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The effect of warm compress on IOP

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Abstract

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THE EFFECT OF WARM COMPRESSES ON IOP

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THE EFFECT OF WARM COMPRESSES ON IOP

Introduction

This study was initiated as a result of being unable to locate information in the library at Pacific University regarding the effects of local warm compresses on intraocular pressure (IOP). To date a search of the English literature has failed to reveal any information on this topic.

The literature search included the location and scanning of articles listed in the index medicines under intraocular pressure over the last 20 years. A computer search of a number of national, on line medical bibliographic files was also completed.

Warm compresses are occasionally used clinically in the management of ocular problems such as marginal blepheritis and chalazion formation. Aside from possible clinical considerations, this is an interesting physiological problem.

Problem

This study was designed as an exploratory study to determine if a warm compress applied to one eye would produce a change in the intraocular pressure of one or both eyes.

It was speculated that the warm compress applied to the orbital region might cause vaso dialation of episcleral and uvealscleral vessels. If vaso dialation occured, the outflow of aqueous might be increased, thereby reducing IOP.

Design

An A.O. non-contact tonometer (NCT) was selected to measure IOP for several reasons. There is less chance of inducing ocular infection, trauma and/or adverse drug reactions by using the non-contact (NCT) tonometer.[1,2,6] Measurement obtained with the NCT compare favorably with those obtained using Goldmann tonometers.[1,5] The massage effect that has been reported present with certain contact tonometers is absent or clinically insignificant with the NCT.[1,3,4,5]

The warm compress consisted of an unwrapped rubber hot water bottle, filled with water at a temperature ranging from 120-130° F. This temperature range was arbitrarily selected.

All subjects underwent the same testing sequence. Baseline control was obtained by taking ten consecutive IOP readings on the right eye followed by 10 readings for the left eye. Blinking readouts were disregarded. Following 10 base line readings for each eye, each subject was instructed to close both eyes.

The warm compress was immediately applied over the closed left eye for 5 minutes. This 5 minute application was arbitary. While the subject remained seated, each subject held the compress with minimal force over their left eye while holding their heads erect.

Immediately following the warm compress, the subjects had 10 consecutive, post-treatment, IOP readings taken first for their right eye followed by 10 readings for their left eye.

Ten optometry students between the ages of 10-35, volunteered to serve as subjects. All stated they were in good health. Each subject had a comprehensive vision exam within the past three years. Distance refraction, in spherical equivalent form, ranged from .50 diopters of hyperopia to 7.00 diopters of myopia. Two subjects wore contact lenses, five wore glasses, and three wore no full-time lenses. No subject reported or displayed any signs of ocular pathology.

Results

Results were analyzed for each subject as well as tabulating the group response. The five percent confidence level ($p = .05$) was selected arbitrarily for statistical analyses. Table 1 contains the computed means and standard deviations for each set of 10 consecutive IOP readings for each of each subject before and after the application of the compress. Table 1 also shows the calculated mean differences, comparing the mean pre-treatment IOP to the mean post-treatment IOP for each eye of

Table 1

	Pre		Post		Post-Pre
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$
Sub 1					
OD	12.7	1.05935	12.5	1.6499	-0.2
*OS	11.4	.6992	10.9	.8756	-0.5
Sub 2					
OD	11.6	1.3499	11.8	1.0328	+0.2
*OS	10.9	.7378	10.4	.6992	-0.5
Sub 3					
OD	14.9	.9944	15.8	1.0328	+0.9
*OS	16.4	1.5776	15.7	1.3375	-0.7
Sub 4					
OD	13.6	1.265	13.7	1.4187	+0.1
*OS	12.6	1.075	10.7	1.567	-1.9
Sub 5					
OD	19.1	1.4491	17.7	1.2517	-1.4
*OS	18.4	1.3499	17.1	1.1972	-1.3
Sub 6					
OD	9.9	.9944	9.4	.9661	-0.5
*OS	8.9	.8756	9.1	.5676	+0.2
Sub 7					
OD	13.1	1.3703	13.5	1.2693	+0.4
*OS	11.1	.5676	11.8	.625	+0.7
Sub 8					
OD	13.5	.9718	15.0	.9428	+1.5
*OS	12.1	1.1972	14.9	1.5239	+2.8
Sub 9					
OD	12.3	1.6364	11.9	.9944	-0.4
*OS	11.9	1.3703	10.4	1.2649	-1.5
Sub 10					
OD	8.7	1.3375	8.9	1.1972	+0.2
*OS	10.2	1.4757	8.8	1.4757	-1.4

Sample means, standard deviations, and standard errors

	$\bar{x}$	S.D.	SE_m	$\bar{x}$	S.D.	SE_m
OD	12.95	2.81	.94	13.02	2.74	.91
*OS	12.59	3.37	1.12	11.98	2.88	.96

*Denotes test eye

each subject. If the pre-treatment mean IOP was greater than the post-treatment mean IOP, a plus (+) sign was assigned to the mean difference, if the reverse occured a negative (-) sign was assigned. Table 1 contains the means, standard deviations, and standard errors of the sample of ten subjects under each of the 4 condition (R_B, R_A, L_B, L_A). No significant differences were found for the average IOP between the pre and post compress measurements. No evidence was found that indicates either the mean or variance was changed by the warm compress.

Further evaluation of Table 1, by the Sign test, show that the first eye measured for each subject, the right eye, gave a consistently higher mean IOP than the left eye (8 out of 10 times before the warm compress and 10 out of 10 after the warm compress). To more completely evaluate this statistical finding, the original data was arranged into the following 4 groups: right eye before the compress (R_B); left eye before the compress (L_B); right eye after the compress (R_A); left eye after the compress (L_A).

These 4 groups of data were then compared to each other, for each subject for each of the 10 measurements in the following manner: (L_B-R_B); (L_A-R_A); (R_A-R_B); (L_A-L_B). The resulting information was plotted in histograms. Two histograms, (L_B-R_B) and (L_A-R_A), are shown in Figures 1 and 2. The information on these two figures show that the distribution of plus and minus differences is significant, indicating an effect in the order in which the eyes were tested. An approximately equal

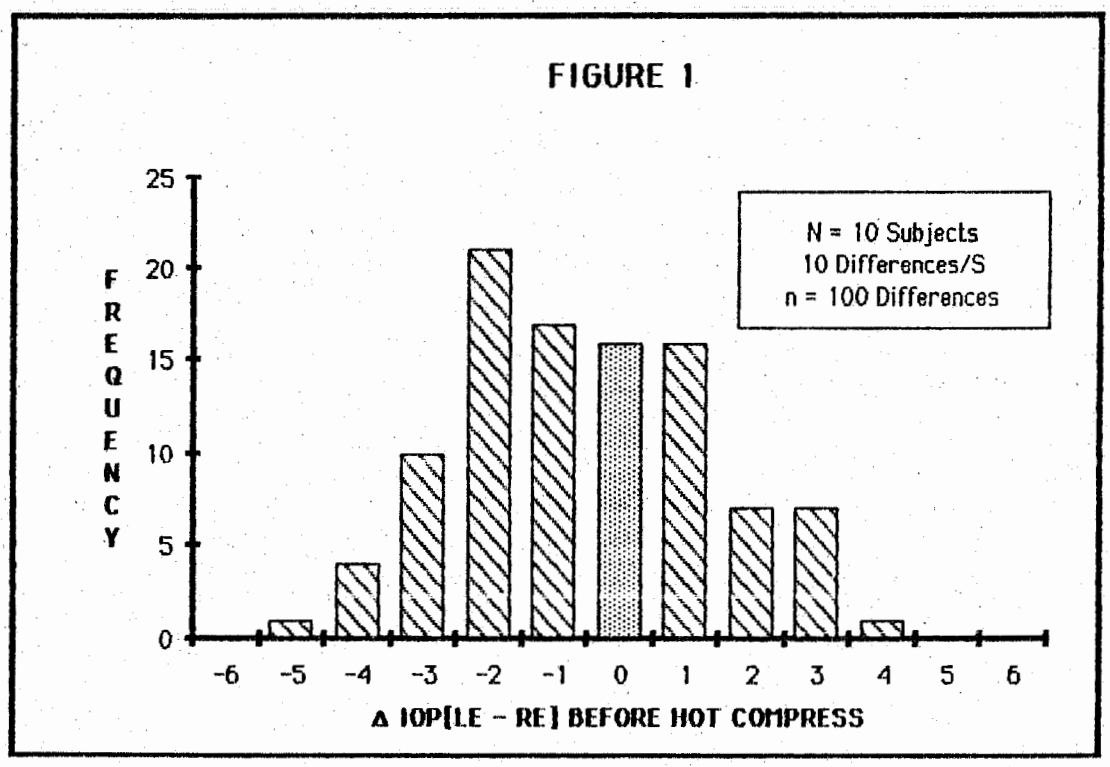

Fig. 1. Frequency distribution of the algerbraic differences obtained by subtracting the right eye's IOP from the left eye's IOP for each of the ten measurements before the warm compress was applied. The predominance of the minus values indicate that; the right eye had a higher IOP reading a significant number of times. The reason for this finding is only partly understood.

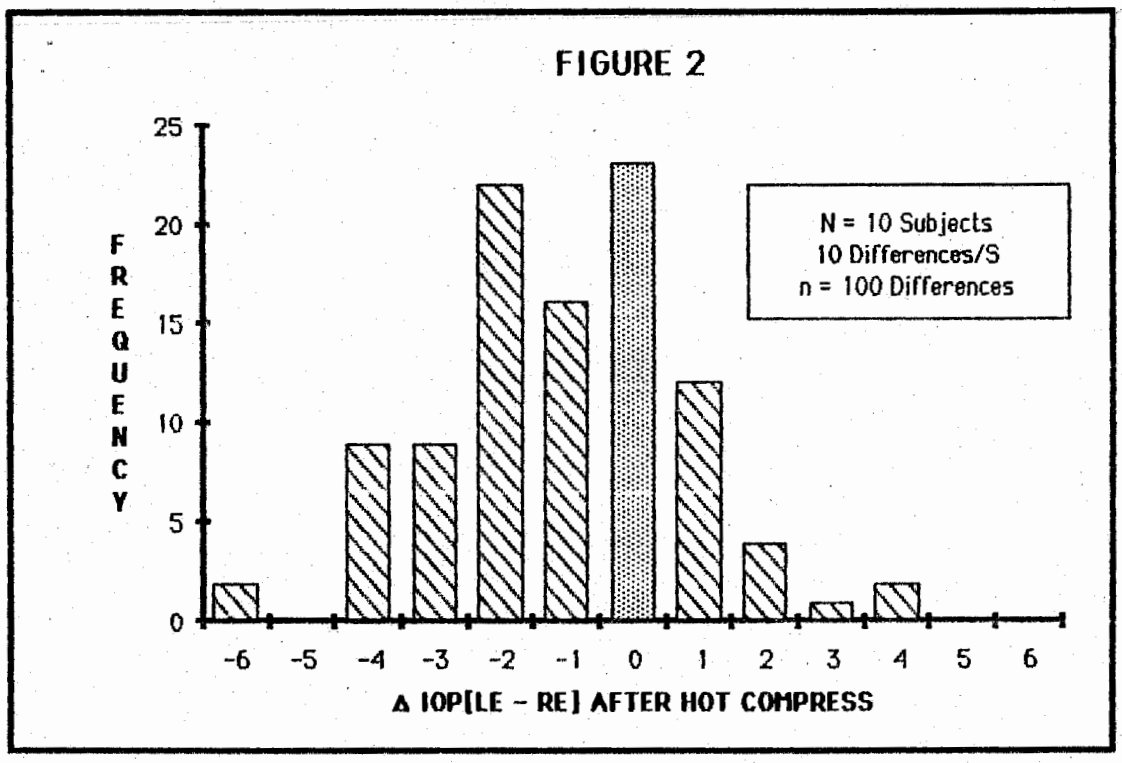

Fig. 2. Frequency distribution of the algerbraic differences obtained by subtracting the right eye's IOP from the left eye's IOP for each of the ten measurements after the application of the warm compress to the left eye. The predominance of the minus values indicate that; the right eye had a higher IOP reading a significant number of times. The reason for this finding is only partly understood. Right and left eye differences before and after the warm compress remained the same.

number of plus and minus differences would be expected if no sequence effect were present.

The ten IOP measurements, for each of the 4 conditions (R_B, R_A, L_B, L_A), for each of the ten subjects, were analyzed by plotting the mean group valued for each position of the ten successive measurements (Figure 3).

The results from Figure 3 indicated a need for further analyses. The first measure IOP for each subject was subtracted from each of the remaining 9 IOP measurements in each of the 4 conditions (R_B, R_A, L_B, L_A). The results were tallied as +, -, or no change (zero difference). Chi square was used to statistically evaluate the number of plus or minus differences. The first measurement, combining all four conditions and all ten subjects, showed a significant difference from the other nine measurements (Figure 4). When the first IOP measurement was dropped from the sequence of measurements, the remaining plus and minus differences did not differ from chance, an example of which is shown if Figure 5. Statistical differences shown in Figures 1, 2 and 4 may have been influenced by the first reading in each series of 10 readings.

Each condition (R_B, R_A, L_B, L_A) were also evaluated separately. The first reading was subtracted from the other 9 readings for each subject in each condition. Table 2 shows the +, -, or no change (zero difference) tally for all 4 conditions. In each condition (R_B, R_A, L_B, L_A), except R_B, the first reading was lower a significant number of times. Interestingly in

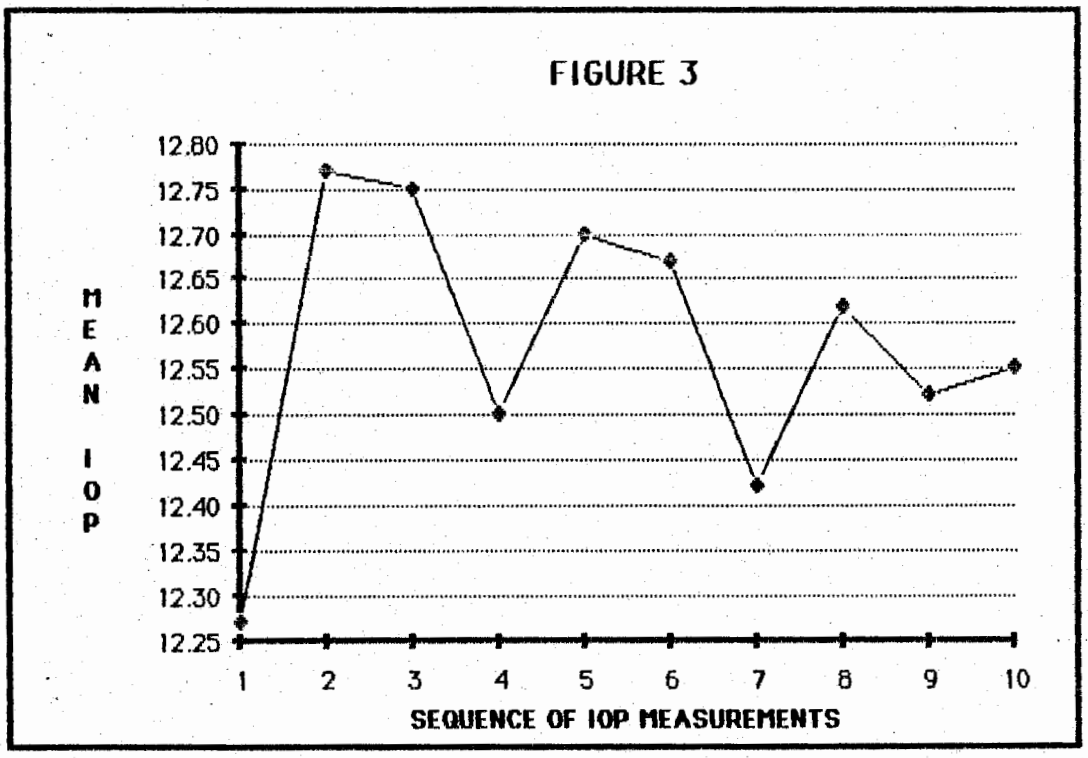

Fig. 3. The mean IOP values are plotted for 10 subjects for each of the ten successive measurements combining the right and left eyes before and after (4 measurements per subject) the warm compress was applied.

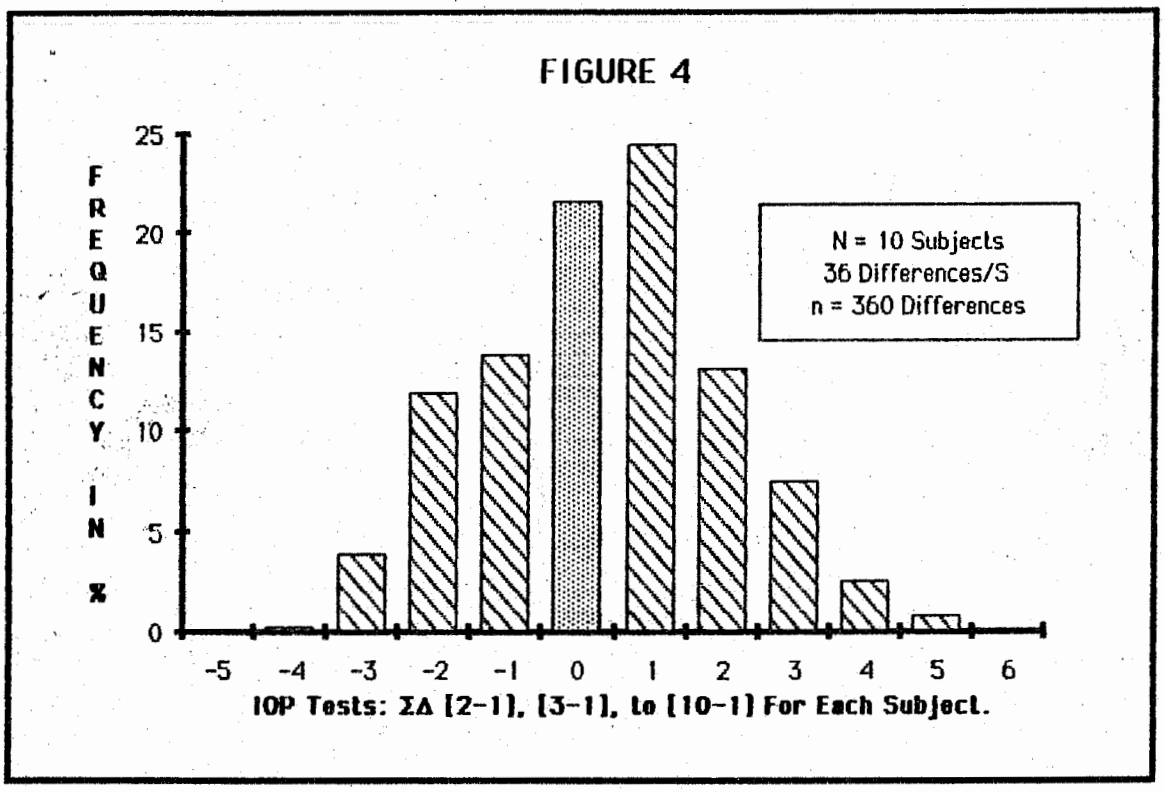

Fig. 4. Contains a histogram of the algerbraic differences obtained from subtracting the first reading of the sequence of 10 measurements from the nine remaining measurements. This was completed for each subject. If no differences were present, about an even number of plus and minus differences would be expected. A significantly greater number of plus values were present (Chi square, 1 df, p = .05).

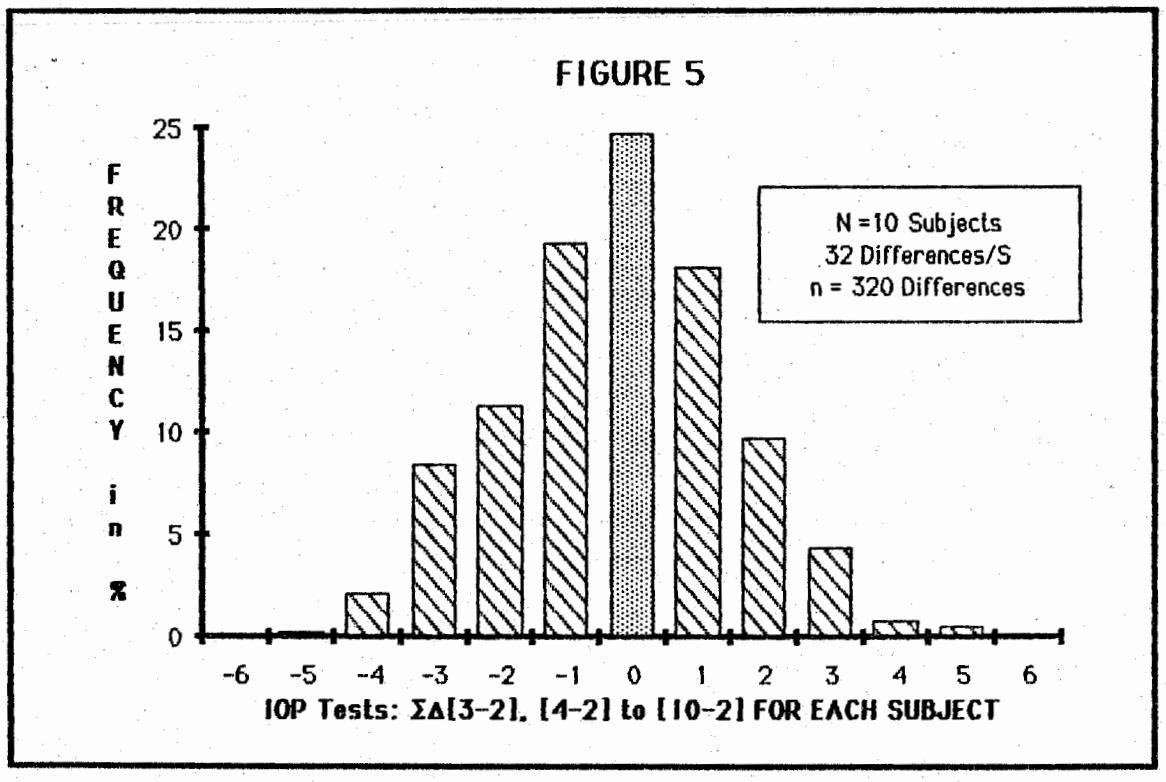

Fig. 5. Contains a histogram of the algerbraic differences obtained by subtracting the second reading of a sequence of ten measurements from measurements 3, 4, 5, 6, 7, 8, 9, and 10. This was completed for each subject. This resulted in a normal distribution.

Table 2

The sum of the differences (2-1, 3-1, ... 10-1)

for ten subjects under 4 separate conditions

	R_B	R_A	L_B	L_A
-5	0	0	0	0
-4	1	0	0	0
-3	12	2	0	0
-2	17	11	12	3
-1	15	13	9	12
0	18	21	17	22
+1	14	20	22	33
+2	9	17	12	10
+3	4	5	10	7
+4	0	1	5	3
+5	0	0	3	0
Totals				
0	18	21	17	22
+	27	43	52	53
-	45	26	21	15

R_B = Right eye before application of warm compress to left eye

R_A = Right eye after application of warm compress to left eye

L_B = Left eye before application of warm compress to left eye

L_A = Left eye after application of warm compress to left eye

condition R_B the first reading was higher than the other 9 a significant number of times. We have no satisfactory explanations of the differences found between R_B and the other 3 conditions.

Discussion

The results of this study, of 10 subjects, indicated that the warm compress, applied to the left eye of the subjects had no effect on the IOP of the experimental or control eye (Table 1). Control runs were not used to evaluate the effect of pressure alone or the five minute wait alone. It is suggested that further studies in this area should implement these controls. Superficial redness of the external surfaces was noticed as an effect of the warm compress but no effect was noticed on the bulbar conjunctiva. This could indicate insufficient application time to effect episcleral and uvealscleral vessels, resulting in no effect on IOP.

The second eye measure, using 10 consecutive measurements did show a lower IOP a significant number of times, before and after the warm compress, indicating that the readings on the right eye taken first influenced the IOP of the left eye which was measured second (Figures 1 and 2). This is an interesting result that may lead to a better understanding of the mechanisms that control IOP.

The first reading in each series of 10 consecutive readings was lower a significant number of times, although the magnitude of this lowering was not clinically significant (less than 1mm Hg). This result is shown in Figures 3 and 4 and may be related

to the apprehension level of the subjects or equipment variables. Interestingly the very first sample of 10 IOP readings for each subject showed the initial reading in the series of 10 to be higher than the other 9 readings in that series a significant number of times. In any of the other three conditions (R_A, L_B, L_A) the first reading in he series of 10 for each subject was lower than the remaining nine (Table 2). This finding is unexplained by this paper but suspected causes are equipment variables with this individual piece of equipment or in A.O. NCT's in general. This is an area that could be explored further. The only additional information discovered with respect of temperature effects on IOP is a report that nonacclimatized subjects exposed to heat, experience an increase in IOP.[7]

Summary

Ten IOP measurements were taken before and after a warm compress had been applied to one eye for 5 minutes. No effect of temperature was found for either the experimental or control eye. A reduction in IOP was noticed as a result of being the second eye tested by a series of 10 measurements. Across the group, the first IOP measurement in the series of 10 had a lower mean value than the other 9 readings in the series.

References

1. Forbes M, Pico G Jr, Grolman B: A non-contact applanation tonometer. Description and Clinical Evaluation. Arch Ophthalmol 91:134-140, 1974.

2. Grolman B: A new Tonometer System. Am J Optom Arch Am Acad Optom 49:646-660, 1972.

3. Myers KJ, Scott CA: The non-contact ("air puff") tonometer: Variability and corneal staining. Am J Optom Physiol Optics 52:36-46, 1975.

4. Myers KJ: Repeatability of IOP measurement with non-contact tonometer. Am J Optom Physiol Optics 51:39-48, 1974.

5. Shields MB: The non-contact tonometer. Its Value and Limitations. Surv Ophthalmol 24:211-219, 1980.

6. Sorenson PN: The Noncontact tonometer correlations. Am J Optom Physiol Optics 54:834-836, 1977.

7. Shapiro A, Shoenfeld Y, Shapiro Y: The Effect of Exposure to Heat on Intraocular Pressure. Albrecht Von Graefes Arch Kin Exp Ophthalmol 210(3):183-185, 1979.

Subject (1)

	Before		After		$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	12	11	12	10	-1	-2	0	-1
2	12	12	10	12	0	+2	-2	0
3	15	11	13	11	-4	-2	-2	0
4	12	11	13	9	-1	-4	+1	-2
5	13	11	14	11	-2	-3	+1	0
6	12	13	15	11	+1	-4	+3	-2
7	13	11	10	11	-2	+1	-3	0
8	12	11	12	11	-1	-1	0	0
9	14	12	14	11	-2	-3	0	-1
10	12	11	12	12	-1	0	0	+1
MEAN	12.7	11.4	12.5	10.9				

Subject (2)

					$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	13	10	10	10	-3	0	-3	0
2	10	11	11	11	+1	0	+1	0
3	12	10	13	11	-2	-2	+1	+1
4	13	12	13	10	-1	-3	0	-2
5	13	10	13	9	-3	-4	0	-1
6	10	11	12	11	+1	-1	+2	0
7	11	11	11	11	0	0	0	0
8	10	12	12	10	+2	-2	+2	-2
9	13	10	11	10	-3	-1	-2	0
10	11	11	12	11	0	-1	+1	0
MEAN	11.6	10.9	11.8	10.4				

Subject ③

	Before		After		$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	13	13	17	15	0	-2	+4	+2
2	15	18	15	15	+3	0	0	-3
3	16	16	16	16	0	0	0	0
4	14	17	16	17	+3	+1	+2	0
5	15	18	15	14	+3	-1	0	-4
6	16	18	17	14	+2	-3	+1	-4
7	15	15	16	17	0	+1	+1	+2
8	15	16	17	16	+1	-1	+2	0
9	16	16	15	15	0	0	-1	-1
10	14	17	14	18	+3	+4	0	+1
MEAN	14.9	16.4	15.8	15.7				

Subject ④

					$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	14	13	14	10	-1	-4	0	-3
2	15	11	13	13	-4	0	-2	+2
3	15	14	15	9	-1	-6	0	-5
4	14	12	12	10	-2	-2	-2	-2
5	13	14	11	12	+1	+1	-2	-2
6	12	13	13	9	+1	-4	+1	-4
7	15	13	15	9	-2	-6	0	-4
8	12	13	14	11	+1	-3	+2	-2
9	12	11	15	11	-1	-4	+3	0
10	14	12	15	13	-2	-2	+1	+1
MEAN	13.6	12.6	13.7	10.7				

Subject (5)

	Before		After		$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	20	17	16	16	-3	0	-4	-1
2	22	19	17	16	-3	-1	-5	-3
3	19	17	17	19	-2	+2	-2	+2
4	19	16	16	16	-3	0	-3	0
5	17	19	18	18	+2	0	+1	-1
6	20	18	20	16	-2	-4	0	-2
7	18	19	19	17	+1	-2	+1	-2
8	20	20	18	17	0	-1	-2	-3
9	18	19	18	17	+1	-1	0	-2
10	18	20	18	19	+2	+1	0	-1
MEAN	19.1	20.4	17.7	17.1				

Subject (6)

					$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	12	10	10	9	-2	-1	-2	-1
2	10	10	11	9	0	-2	+1	-1
3	11	8	10	9	-3	-1	-1	+1
4	10	9	9	10	-1	+1	-1	+1
5	10	10	9	8	0	-1	-1	-2
6	9	9	9	9	0	0	0	0
7	9	8	8	9	-1	+1	-1	+1
8	10	8	10	10	-2	0	0	+2
9	9	9	8	9	0	+1	-1	0
10	9	8	10	9	-1	-1	+1	+1
MEAN	9.9	8.9	9.4	9.1				

Subject (7)

	Before		After		$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	13	11	14	11	-2	-3	+1	0
2	14	10	13	11	-4	-2	-1	+1
3	14	12	12	12	-2	0	-2	0
4	14	11	14	12	-3	-2	0	+1
5	11	11	16	13	0	-3	+5	+2
6	11	12	14	12	+1	-2	+3	0
7	12	11	14	12	-1	-2	+2	+1
8	14	11	14	11	-2	-3	0	0
9	15	11	12	12	-3	0	-3	+1
10	13	11	12	12	-2	0	-1	+1
MEAN	13.1	11.1	13.5	11.8				

Subject (8)

					$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	14	13	15	13	-1	-2	+1	0
2	15	14	15	16	-1	+1	0	+2
3	13	11	14	14	-2	0	+1	+3
4	13	12	15	13	-1	-2	+2	+1
5	15	11	17	17	-4	0	+2	+6
6	13	14	16	16	+1	0	+3	+2
7	12	12	14	14	0	0	+2	+2
8	13	12	15	14	-1	-1	+2	+2
9	14	11	14	17	-3	+3	0	+6
10	13	11	15	15	-2	0	+2	+4
MEAN	13.5	12.1	15.0	14.9				

Subject (9)

	Before		After		$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	14	9	11	11	-5	0	-3	+2
2	14	12	13	9	-2	-4	-1	-3
3	14	12	11	13	-2	+2	-3	+1
4	14	14	13	9	0	-4	-1	-5
5	11	12	12	10	+1	-2	+1	-2
6	11	12	12	10	+1	-2	+1	-2
7	10	13	12	9	+3	-3	+2	-4
8	11	13	13	11	+2	-2	+2	-2
9	11	11	12	11	0	-1	+1	0
10	13	11	10	11	-2	+1	-3	0
MEAN	12.3	11.9	11.9	10.4				

Subject (10)

	Before		After		$L_B - R_B$	$L_A - R_A$	$R_A - R_B$	$L_A - L_B$
	OD	OS	OD	OS				
1	9	10	8	8	+1	0	-1	-2
2	10	11	9	7	+1	-2	-1	-4
3	7	8	8	12	+1	+4	+1	+4
4	7	10	9	10	+3	+1	+2	0
5	8	13	9	7	+4	-2	+1	-6
6	8	10	10	9	+2	-1	+2	-1
7	11	10	11	9	-1	-2	0	-1
8	9	11	7	9	+2	+2	-2	-2
9	8	11	10	8	+3	-2	+2	-3
10	10	8	8	9	-2	+1	-2	+1
MEAN	8.8	10.2	8.9	8.8				