Direct Ophthalmoscopy Toward The Retinal Periphery: A Quantitative Study

T. David Williams*
and
A. DiPasquale**

Abstract

Examination of the vortex vein region (some 3 mm posterior to the equator of the eye) requires from 3 to 5 D of extra plus power in the direct ophthalmoscope, relative to the power required to examine the optic nerve head. The method used to obtain the above estimate for a single subject is described in an earlier report by Williams and Bader[1]. The purpose of this report is to describe a larger, quantitative, study involving 13 subjects.

Abrégé

L'examen, avec ophtalmoscope direct, de la région veineuse, dite du tourbillon, (3 mm. postérieur de l'équateur du globe) exige une augmentation de trois à cinq dioptries de puissances convexe que l'examen de la papille de Mariotte. La technique utilisée pour établir cet estimé a été décrite précédemment. Le présent travail décrit une étude quantitative plus vaste utilisant 13 sujets.

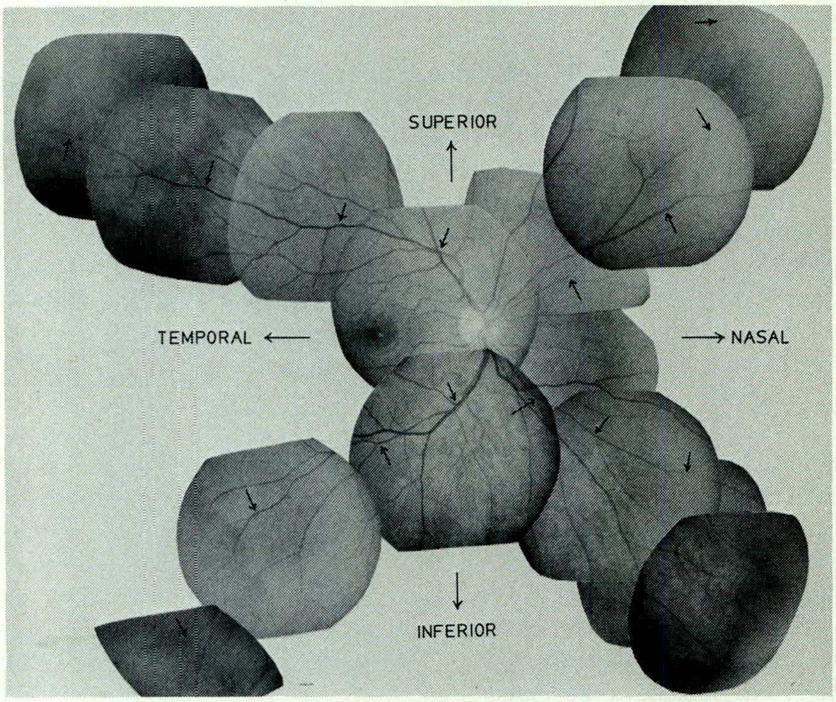

Fig. 1

Method

Ocular fundus photographs were taken along the four major divisions of the central retinal vessels up to the vortex veins in the right eye of thirteen healthy third year university students. For each subject, a composite of these photographs was prepared, and markers were placed at four readily identifiable points in each of the four quadrants, at intervals of approximately 15 degrees, starting at the disc. Fig. 1 shows a composite photograph for a single subject (subject 13). Direct ophthalmoscopy was performed on each subject, each of the selected landmarks was located, and the maximum amount of plus power permitting a clear view of the selected fundus detail was determined. Three readings were obtained for each landmark and averaged. Prior to ophthalmoscopy, two drops of 0.5% tropicamide were instilled in the examininer's and the subject's eye. Ophthalmoscopy was done with the instrument held as close as possible to the subject's and examiner's eye. Observations were made through the apical cap of the cornea.

Results

The results are shown in Figs. 2, 3, and 4. The data points give the average ophthalmoscope lens power (relative to that used to view the optic nerve head) required to view the landmarks in 13 subjects. For example, in Fig. 1, the average lens power used to view the disc was −4.6 D, while the average lens power used to view the remotest marker in the superior temporal quadrant was +2.6 D. Thus, the *change* in ophthalmoscope lens power required to view this point is +6 D, which happens to coincide with the average for all thirteen subjects, shown on the extreme left in Fig. 2.

Discussion

If we interpret the changes in ophthalmoscope lens power as being due to changes in retinal level, then Fig. 2 indicates that there is a slight but measurable lowering of the retinal level at 15 degrees from the nerve head in the inferior nasal and superior temporal quadrants. Such a lowering of retinal level occurs in the inferior temporal quadrant also, as shown in Fig. 3. The superior nasal quadrant, however, does not show such a retinal downslope, but rather

* O.D., M.S., Ph.D., Associate Professor, School of Optometry, University of Waterloo, Waterloo, Ontario N2L 3G1

** O.D., 189 Church St., Box 668, Belle River, Ontario N0R 1A0

its level rises steadily upward. From Fig. 2 it would appear that the center of symmetry of the retina is the nerve head; however, from Fig. 3, it would appear that the center of symmetry is shifted toward the fovea centralis. When the data of Figs. 2 and 3 are replotted in a single graph (Fig. 4), it appears that the slopes of the two temporal quadrants are similar. The two nasal quadrants are both more steeply sloped than the temporal quadrants, and resemble each other closely, except for the 15 degree point along the superior nasal quadrant.

Inspection of Fig. 4 leads to a tempting speculation. Nasal fundus ectasia[2,3] is a condition in which the nasal retina (particularly the inferior nasal retina) slopes downward in a dramatic fashion. It is associated with inferior conus, tilted nervehead, and inverse entrance of the central retinal vessels (situs inversus), and such patients frequently show a refractive scotoma in the temporal visual field. There is an associated pallor and poor choroidal circulation in the inferior nasal retina. In many cases, the division between normal and abnormal body structure is only quantitative and not qualitative. For example, many patients have one eye which is slightly smaller than the other: at what point would that eye be termed microphthalmic? It may similarly be true that nasal ectasia is simply a quantitative exaggeration of a tendency which is present in the 'normal' population. This appears to be the case for the inferior nasal quadrant plotted in Fig. 2.

Some comment should be made concerning individual differences. It appears that at least two types of slope may be seen when individual data are plotted in a fashion similar to Fig. 4. It appears that for some subjects (e.g. subjects 4, 7, and 13, shown in Figs. 5, 6, and 7 respectively), there is a steep slope to the retina in all quadrants, while for others (e.g. subjects 2, 3, and 10, shown in Figs. 8, 9, and 10 respectively), there is little change in retinal level until the more peripheral points are reached. The slopes shown in Fig. 8 would appear to be intermediate between those of Figs. 9 and 10 and those shown in Figs. 5, 6, and 7.

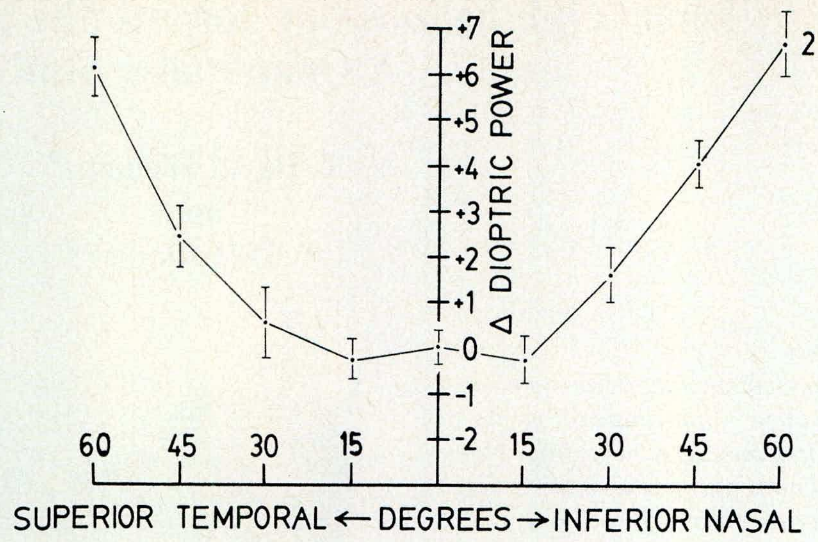

Fig. 2

There appears to be no correlation between the slopes shown in Figs. 5-10 and either the subjects' refractive errors or their corneal curvatures: for example, the subjects shown in Figs. 7 and 10 have nearly identical refractive errors and corneal curvatures. The subject in Fig. 7 is a 3 diopter myope with keratometer readings of 41.12 @ 180 and 42.00 @ 90, while the subject in Fig. 10 has a refractive error of −2.75 −2.00x23 with keratometer readings of 41.50 @ 12 and 43.00 @ 102. The subjects shown in Figs. 9, 10, and 8 have rather low corneal curvatures (40.75 @ 180 and 42.25 @ 90; 41.50 @ 12 and 43.00 @ 102; 37.87 @ 160 and 38.37 @ 70 respectively), but so does the subject shown in Fig. 7.

Elschnig disc type does not appear to play a role in these individual differences: subjects shown in Figs. 5, 7, 10 are type III; those in Figs. 6, 9, 11 are type IV; in Fig. 8, type II.

The subject shown in Fig. 6 presents some contradictions also. This peson has a refractive error of −7.75 D, and keratometer readings of 46.62 in both principal meridians. Judging from the keratometer readings, this appears to be a refractive ametropia. However, there is a very steep slope to the data shown in Fig. 6, suggesting that the shape of the posterior pole region (in terms of changes of dioptric power) is independent of the nature of ametropia (refractive or axial). The subject

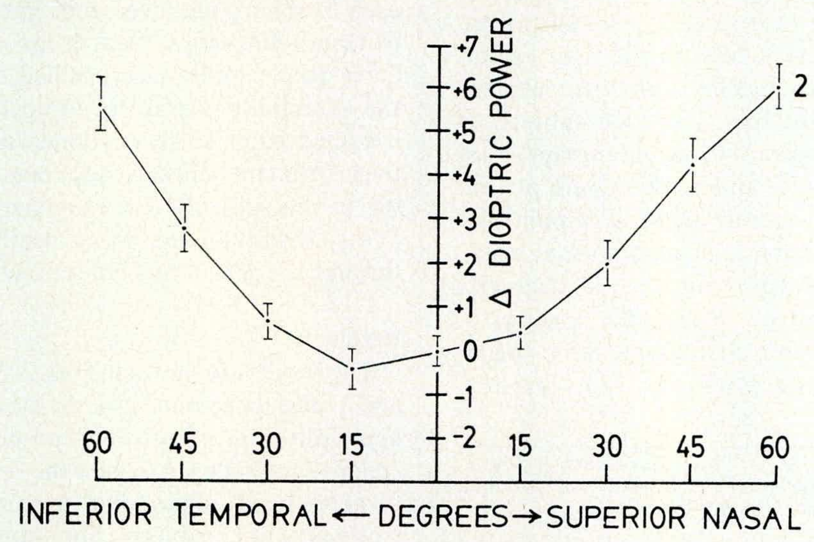

Fig. 3

shown in Fig. 11 has a refractive error of −10.00 −1.75 x 20 and keratometer readings of 42.25 @ 17 and 43.50 @ 107, yet the retinal levels appear to rise only very slowly until the 30 degree point is reached. This subject appears to be an axial myope, yet the slopes seen in Fig. 11 suggest a flatter posterior pole than that seen in Figs. 5, 6, and 7.

It appears that the ocular fundus, far from being a smooth curve of constant radius, is made up of many different curvatures, and possesses many little hills and valleys irregularly located over the surface of the retina.

Table I lists for each subject the number of quadrants in which the retinal level (as determined dioptrically) is lower at a point 15 degrees from the nerve head. The dots to the right of each subject number indicate which quadrant(s) are lower at this point. In eleven of thirteen eyes, there is retinal lowering in at least one quadrant; thus, it would appear that this retinal lowering is the rule rather than the exception. Of a possible 52 quadrants (13 x 4), the retinal level (at a position of 15 degrees from the disc) is lowered in 21 quadrants. it appears that the quadrant in which retinal lowering occurs most frequently is the superior temporal (8 out of 13 eyes), followed in order of decreasing frequency by the inferior nasal (6/13), inferior temporal (5/13), and superior nasal (2/13). The lowered retinal level temporal to the nerve head is to be expected, since the nerve head is medial to the posterior pole of the

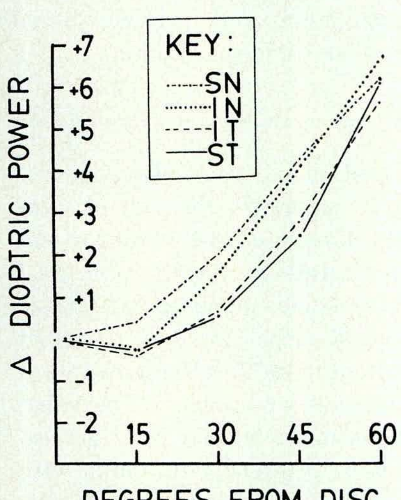

Fig. 4

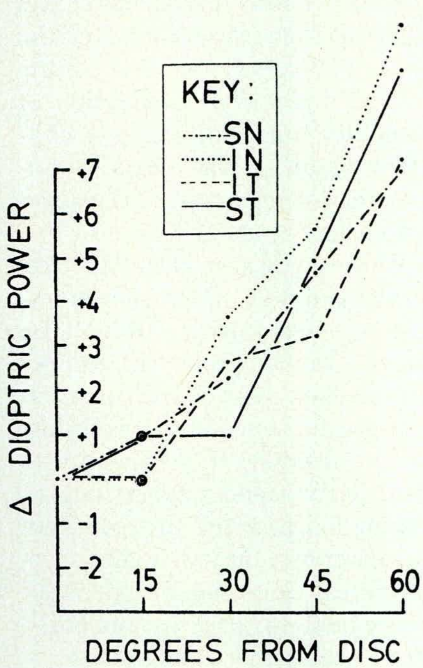

Fig. 5

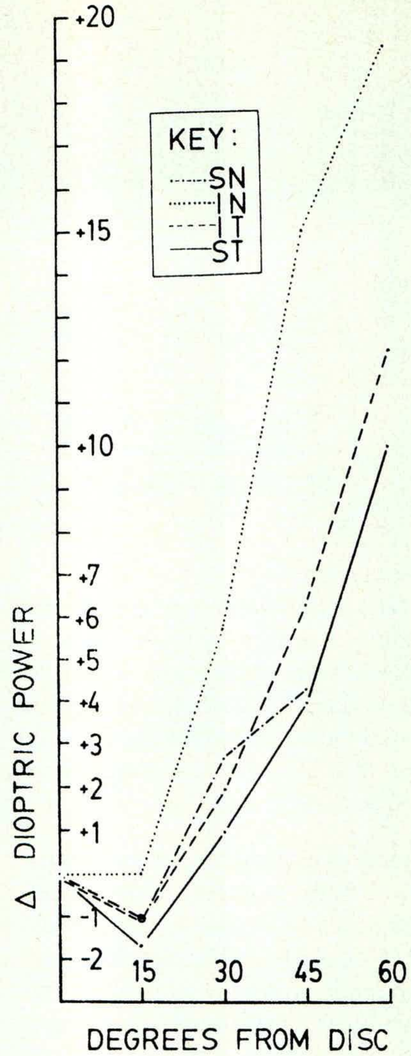

Fig. 6

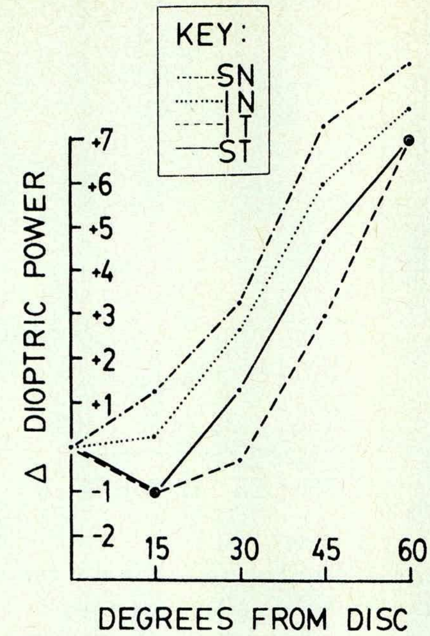

Fig. 7

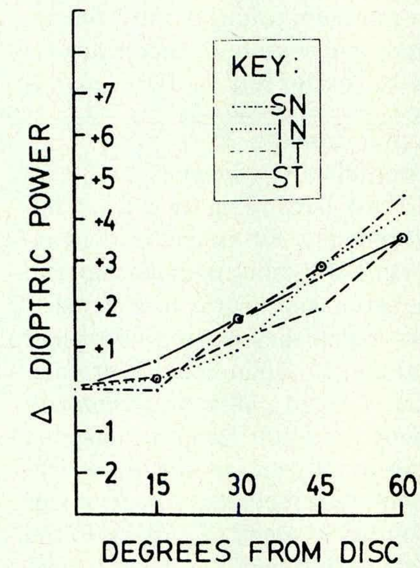

Fig. 8

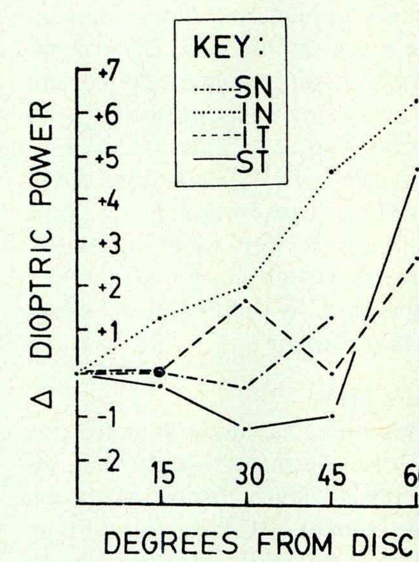

Fig. 9

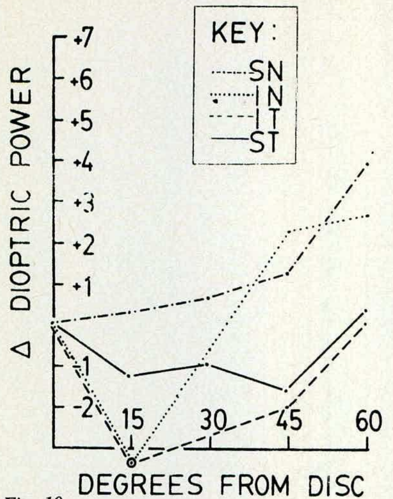

Fig. 10

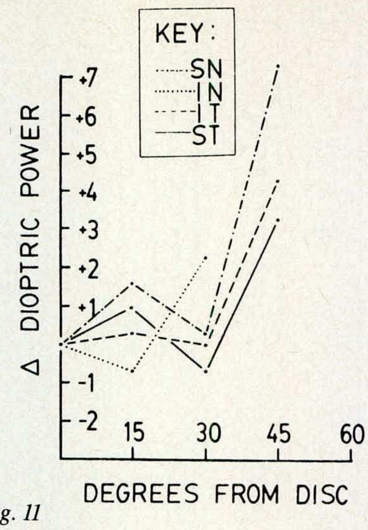

Fig. 11

SUBJECT #	# of QUADRANTS	SN	IN	IT	ST
1	1		•		
2	0				
3	1				•
4	0				
5	1		•		
6	4	•	•	•	•
7	3	•		•	•
8	1				•
9	1		•		
10	3		•	•	•
11	1				•
12	3		•	•	•
13	2			•	•

(WHICH QUADRANT(S)? — SN IN IT ST)

Table 1.

globe. The lowered retinal level nasal to the nerve head, on the other hand, is unexpected, and suggests (as mentioined above) that some degree of outpouching of the retina inferior and nasal to the nerve head is to be expected in the normal population.

The ophthalmoscope lens powers required for viewing the retina in the vortex vein region are similar to those reported earlier, although we found increases in plus on the order of 5 to 6 D were necessary, in contrast to the 4 to 5 D change reported earlier.

The embryonic and clinical implications of this study merit further investigation, and certainly should stimulate some speculation.

---

cont'd. from pg. 88

Association Newsletters

These have room for a lot of improvement. An enlightened membership is a strong membership, and the problem with provincial newsletters is that they are too infrequent and don't contain enough information. I plead guilty on Manitoba's count for I still haven't found the time to get out newsletters as frequently as I feel they are warranted. There is so much to pass on to the membership and too much in one letter is as bad as too little. The answer is frequent newsletters, appearing at pre-set intervals. These newsletters should automatically be sent to every provinical president — to every CAO councillor and to every provincial office or executive director. If we are to work as a unit, all of us must be kept completely informed of every single thing that has happened to optometry in every part of Canada.

Eye Charts

Manitoba has made very effective use of these charts — each year, we supply 20,000 free to the Manitoba Department of Education and they distribute them to all of the schools in the province. This chart is used in schools of nursing, and in university lecture halls, as well as in the offices of our members, and in many medical offices. In 1980, the Western Communications Program made the decision to have the charts printed with their provincial names and use them in a manner similar to Manitoba. All used up their orders in a short time. At our last meeting, we decided to revise the chart, and at our next meeting we'll finalize our revisions and order a large amount of new charts.

Eye Plaques

British Columbia — as an outcome of the Reader's Digest messages, had an office plaque developed — stressing vision care of the young child. They had it produced by a workshop for the mentally handicapped and made it available to their membership and to the other provinces at cost. This is an excellent in-office public education item. If you are interested in having a great number of three year old patients, then get a plaque. Believe me — it works only too well.

The Family Guide to Vision Care

This, of course, was an American publication and we received permission to reprint it. We met in Winnipeg and revised the wording to suit our Canadian needs and had 375,000 copies made up at a cost of 5.7 cents each. This is an excellent hand-out item. The last item I want to mention is pamphlets. The Western communications program intends to produce pamphlets with distinctively Canadian content. We feel the need for this as most CAO pamphlets are close copies of the AOA pamphlets. Our first efforts will be directed at production of pamphlets on: sunglasses — children's vision — low vision — optometric treatment — the Canadian optometrist — contact lenses.

We are going to go ahead full blast on the audio-visual presentations. Contact lens fitting PR will be stressed as the optometrist and not the optician, must be recognized as the specialist in contact lens fitting. We are planning to go ahead with third party support advertising — placing full page ads in trade journals describing the availability of occupational vision care programs.

The fields to tackle are endless — all we need is money and time.