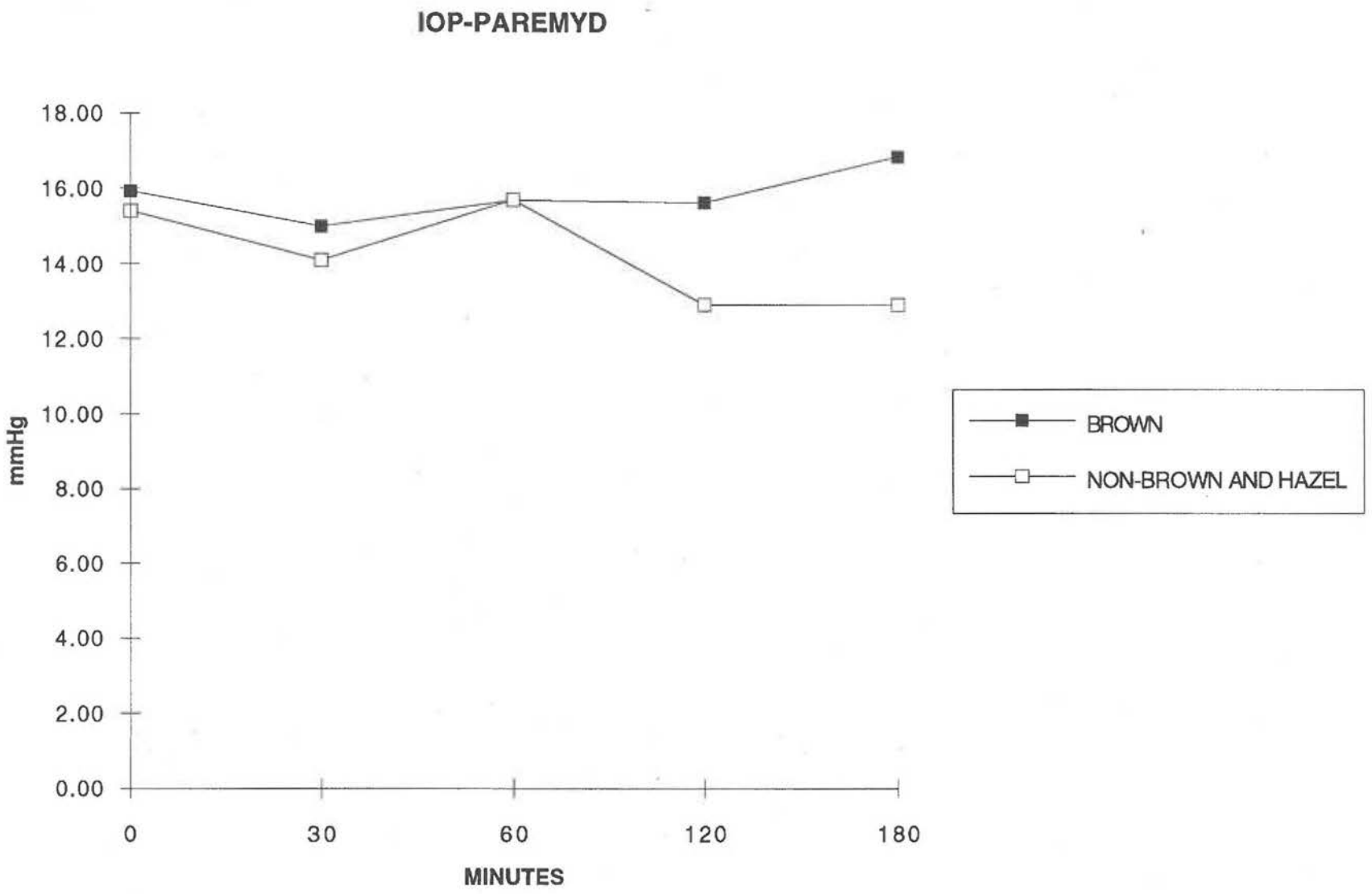

Figure 2-6: IOP vs. Time post instillation of Paremyd

	0	10	20	30	45	60	90	120	150	180
1-D OD	4.00	6.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
2-D OD	3.00	4.50	6.00	7.00	7.00	7.00	7.00	6.00	6.00	6.00
3-D OD	4.00	6.00	6.00	7.00	7.00	7.00	7.00	7.00	6.00	6.50
4-D OD	4.00	5.00	6.00	5.50	6.00	7.00	6.50	7.00	6.50	6.00
5-D OD	3.00	5.50	7.00	7.00	8.00	7.00	7.00	7.00	7.00	7.00
6-D OD	3.00	5.00	6.00	6.50	7.00	7.00	7.00	6.00	6.00	6.00
7-D OD	3.50	6.00	8.00	7.00	8.00	7.00	7.00	7.00	7.00	7.00
8-D OD	3.00	4.00	5.00	5.00	7.00	7.00	5.00	6.00	6.00	4.00
9-D OD	4.00	7.00	8.00	8.50	9.00	8.50	8.00	8.00	7.00	6.00
10-D OD	3.00	5.00	6.50	7.00	7.50	7.00	7.00	7.50	7.00	7.00
11-D OD	3.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
12-D OD	5.00	6.00	6.50	7.00	7.00	7.00	7.00	6.00	6.00	6.00
13-D OD	3.50	5.00	7.50	8.00	8.50	9.00	9.00	8.50	9.00	8.50
14-D OD	3.00	8.00	9.00	9.00	9.00	9.00	9.00	8.00	8.50	8.00
15-D OD	4.00	4.00	7.00	8.00	8.00	8.00	8.00	8.00	7.00	7.00
16-D OD	3.00	3.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	5.00
17-D OD	3.00	5.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
18-D OD	4.00	6.00	7.00	8.00	8.00	8.00	8.00	8.00	7.00	6.00
19-D OD	3.00	4.00	7.00	7.00	7.00	7.00	7.00	6.00	6.00	6.00
20-D OD	3.00	5.00	7.00	7.00	8.00	7.50	7.00	7.00	6.50	6.00
21-D OD	4.00	8.00	9.00	9.50	8.00	8.00	9.50	8.00	9.00	7.00
22-D OD	3.50	6.00	8.00	8.50	9.00	8.50	8.00	8.00	8.00	8.00
23-D OD	4.00	7.00	8.00	8.00	8.00	7.00	9.00	7.50	6.50	7.00
24-D OD										
25-D OD										
26-D OD										
27-D OD										
28-D OD										
29-D OD										
30-D OD										
AVERAGES	**3.50**	**5.52**	**6.98**	**7.28**	**7.57**	**7.41**	**7.39**	**7.11**	**6.91**	**6.57**
1-D OS	4.00	5.00	5.00	6.50	7.00	7.00	7.00	7.00	6.50	6.50
2-D OS	3.00	3.00	5.00	6.00	6.00	6.50	6.50	6.00	6.00	6.00
3-D OS	3.00	4.00	6.00	6.00	7.00	7.00	7.00	6.00	7.00	6.00
4-D OS	3.50	3.50	3.75	3.50	4.50	4.50	4.50	4.00	4.00	3.50
5-D OS	3.00	4.00	5.00	6.00	6.00	7.00	7.00	6.00	6.00	6.00
6-D OS	3.00	4.00	5.00	6.00	6.00	6.50	6.00	6.00	5.50	6.00
7-D OS	3.00	4.00	6.00	6.00	7.00	7.00	6.00	7.00	7.00	6.00
8-D OS	3.00	4.00	6.00	6.00	7.00	6.00	6.00	6.00	6.00	3.00
9-D OS	4.00	5.00	7.50	8.00	8.00	8.00	7.00	7.00	7.00	5.00
10-D OS	3.50	4.50	6.50	7.00	7.50	6.50	7.00	7.50	6.00	6.00
11-D OS	3.00	5.00	6.00	7.00	6.00	7.00	6.00	6.00	6.00	6.00
12-D OS	4.00	5.00	6.00	6.50	7.00	7.00	7.00	6.00	6.00	6.00
13-D OS	3.50	5.00	7.00	8.00	9.00	9.00	8.00	9.00	9.00	9.00

14-D OS	3.00	5.00	8.00	9.00	9.00	8.50	8.50	8.00	7.00	7.00
15-D OS	4.00	4.00	7.00	8.00	8.00	9.00	8.50	8.00	8.00	8.00
16-D OS	4.00	4.00	6.00	6.00	7.00	6.00	7.00	7.00	6.00	6.00
17-D OS	3.50	5.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	6.00
18-D OS	4.00	5.00	7.00	7.00	7.00	8.00	8.00	7.00	7.00	7.00
19-D OS	3.00	3.00	5.00	6.00	6.00	7.00	5.00	6.00	5.00	4.00
20-D OS	3.00	3.00	5.00	7.00	7.00	7.00	7.00	7.00	6.50	6.00
21-D OS	4.00	4.00	7.00	8.00	9.00	7.00	8.50	6.50	5.00	6.00
22-D OS	3.50	3.00	4.00	5.00	6.00	8.00	6.00	5.00	4.00	4.00
23-D OS	3.00	3.00	5.00	7.00	8.00	7.00	7.00	7.00	5.00	6.00
24-D OS										
25-D OS										
26-D OS										
27-D OS										
28-D OS										
29-D OS										
30-D OS										
AVERAGES	**3.41**	**4.13**	**5.90**	**6.63**	**7.04**	**7.11**	**6.85**	**6.61**	**6.20**	**5.87**
1-AA OD	8.00	19.50	47.00	47.00	48.00	48.00	42.00	34.50	24.00	20.00
2-AA OD	5.00	13.00	22.00	24.00	25.00	21.00	27.00	12.50	12.00	8.00
3-AA OD	5.00	28.50	34.00	39.50	36.50	27.00	30.50	26.00	25.50	18.50
4-AA OD	5.00	11.00	17.50	26.50	27.00	27.00	12.00	12.00	10.00	10.00
5-AA OD	10.00	18.00	30.00	39.50	40.00	34.00	26.00	24.00	20.50	20.00
6-AA OD	5.00	14.00	25.00	26.00	32.00	38.00	36.00	24.00	22.00	18.00
7-AA OD	9.00	23.00	38.00	46.00	41.00	31.00	13.50	13.00	14.00	12.00
8-AA OD	10.50	30.00	32.00	37.00	16.50	16.00	11.00	13.00	13.00	11.00
9-AA OD	7.00	35.50	40.00	46.50	34.00	16.00	9.50	9.00	7.50	8.50
10-AA OD	6.00	24.00	30.00	48.00	50.00	45.00	33.00	24.00	13.00	10.00
11-AA OD	6.50	16.00	33.50	37.00	42.00	32.00	25.00	16.00	12.00	10.00
12-AA OD	9.00	10.00	14.00	14.00	13.00	12.00	13.50	8.00	7.00	8.00
13-AA OD	7.50	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	58.00
14-AA OD	7.00	15.50	21.00	25.50	22.00	19.00	11.00	9.50	9.50	8.00
15-AA OD	10.00	14.00	17.50	20.00	20.00	19.00	13.00	14.50	14.50	13.50
16-AA OD	6.00	20.00	25.00	38.00	39.00	41.00	25.00	15.50	13.00	13.00
17-AA OD	9.00	11.00	27.00	32.00	26.50	24.00	20.00	15.50	14.50	11.00
18-AA OD	6.00	13.00	18.50	18.50	29.00	22.00	18.00	13.50	14.00	10.00
19-AA OD	6.00	18.00	39.00	50.00	48.00	44.00	17.50	13.00	11.00	11.00
20-AA OD	9.50	30.00	33.50	65.50	54.00	51.00	25.50	22.50	14.00	13.00
21-AA OD	19.00	20.50	44.00	36.50	15.50	24.50	21.00	16.50	17.00	15.00
22-AA OD	7.00	13.50	15.00	16.00	14.50	13.50	11.50	9.50	10.00	9.00
23-AA OD	10.50	35.00	40.50	42.50	37.00	38.00	39.00	29.00	19.00	18.50
24-AA OD										
25-AA OD										

26-AA OD										
27-AA OD										
28-AA OD										
29-AA OD										
30-AA OD										
AVERAGES	**7.98**	**21.43**	**30.61**	**36.33**	**33.50**	**30.57**	**23.50**	**18.91**	**16.39**	**14.52**
1-AA OS	6.50	10.00	12.50	18.00	19.00	15.00	17.00	12.50	11.50	9.00
2-AA OS	6.00	6.00	9.00	13.00	13.00	12.00	14.00	9.50	9.00	6.50
3-AA OS	5.00	14.00	20.50	23.50	24.00	21.00	18.00	14.00	15.00	11.00
4-AA OS	4.50	5.00	5.00	7.00	9.00	9.00	6.00	5.00	6.00	4.50
5-AA OS	11.00	18.00	20.00	22.50	21.00	19.00	16.00	16.50	13.00	14.00
6-AA OS	6.00	10.00	15.00	17.50	22.00	19.00	18.50	16.00	16.50	14.00
7-AA OS	9.50	13.50	18.00	18.50	16.50	15.00	11.50	14.50	12.50	13.00
8-AA OS	8.50	16.00	21.00	19.00	11.50	12.50	12.00	12.00	12.00	10.00
9-AA OS	5.00	10.00	11.50	13.00	10.50	8.00	7.00	7.00	7.50	7.50
10-AA OS	7.00	15.00	30.00	26.00	37.00	23.00	18.00	11.00	9.00	5.00
11-AA OS	7.00	12.00	15.00	18.00	20.00	15.00	14.00	11.00	11.00	10.00
12-AA OS	8.00	9.00	10.00	10.00	11.00	11.00	9.00	8.00	6.50	7.00
13-AA OS	8.00	46.50	60.00	60.00	60.00	60.00	60.00	60.00	60.00	46.00
14-AA OS	6.00	10.00	14.50	16.00	13.50	13.00	10.00	9.00	9.00	8.50
15-AA OS	9.00	20.00	27.00	31.00	28.00	22.00	15.00	14.00	14.50	13.50
16-AA OS	5.50	14.00	25.00	32.00	33.00	31.00	18.00	13.50	12.50	12.00
17-AA OS	8.00	13.00	19.00	23.00	21.00	16.00	19.00	14.50	12.50	11.00
18-AA OS	4.00	9.50	18.00	16.00	32.00	31.00	14.50	14.50	13.50	10.00
19-AA OS	4.50	7.50	11.50	13.00	13.50	10.00	10.00	7.00	9.00	9.00
20-AA OS	8.50	13.50	13.00	25.00	24.00	21.00	17.00	13.50	12.00	12.00
21-AA OS	10.00	16.00	21.00	22.00	19.00	15.00	15.50	15.00	17.00	22.00
22-AA OS	7.00	8.00	9.00	11.00	10.00	10.00	10.00	8.50	10.00	7.50
23-AA OS	9.50	23.00	34.00	38.50	40.50	33.00	37.00	22.00	13.50	9.50
24-AA OS										
25-AA OS										
26-AA OS										
27-AA OS										
28-AA OS										
29-AA OS										
30-AA OS										
AVERAGES	**7.13**	**13.89**	**19.11**	**21.46**	**22.13**	**19.20**	**16.83**	**14.28**	**13.61**	**11.85**
	0	**30**	**60**	**120**	**180**					
1-I OD	12.00	13.00	13.00	12.00	12.00					
2-I OD	13.00	12.00	13.00	16.00	14.00					

3-I OD	12.00	10.00	14.00	12.00	12.00					
4-I OD	12.00	13.00	10.00	14.00	12.00					
5-I OD	12.00	11.00	13.00	12.00	12.00					
6-I OD	13.00	14.00	14.00	13.00	13.00					
7-I OD	17.00	17.00	17.00	17.00	17.00					
8-I OD	15.00		15.00	14.00	12.00					
9-I OD	13.00	12.00	13.00	11.00	14.00					
10-I OD	20.00	20.00	20.00	15.00	18.00					
11-I OD	19.00	24.00	17.00	20.00	16.00					
12-I OD	22.00	19.00	19.00							
13-I OD	15.00	13.00	13.00	16.00	18.00					
14-I OD	15.00	12.00	13.00	11.00	11.00					
15-I OD	19.00	21.00	18.00	16.00	16.00					
16-I OD	23.00	19.00	18.00	18.00	24.00					
17-I OD	18.00	13.00	16.00	16.00	18.00					
18-I OD	17.00	15.00	14.00	17.00	17.00					
19-I OD	13.00	12.00	12.00	12.00	16.00					
20-I OD	15.00	16.00	16.00	15.00	16.00					
21-I OD	14.00	14.00	17.00	15.00	15.00					
22-I OD	13.00	12.00	14.00	12.00	13.00					
23-I OD	20.00	20.00	14.00	18.00	19.00					
24-I OD										
25-I OD										
26-I OD										
27-I OD										
28-I OD										
29-I OD										
30-I OD										
AVERAGES	**15.74**	**15.09**	**14.91**	**14.64**	**15.23**					
1-I OS	12.00	13.00	13.00	11.00	14.00					
2-I OS	17.00	16.00	20.00	17.00	19.00					
3-I OS	12.00	11.00	11.00	16.00	15.00					
4-I OS	13.00	10.00	11.00	14.00	12.00					
5-I OS	12.00	14.00	14.00	13.00	12.00					
6-I OS	12.00	14.00	13.00	13.00	13.00					
7-I OS	13.00	17.00	15.00	16.00	18.00					
8-I OS	15.00		14.00	14.00	13.00					
9-I OS	15.00	11.00	13.00	14.00	14.00					
10-I OS	17.00	19.00	19.00	18.00	22.00					
11-I OS	17.00	19.00	19.00	19.00	23.00					
12-I OS	22.00	23.00	22.00							
13-I OS	15.00	13.00	14.00	14.00	15.00					
14-I OS	14.00	13.00	12.00	10.00	8.00					
15-I OS	20.00	21.00	18.00	17.00	18.00					
16-I OS	26.00	20.00	20.00	18.00	24.00					

17-I OS	19.00	17.00	15.00	15.00	19.00					
18-I OS	17.00	15.00	16.00	17.00	17.00					
19-I OS	13.00	13.00	13.00	14.00	12.00					
20-I OS	16.00	13.00	18.00	15.00	15.00					
21-I OS	14.00	12.00	16.00	13.00	15.00					
22-I OS	12.00	15.00	17.00	15.00	14.00					
23-I OS	18.00	17.00	18.00	19.00	16.00					
24-I OS										
25-I OS										
26-I OS										
27-I OS										
28-I OS										
29-I OS										
30-I OS										
AVERAGES	**15.70**	**15.27**	**15.70**	**15.09**	**15.82**					
Number of Subjects	23	22								
PUPIL DIAMETER (mm)	0	10	20	30	45	60	90	120	150	180
TROPICAMIDE/PHENYLEPHRINE	**3.50**	**5.52**	**6.98**	**7.28**	**7.57**	**7.41**	**7.39**	**7.11**	**6.91**	**6.57**
PAREMYD	**3.41**	**4.13**	**5.90**	**6.63**	**7.04**	**7.11**	**6.85**	**6.61**	**6.20**	**5.87**
ACCOMMODATIVE AMPLITUDE (D)	0	10	20	30	45	60	90	120	150	180
TROPICAMIDE/PHENYLEPHRINE	**12.53**	**4.67**	**3.27**	**2.75**	**2.99**	**3.27**	**4.26**	**5.29**	**6.10**	**6.89**
PAREMYD	**14.02**	**7.20**	**5.23**	**4.66**	**4.52**	**5.21**	**5.94**	**7.00**	**7.35**	**8.44**
IOPs (mmHg)	0	30	60	120	180					
TROPICAMIDE/PHENYLEPHRINE	**15.74**	**15.09**	**14.91**	**14.64**	**15.23**					
PAREMYD	**15.70**	**15.27**	**15.70**	**15.09**	**15.82**					
% RESIDUAL AMPLITUDE	0	10	20	30	45	60	90	120	150	180
TROPICAMIDE/PHENYLEPHRINE	**100.00**	**37.22**	**26.07**	**21.96**	**23.82**	**26.10**	**33.95**	**42.18**	**48.67**	**54.94**
PAREMYD	**100.00**	**51.33**	**37.32**	**33.23**	**32.22**	**37.15**	**42.38**	**49.92**	**52.40**	**60.18**
PUPIL DIAM-TROPIC/PHENYL	0	10	20	30	45	60	90	120	150	180
BROWN	**3.35**	**5.12**	**6.62**	**6.92**	**7.15**	**7.12**	**7.19**	**6.88**	**6.65**	**6.54**
NON-BROWN AND HAZEL	**3.70**	**6.05**	**7.45**	**7.75**	**8.10**	**7.80**	**7.65**	**7.40**	**7.25**	**6.60**
PUPIL DIAM-PAREMYD	0	10	20	30	45	60	90	120	150	180
BROWN	**3.31**	**4.00**	**5.56**	**6.38**	**6.77**	**6.77**	**6.54**	**6.58**	**6.12**	**5.92**
NON-BROWN AND HAZEL	**3.55**	**4.30**	**6.35**	**6.95**	**7.40**	**7.55**	**7.25**	**6.65**	**6.30**	**5.80**

AA-TROPICAMIDE	0	10	20	30	45	60	90	120	150	180
BROWN	14.61	4.33	3.00	2.43	2.48	2.62	3.31	4.27	5.20	5.94
NON-BROWN AND HAZEL	10.58	5.18	3.70	3.34	4.07	4.83	6.76	7.66	7.87	8.70
AA-PAREMYD	0	10	20	30	45	60	90	120	150	180
BROWN	15.12	6.86	4.82	4.13	3.87	4.56	4.88	6.21	6.58	8.15
NON-BROWN AND HAZEL	12.82	7.69	5.88	5.59	5.78	6.39	8.30	8.40	8.66	8.85
IOPS-TROPIC/PHENYL	0	30	60	120	180					
BROWN	15.77	15.31	14.62	15.15	16.00					
NON-BROWN AND HAZEL	15.70	13.30	15.30	12.50	12.70					
IOPS-PAREMYD	0	30	60	120	180					
BROWN	15.92	15.00	15.69	15.62	16.85					
NON-BROWN AND HAZEL	15.40	14.10	15.70	12.90	12.90					