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TO DILATE OR NOT TO DILATE: A CLINICAL COMPARISON OF 500 CASES

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by

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Place: Pacific University
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ABSTRACT

To compare the quality of fundus evaluations conducted with natural and dilated pupils, 500 typical adult subjects, divided into 5 age categories, were examined using both techniques. Direct and monocular indirect ophthalmoscopes were used with the natural pupils; direct and binocular indirect scopes were used for the dilated exams. Retinal anomalies were classified on the basis of posterior pole or peripheral location and whether the anomalies would require significant action by the doctor. Of the 29 posterior pole anomalies which required action, 38% were missed during the natural pupil examination; 49% of the anomalies not requiring immediate action were also missed. These miss rates, along with the 287 anomalies found in the periphery (20 of which required immediate action), suggest that dilation should be strongly considered for all patients so as to optimize the probability of detecting fundus anomalies.

INTRODUCTION

Optometrists in all fifty states are now able to use diagnostic pharmaceutical agents (DPAs) for performing dilated fundus examinations. However, even though mydriatics have been shown to be quite safe when used appropriately,[1] questions still remain about when to use these drugs.[2] Results of a recent survey[3] indicate that only 7% of the private practice optometrists who responded include a dilated fundus evaluation as a routine part of their examinations. Another survey[4] found that most members (94%) of an optometric panel did not dilate their patients' eyes on a routine and frequent basis, 20% did not dilate at all, and one optometrist even commented that if the fundus could be seen through the natural pupil, the inconvenience of dilation wasn't required for most patients.

Several authors have examined the question of who and when to dilate. Patorgis and Augeri[5] approached this question by developing tables based on patient age and symptom occurrence to indicate when dilation was recommended, and Alexander and Scholles[6] established a list of criteria which they considered to be "definite indications" for dilation. Although such lists and tables are useful, they might also be taken to imply that dilation is <u>not</u> indicated for patients presenting without any of the criteria specified; this can create a potentially dangerous situation.

For many optometrists, the current standard of care used by the majority of their colleagues dictates who and when to dilate, but what is the current standard of care? Alexander and Scholles[6] have pointed out that with respect to dilation "... the profession is moving toward an acceptance of ophthalmic drug use that will establish a standard of care requiring even more widespread use of this procedure." In a discussion of the optometrist's duty to dilate in order to detect retinal detachment, Classe'[7] noted that: "Indeed, such an examination (i.e., into the periphery) may be a duty...because of the standard of care expected of optometric practitioners certified to employ diagnostic agents."

In a letter to the Journal of the American Optometric Association, Lynch[8] raised questions regarding liabilities produced by dilation. He asked whether the liability associated with an

automobile accident that results from driving after dilation is of greater consequence than the possibility of missing a disease in an asymptomatic patient. Classe'[9] responded that optometrists need to warn their patients regarding possible dangers associated with dilation, but he also concluded that "... the great majority of practitioners would maintain that routine dilation - in the absence of signs or symptoms of disease - is not the standard of care." This implies that the current standard of care mandates the dilation of symptomatic patients and those determined to be at high risk of disease, but dilation of low risk, asymptomatic patients is not required. Responding to this, Silverman[10] cited two cases in which diseases were discovered in asymptomatic patients as a result of routine dilation. He argued that the standard of care as presented by Classe' "... is not good enough for the optometrist of the 1980s and certainly represents less than adequate eye care standards in the profession at this time."

What then does the optometrist do with the patient currently in the chair? How is the decision made regarding whether or not to dilate? Certainly, if there are obvious signs or symptoms of disease dilation is required, but what about the asymptomatic patient, or the one who was dilated last year (or five years ago), or the patient who is only 25 years old?

As reviewed by Gottschalk,[11] arguments opposing routine dilation include the time required for the procedure, the possible disruption of the doctor's and patient's schedules, the risk of ocular trauma resulting from DPA use, the possibility that the patient will have an accident while vision is compromised because of dilation, patient dislike of dilation, the knowledge that disease occurrence rates are relatively low in most age categories (especially in the young), and the presumption that using the direct ophthalmoscope to examine the posterior pole through the natural pupil gives an adequate view of the most important structures in the eye - the disc and macula.

Arguments in favor of routine and regular dilation include the possibilities that disease might occur in the peripheral areas of the retina not observable through the natural pupil, that a disease could

develop within the time since the last examination, and that even in young patients with clear media the view of the posterior pole using the direct ophthalmoscope through the natural pupil is not as good as most optometrists believe it to be.

To add data to what has largely been an exchange of anecdotes, case studies, and opinions, the study reported here was conducted to assess the quality of fundus examinations performed with natural and dilated pupils. To accomplish this, 500 adult subjects of various ages were recruited and examined using direct and monocular indirect (MIO) ophthalmoscopes through natural pupils, and again using direct and binocular indirect (BIO) scopes through dilated pupils.

Examination quality was assessed in two ways. First, a determination was made regarding how well the posterior pole could be examined by counting the number of anomalies found or missed with each technique. If a significant number of anomalies were found with dilation and missed with the natural pupil, concerns would be raised about the quality of the natural pupil examination. Benign anomalies, such as nevi, were counted along with serious anomalies, like tumors, because the ability to detect the relatively common benign anomalies provides a good indication of how well less frequently occurring lesions would be found.

As a second indication of examination quality, counts were made of how many benign and serious anomalies were detected in the peripheral retina which is not visible through the natural pupil. These counts provide an indication of the occurrence rates for conditions that would be missed without dilation.

SUBJECTS AND METHODS

SUBJECTS

The subject population consisted of the first 100 volunteers in five age categories: 20-29, 30-39, 40-49, 50-59 and 60 plus. Subjects were recruited via news stories and were offered a vision examination in compensation for project participation. Typical subjects were middle class, employed, and in good health. Eighty-

one percent were white, 15% hispanic, 4% asian, and less than 1% black; 59% were female and 41% male.

Of the potential subjects applying for the project, nine (2%) were rejected; seven had angles of less than grade 2 (von Herrick) and two were on miotic therapy for glaucoma.

PROCEDURES

Each subject was assigned a one-hour appointment during which the project was explained and an informed consent form signed. The subject's fundi were then examined through natural (non-dilated) pupils using a Welch Allyn halogen direct ophthalmoscope and an American Optical MIO. Standard examination techniques were used in which the subject moved his/her eyes to various positions of gaze so as to insure that the entire posterior pole (the region out to but not including vortex vein insertions), or that portion of the posterior pole observable given limitations imposed by the subject's pupil size, was examined. White ophthalmoscope light was used for all examinations; intensity was adjusted to obtain the best view for each subject. Fundus viewing times were approximately 1.0 minute per eye with each instrument.

Following completion of the natural pupil examination, the examiner obtained information on the subject's history, and recorded normative values for distance Snellen acuity, lens prescription, Goldmann IOP, von Herrick angle estimation, ambient-light pupil size, and media clarity (five point scale with zero meaning clear and 4 meaning opaque). These data are summarized in Table 1. Values are means for both eyes of all subjects with standard deviations

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Insert Table 1 about here

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shown in parenthesis. Acuities were obtained as Snellen values and converted to decimal for calculation and presentation purposes (e.g., 20/20 equals 1.0, 20/40 equals 0.5, etc.); lens prescriptions are spherical equivalents. Trends associated with increasing age include an increase in IOP, and reductions in acuity, myopia, anterior angle, pupil size, and media clarity.

After the natural pupil examination and normative data acquisition, the examiner dilated the subject's pupils using a topical anesthetic and one drop of 2.5% phenylephrine, followed in 5 minutes by one drop of 1% tropicamide. Twenty-three (4.6%) of the subjects required a second set of mydriatic drops to achieve adequate dilation, and 58 (11.6%) of the subjects received only tropicamide because of cardiovascular problems, diabetes, hyperthyroid, and/or medications incompatible with phenylephrine.

Thirty minutes after final drop instillation, a second examiner, without knowledge of the subject's history, normative values, or results of the natural pupil examination, examined the subject's fundi through the dilated pupils using a Welch Allyn direct ophthalmoscope and an Exeter standard BIO with a 20D double aspheric, yellow Volk condensing lens. At the time of this second examination, mean ambient-light pupil diameters for the 5 age categories were 7.5 mm (SD = 0.5), 7.4 mm (0.7), 7.2 mm (0.7), 6.7 mm (0.7), and 6.6 mm (2.3), in order of increasing age.

Posterior pole (out to the vortex veins) and peripheral aspects (including the vortex veins and beyond) of each fundus were examined and anomalies were recorded. Again, standard techniques using white lights were used with examination facilitated by having the subject move her/his eyes to various positions. Scleral indentation was not used. The viewing times for the posterior pole of each fundus were approximately 1.0 min for the direct scope and 0.5 min for the BIO; viewing the periphery with the BIO required approximately 3.5 min per eye.

After the dilated fundus examination, Goldmann pressures were again measured. Mean and standard deviations of the IOPs for the 5 age categories, in order of increasing age, were: 14.7 mm Hg (SD=2.6), 14.7 mm Hg (2.8), 15.6 mm Hg (2.7), 16.0 mm Hg (3.4), and 16.9 mm Hg (3.5). Reference to the pre-dilation IOPs shown in Table 1 indicates that dilation caused a mean decrease of about 0.7 mm Hg across all age groups with the decrease being slightly greater for the younger subjects.

After final IOP measurements were made, subjects were released with instructions to notify the experimenters if adverse reactions to the dilation procedure were noted; no subject found it

necessary to do so. Except for two subjects who experienced transient and self-correcting IOP increases of 9 and 11 mm Hg following dilation, no untoward events occurred as a result of dilating the 500 subjects in the population.

EXAMINERS

Two examiners participated in this project. Both were military optometrists with eleven and seven years of practice experience, respectively. They were highly skilled with the equipment used in the study having each examined over 20,000 patients. For each subject, one examiner performed the natural pupil exam and the other performed the dilated examination. They recorded their findings independently and did not disclose them to each other until completion of the subject's evaluation. To compensate for any differences in anomaly detection ability between examiners, they alternated performing non-dilated and dilated examinations on consecutive subjects.

RESULTS

Table 2 presents the categories of anomalies detected in the population. The anomalies are divided into two types: A and O. Type

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Insert Table 2 about here

A (Action) anomalies are those which at the time of detection would generally require treatment, referral for treatment or immediate follow-up care, action to rule out a vision or health threatening condition, re-evaluation more frequently than every 4 months, or which could pose a current and/or significant threat to vision or health. Type O (Other) anomalies are those which at the time of detection would generally require a notation in the record, documentation by photos, etc., re-evaluation less frequently than every 4 months, or are those which would not pose a current and/or significant threat to vision or health.

Categorization of anomalies into types A and O was accomplished by vote of 10 experienced optometrists. There was

good agreement between the optometrists on classifications but all indicated that extenuating circumstances could shift the category of an anomaly. (For readers who wish to use their own classification system, an Appendix is provided which shows the detection frequency for each separate anomaly.)

Counts of individual subjects with type A or O anomalies and with anomalies of both types are shown in Table 3. To be included

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Insert Table 3 about here

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in these counts, a subject had to have one or more anomalies in either or both eyes, but no matter how many separate anomalies were observed in a single subject, she or he was counted only once. Of the 500 subjects, well over half of them (63%) had an ocular anomaly and about 8% of them had a type A anomaly which would require action by the doctor.

Table 4 shows summary counts of type A (A), type O (O), and total (T) anomalies detected during the natural pupil and dilated

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Insert Table 4 about here

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examinations. (See Appendix for counts of specific anomalies.) For this Table, the posterior pole was defined as that part of the retina, maximally limited by the vortex vein insertions, which could be seen using the natural or the dilated pupils. This meant that if a subject had small pupils, the area observed and defined as the posterior pole would be smaller for the natural pupil examination than the area observed and defined as the posterior pole for the dilated examination.

In Table 4, anomalies detected, not subjects, are counted so that each subject could contribute several counts if she or he had multiple anomalies. (Multiple occurrences of the same anomaly, e.g., several nevi in one or both eyes of the same subject were counted as only one occurrence.) Values shown as "percent missed" were determined by expressing the difference between the natural pupil and dilated counts as a percentage of the dilated count. A pattern is consistent across age and anomaly categories: detection rates are

higher for posterior pole anomalies when dilation techniques were used.

Using conventional examination techniques, anomalies occurring in the retinal periphery (i.e., beyond the vortex vein insertions) are difficult or impossible to detect through the natural pupil. Table 5 shows the 287 anomalies which would have been

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Insert Table 5 about here

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missed if the population of 500 subjects had not been dilated. (See Appendix for counts of specific anomalies.)

DISCUSSION

The number of posterior pole and peripheral anomalies missed in this study indicates a difference in quality between the two fundus examination techniques. But how important is this difference, why are there so many posterior pole anomalies missed without dilation, and is the difference in quality sufficient to suggest that the current standard of optometric care be changed to replace natural pupil fundus exams with dilated examinations?

The importance of the difference in quality can be assessed by considering the miss rates for various anomalies and the problems that could occur for both patient and doctor if these anomalies were not detected. Failure to dilate any of the subjects in this study (which is apparently the standard of practice used by 20% of the optometrists in the Review of Optometry panel[4]) would mean that 12 type A posterior pole anomalies and 20 type A peripheral anomalies would have gone undetected. In each of these cases, a vision or life threatening condition could have been missed and a significant personal and/or legal tragedy might have resulted. The difference in examination quality is, therefore, very important.

While it is expected that peripheral anomalies would not be found without dilation, it is surprising that almost half of the posterior pole anomalies were missed. Why was the miss rate so high? There are at least three possibilities. First, it might be assumed that most of the missed anomalies were in older subjects

with small pupils and cloudy media; small pupils would limit the area of the retina observable and cloudy media could make detection of anomalies difficult. The importance of these factors can be evaluated by referring to Tables 1 and 4. Table 1 shows a steady decrease in pupil size with increasing age and a decrease in media clarity for patients over the age of 50. If media clarity and pupil size were the major contributors to the high posterior pole miss rate, the miss rates for all anomalies should increase with age. This is not the case (see Table 4). For nevi, the miss rate shows no such trend, nor are there trends for most of the other anomalies. The total miss rates for subjects age 30 and over also do not demonstrate a clear association with age. Overall, pupil size and media clarity did not seem to play a major role in determining why so many more posterior pole anomalies are found with dilation.

Another factor which might explain the higher anomaly detection rate for dilated examinations is the stereopsis provided by the BIO. In several cases, especially those involving elevated or depressed anomalies of the disc or macula, the lesion could be seen easily with the BIO but could not be detected using the direct or MIO, even when its location was known to the examiner. (The importance of stereo cues for anomaly detection raises interesting questions about the quality of an examination conducted by an optometrist who cannot achieve stereopsis with the BIO, but such questions are beyond the scope of this paper.)

A third factor which might explain the difficulty in detecting posterior pole anomalies through the natural pupil involves the area of the retina that could be seen at any one time with the various ophthalmoscopes. The approximately 40 degree field of view provided by the BIO[12] made it easier to detect gradations in color and texture corresponding to pigment anomalies such as hypertrophy and window defects; red hemorrhages and other vascular anomalies also seemed to stand out better (i.e., have more contrast against the background of the fundus) with the larger field of view afforded by the BIO.

The larger field of view was also advantageous for examining subjects' fundi because it increased the probability that a lesion

would be within the examiner's field of view at some time during the examination. Simple geometric calculations (which neglect overlapping circular fields of view, curvature of the retina, etc.) illustrate this point. According to Borish[12], the field of view for a BIO with a 20D lens is approximately 40 degrees, the field of view for an MIO is approximately 22 degrees, and the direct ophthalmoscope has a field of view of approximately 10 degrees. This means that, under ideal conditions, to cover the area of the posterior pole (about 120 degrees between vortex vein insertions), approximately 9 fixations with the BIO would be required, the MIO would have to be positioned approximately 30 times, and the direct would have to be moved to approximately 144 different locations on the retina! Given the duration of a typical posterior pole examination, it is not surprising that more anomalies were found with the BIO than with the direct. The greater magnification afforded by the direct ophthalmoscope may be useful in studying anomalies which have already been found, but can be a handicap when simply searching for anomalies in the posterior pole. In this study, the direct ophthalmoscope was just not as good a tool for finding certain types of anomalies as was the BIO (or, to a lesser extent, the MIO).

In spite of the limitations of the direct ophthalmoscope, examining the posterior pole with this instrument seems to be the current standard of practice for optometry. Is this standard good enough? Should it be changed? Natural pupil fundus evaluations are relatively quick (about 1.0 min of observation time per eye in this study), involve minimal inconvenience for doctor and patient, and found over half of the posterior pole anomalies in this study. Dilated examinations take longer (about 5 min of observation time per eye in this study, plus the time associated with patient explanations, drug instillation, waiting for mydriasis, etc.), and involve more risk (albeit minimal) for the doctor and patient.

To decide whether to change the current standard of optometric care, public health experts might subject the problem to a cost-effectiveness analysis in which the costs (expenses, risks, etc.) associated with each examination technique are compared to

the number and importance of the anomalies that would be detected.[13] In other fields, such cost-effectiveness analyses have led to very interesting and controversial conclusions. For example, it had been recommended that pap smears for cervical cancer be done every three years rather than every year as was the previous standard of medical practice.[14] From an efficiency and cost containment standpoint, the three year examination cycle seems best but from an individual patient's perspective (especially one whose cancer has gone undetected for the extra two years), the cost-effectiveness analysis may not be very meaningful. Similarly, it seems logical that dilation on a three to five year cycle might be cost-effective but there could be an increase in the risk of missing anomalies which would have been detected if the patient had been dilated more frequently.

Another analogy might help to put the dilation versus natural pupil examination question into perspective. Typically, physicians use a stethoscope for checking the health of the heart even though most know that more complete information could be obtained with the electrocardiogram (ECG). The ECG is, however, often reserved for those patients who have signs or symptoms of cardiac difficulties. Perhaps the use of signs and symptoms suggesting an ocular disease would lead to a more cost-effective determination about when to dilate.

To evaluate this possibility, histories of subjects with and without type A anomalies were compared. The comparison was based on questions regarding 14 conditions (such as flashes and floaters, ocular/head trauma, diabetes, sudden field or acuity loss, etc.) which were listed by Alexander and Scholles[6] as definite indications for dilation. Of the 44 subjects with type A anomalies, six (14%) did not respond positively to any of the questions regarding these conditions and so would not have been dilated if history had been the only criterion used. Conversely, 77% of the 458 subjects without a type A anomaly responded positively to one or more of the history questions and thus would have been false positives. Clearly, the history questions used in this study did not

produce a cost-effective method for determining who needed to be dilated.

Perhaps in the future a refined set of history questions, in combination with considerations regarding the patient's age, etc., could be used to make a more cost-effective decision regarding dilation, but at this time deciding who and when to dilate remains open to the individual optometrist's judgement. It seems clear, however, that ophthalmoscopy through the natural pupil is not a very effective technique for detecting posterior pole anomalies (and certainly not for finding peripheral anomalies). The optometrist who wishes to provide the best possible care must, therefore, seriously consider dilating all patients in order to maximize the probability of detecting posterior pole and peripheral anomalies.

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APPENDIX

Detection counts for individual anomalies. For posterior pole anomalies, counts for natural pupil examinations are shown first and are separated from dilated examination counts by a slash. See text for details regarding areas observed, etc.

POSTERIOR POLE ANOMALIES

	Age Groups				
	20-29	30-39	40-49	50-59	60 Plus
Disc Anomalies					
Tilted Disc	2/2	3/2	1/1	-	1/1
Coloboma	-	-	-	-	1/1
Myopic/Scleral Crescent	1/2	2/3	4/4	-	1/1
Notched Rim	-	-	-	-	2/2
Atrophy/Pallor	-	-	-	-	0/2
Physiological Elevation	-	0/1	-	0/1	-
Congested Elevation	-	-	-	-	0/1
Drusen	1/2	1/1	-	0/1	-
Pigment Crescent	-	4/4	1/1	2/2	-
Peripapillary Atrophy	1/1	1/1	0/1	2/2	5/8
Glia/Bergmeister's	6/6	1/1	2/2	1/1	-
Medulated Nerves	-	-	-	1/1	-
Macular Anomalies					
Pre-retinal Fibrosis	-	1/1	1/1	-	3/7
Pigment Mottling	2/2	0/1	1/1	0/5	2/13
Edema	-	-	-	-	0/1
Resorbed Edema	-	0/1	-	0/1	-
Drusen	0/1	1/2	1/5	2/6	3/8
Histoplasmosis Scar	-	-	-	1/1	1/1
Traumatic Scar	-	-	-	1/1	1/1
Window Defect	-	-	-	-	1/2

Vascular Anomalies					
Dot/Blot Hemorrhages	-	-	0/1	1/2	2/2
Exudates	-	-	-	1/1	2/2
Hypertensive Changes	-	-	-	3/4	8/12
Vessel Malformations	0/1	-	1/1	-	1/1
Pigment Anomalies					
Clumping	-	-	-	1/2	-
Hypertrophy	1/2	7/8	2/3	3/4	1/1
Window Defect	-	1/3	1/4	0/1	3/8
Bone Spicules	-	-	-	-	0/1
Non-specific	-	-	-	2/2	1/4
Chorio-Retinal Scars					
Histoplasmosis	-	0/1	-	1/1	1/1
Toxoplasmosis	-	-	1/1	-	-
Post-surgical	-	-	-	-	2/2
Non-specific	2/2	1/1	-	-	1/1
Chorio-Retinal Atrophy					
Peripapillary	1/1	1/1	0/1	2/2	5/8
Non-specific	-	1/2	-	1/1	-
Nevi					
Choroidal	-	0/5	0/8	1/7	0/8
Non-Disc Myelin					
Non-disc	-	-	1/1	0/1	0/1
Retinal Degeneration					
Reticular Pigment	-	-	-	0/1	1/1

Vitreo-Retinal Traction					
Associated with Scar	-	-	-	0/1	1/1
Non-specific	-	-	-	0/1	-
Vitreous Anomalies					
Prominent Floater	1/1	0/2	3/6	5/7	3/10
Posterior Detachment	-	-	0/1	0/5	11/13
Asteroid Hyalosis	-	-	1/1	-	3/3
Tumors					
Osteoma	1/1	-	-	-	-

PERIPHERIAL ANOMALIES

	Age Groups				
	20-29	30-39	40-49	50-59	60 Plus
Vascular					
Blot/Dot Hemorrhages	-	1	-	2	2
Varix of Vortex Vein	1	4	-	1	-
Pigment Anomalies					
Clumping	8	7	7	6	7
Hypertrophy	6	8	7	4	4
Window Defect	1	2	2	4	1
Bone Spicules	-	-	-	-	1
Non-specific	-	1	1	-	1
Chorio-Retinal Scars					
Post-surgical	1	-	-	-	-
Non-specific	-	2	-	-	2

Chorio-Retinal Atrophy					
Pavingstone	5	13	6	14	12
Non-specific	2	3	5	5	5
Nevi					
Choroidal	2	1	4	2	1
Myelin					
Non-disc	-	1	-	1	-
Retinal Degeneration					
Lattice	3	3	2	1	2
Snail Track	2	2	2	-	1
Reticular Pigment	1	0	3	4	22
Retinoschisis	1	2	1	-	1
Retinal Holes/Tears					
Atrophic Hole	2	3	3	3	7
Within Lattice or Snail Track	-	1	-	-	-
Operculated	-	-	-	1	1
Horse Shoe	-	-	-	-	2
Vitreo-Retinal Traction					
White w/o Pressure	10	4	-	-	1
With Pigment Clumping	1	4	1	1	1
With Lattice or Snail Track	-	-	1	-	-
With Retinoschisis	1	-	-	-	-
With Scarring	-	-	-	-	1
Non-specific	2	1	-	-	-
Viterous Anomalies					
Prominent Floater	2	2	1	-	1
Tumors					
Malignant Melanoma	-	-	-	-	1

TABLE 1 - NORMATIVE DATA

Age Category	Mean Age	Percent Females	Decimal Acuity	Lens Power	IOP (mm Hg)	Angle Grade	Pupil (mm)	Media Clarity
20-29	25.4 (2.5)	55	0.9 (0.2)	-3.2 (2.6)	15.7 (2.3)	3.9 (0.3)	5.1 (0.9)	0.0 (0.2)
30-39	34.2 (2.7)	54	0.9 (0.5)	-2.1 (2.6)	15.7 (2.6)	3.9 (0.4)	4.3 (0.8)	0.0 (0.1)
40-49	46.1 (2.8)	62	0.9 (0.2)	-1.6 (2.5)	16.3 (2.2)	3.7 (0.6)	4.1 (0.8)	0.0 (0.1)
50-59	53.9 (2.8)	56	0.8 (0.2)	-1.0 (2.8)	16.7 (2.6)	3.4 (0.7)	3.7 (0.7)	0.1 (0.3)
60 Plus	68.4 (6.4)	67	0.7 (0.4)	+0.6 (2.1)	17.1 (3.1)	3.2 (0.7)	3.5 (0.7)	0.6 (2.3)
MEAN	45.2 (15.5)	59	0.8 (0.3)	-1.1 (2.8)	16.3 (2.7)	3.7 (0.6)	4.1 (1.0)	0.2 (1.1)

TABLE 2 - ANOMALIES DETECTED

CATEGORY	ANOMALIES
DISC	
Type A	Notched rim tissue; elevation (congestion); optic atrophy/ pallor
Type O	Tilted disc; coloboma; myopic/scleral crescent; elevation (physiological); drusen; pigment crescent; peripapillary atrophy; glia/Bergmeister's; medulated nerves
MACULAR	
Type A	Macular edema
Type O	Pre-retinal fibrosis; pigment mottling; resorbed edema; drusen; histoplasmosis scar; traumatic scar; window defect
VASCULAR	
Type A	Blot/dot hemorrhages; exudates; hypertensive changes
Type O	Arterio-venous malformations; varix of the vortex vein
PIGMENT	
Type A	Bone spicules
Type O	Pigment clumping; hypertrophy; window defect; non-specific
CHORIO-RETINAL SCARS	
Type A	None
Type O	Histoplasmosis; toxoplasmosis; post-surgical; non-specific

CHORIO-RETINAL ATROPHY	
Type A	None
Type O	Pavingstone degeneration; peripapillary atrophy; non-specific
NEVI	
Type A	None
Type O	Choroidal
NON-DISC MYELIN	
Type A	None
Type O	Myelin located away from disc
RETINAL DEGENERATION	
Type A	Retinoschisis
Type O	Lattice; snail track; reticular pigment
RETINAL HOLES/ TEARS	
Type A	Holes within lattice/snail track; operculated holes; horse shoe tears
Type O	Atrophic holes
VITREO-RETINAL TRACTION	
Type A	Associated with lattice/snail track degeneration; associated with retinoschisis
Type O	White without pressure; associated with pigment clumping; associated with scars; non-specific

VITREOUS ANOMALIES	
Type A	None
Type O	Prominent floater; posterior attachment; asteroid hyalosis
TUMORS	
Type A	Malignant melanoma; osteoma
Type O	None

TABLE 3 - SUBJECTS WITH ANOMALIES

ANOMALY TYPE	AGE CATEGORY 20-29	30-39	40-49	50-59	60 Plus	Total
A (ONLY)	1	2	1	4	7	**15**
A and O (BOTH)	1	2	2	5	17	**27**
O (ONLY)	44	52	53	56	66	**271**
TOTAL	**46**	**56**	**56**	**65**	**90**	**313**

TABLE 4: POSTERIOR POLE ANOMALIES DETECTED

CATEGORY	20-29			30-39			40-49			50-59			60 Plus			TOTAL		
	A	O	T	A	O	T	A	O	T	A	O	T	A	O	T	A	O	T
DISC ANOMALIES																		
NON-DILATED	0	11	11	0	11	11	0	8	8	0	6	6	2	8	10	2	44	46
DILATED	0	13	13	0	14	14	0	9	9	0	8	8	4	11	16	5	55	60
% MISSED	-	15	15	-	21	21	-	11	11	-	25	25	60	27	38	60	20	23
MACULAR ANOMALIES																		
NON-DILATED	0	3	3	0	2	2	0	3	3	0	3	3	0	11	11	0	22	22
DILATED	0	4	4	0	5	5	0	7	7	0	13	13	1	32	33	1	61	62
% MISSED	-	25	25	-	60	60	-	57	57	-	77	77	100	66	67	100	64	65
VASCULAR ANOMALIES																		
NON-DILATED	0	0	0	0	0	0	0	1	1	5	0	5	12	1	13	17	2	19
DILATED	0	1	1	0	0	0	1	1	2	7	0	7	16	1	17	24	3	27
% MISSED	-	100	100	-	-	-	100	0	50	29	-	29	25	0	24	29	33	30
PIGMENT ANOMALIES																		
NON-DILATED	0	1	1	0	8	8	0	3	3	0	6	6	0	5	5	0	23	23
DILATED	0	2	2	0	11	11	0	7	7	0	9	9	1	13	14	1	42	43
% MISSED	-	50	50	-	27	27	-	57	57	-	33	33	100	62	64	100	45	47
CHORIO-RETINAL SCARS																		
NON-DILATED	0	2	2	0	1	1	0	1	1	0	1	1	0	4	4	0	9	9
DILATED	0	2	2	0	2	2	0	1	1	0	1	1	0	4	4	0	10	10
% MISSED	-	0	0	-	50	50	-	0	0	-	0	0	-	0	0	-	10	10
CHORIO-RETINAL ATROPHY																		
NON-DILATED	0	1	1	0	2	2	0	0	0	0	3	3	0	5	5	0	11	11
DILATED	0	1	1	0	3	3	0	1	1	0	3	3	0	8	8	0	16	16
% MISSED	-	0	0	-	33	33	-	100	100	-	0	0	-	38	38	-	31	31
NEVI																		
NON-DILATED	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
DILATED	0	0	0	0	5	5	0	8	8	0	7	7	0	8	8	0	28	28
% MISSED	-	-	-	-	100	100	-	100	100	-	86	86	-	100	100	-	96	96
NON-DISC MYELIN																		
NON-DILATED	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1
DILATED	0	0	0	0	0	0	0	1	1	0	1	1	0	1	1	0	3	3
% MISSED	-	-	-	-	-	-	-	0	0	-	100	100	-	100	100	-	66	66

TABLE 4: POSTERIOR POLE ANOMALIES DETECTED

CATEGORY	20-29			30-39			40-49			50-59			60 Plus			TOTAL		
	A	O	T	A	O	T	A	O	T	A	O	T	A	O	T	A	O	T
RETINAL DEGENERATION																		
NON-DILATED	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1
DILATED	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	2	2
% MISSED	-	-	-	-	-	-	-	-	-	-	100	100	-	0	0	-	50	50
RETINAL TEARS/ HOLES																		
NON-DILATED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DILATED	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% MISSED	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VITREO-RETINAL TRACTION																		
NON-DILATED	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1
DILATED	0	0	0	0	0	0	0	0	0	0	2	2	0	1	1	0	3	3
% MISSED	-	-	-	-	-	-	-	-	-	-	100	100	-	0	0	-	66	66
VITREOUS ANOMALIES																		
NON-DILATED	0	1	1	0	0	0	0	4	4	0	5	5	0	17	17	0	27	27
DILATED	0	1	1	0	2	2	0	8	8	0	12	12	0	44	44	0	67	67
% MISSED	-	0	0	-	100	100	-	50	50	-	58	58	-	61	61	-	60	60
TUMORS																		
NON-DILATED	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
DILATED	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
% MISSED	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	0	-	0
TOTALS																		
NON-DILATED	1	19	20	0	24	24	0	21	21	5	25	30	14	53	67	20	142	162
DILATED	1	24	25	0	42	42	1	43	44	7	57	64	23	124	147	32	290	322
% MISSED	0	21	20	-	43	43	100	51	52	29	56	53	39	57	54	38	51	50

TABLE 5: PERIPHERAL ANOMALIES DETECTED

CATEGORY	20-29			30-39			40-49			50-59			60 Plus			TOTAL		
	A	O	T	A	O	T	A	O	T	A	O	T	A	O	T	A	O	T
VASCULAR ANOMALIES	0	1	1	1	4	5	0	0	0	2	1	3	3	0	3	6	6	18
PIGMENT ANOMALIES	0	15	15	0	18	18	0	17	17	0	14	14	1	13	14	1	77	78
CHORIO-RETINAL SCARS	0	1	1	0	2	2	0	0	0	0	0	0	0	2	2	0	5	5
CHORIO-RETINAL ATROPHY	0	7	7	0	15	15	0	11	11	0	19	19	0	17	17	0	69	69
NEVI	0	2	2	0	1	1	0	4	4	0	2	2	0	1	1	0	10	10
NON-DISC MYELIN	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	2	2
RETINAL DEGENERATION	1	5	6	2	5	7	1	7	8	0	5	5	1	25	26	5	47	52
RETINAL TEARS/ HOLES	0	2	2	1	3	4	0	3	3	1	3	4	3	7	10	5	18	23
VITREO-RETINAL TRACTION	1	13	14	0	9	9	1	1	2	0	1	1	0	3	3	2	27	29
VITREOUS ANOMALIES	0	2	2	0	2	2	0	1	1	0	0	0	0	1	1	0	6	6
TUMORS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1
TOTALS	**2**	**48**	**50**	**4**	**60**	**64**	**2**	**44**	**46**	**3**	**46**	**49**	**9**	**69**	**78**	**20**	**267**	**287**