

# 19 COMMON CLINICAL CONDITIONS

## 19.1 Congenital Cataract

Congenital cataract is the commonest treatable condition in the series and the second commonest genetic condition.

### 19.1.1 Patients and Sibships

The number of patients with cataract as a primary pathology was 132 forming 91% of the lens group (n = 145). The figure rises to 164 when patients in whom cataract as a secondary pathology are added (n=32), and 185 when all cases with cataract are included, see table 19.1.'

In comparison to the rest of the series, this group of patients included the largest proportion of cases recruited from the outpatient clinic, which contained insufficient data on history, demography, consanguinity etc. Their inclusion in the study was necessary to provide comprehensive, unbiased information on the size of the problem of the various conditions in particular lens disorders and their prevalence in the region.

Ratios of the sibships and pedigrees are shown in Table 19-1. Consanguineous marriage in these sibships was 81%.

	Patients with Cataract							
	Primary		Secondary		Others		Total	
West Bank	62	<b>47</b>	15	<b>52</b>	7	<b>64</b>	84	<b>49</b>
Gaza Strip	58	<b>44</b>	11	<b>38</b>	4	<b>36</b>	73	<b>42</b>
Others	12	<b>9</b>	3	<b>10</b>	0	<b>0</b>	15	<b>9</b>
Total OPT	132	<b>100</b>	29	<b>100</b>	11	<b>100</b>	172	<b>100</b>

Percentages in *Italic bold*

**Table 19-1: 19-1: All cataract cases: patients, sibships and pedigrees**

### **19.1.2 Age Distribution**

There were 94 patients (23.2% of the total study) <16 with CC as a primary condition and 110 (27%) when secondary cases were included. Regionally, the condition affected 22.4% and 20.7% of children the WB and GS respectively. In adults, the percentage in the GS was double that of the WB at 19.2 and 10.5 % respectively.

### **19.1.3 Gender**

Male to female ratio in CC demonstrates male preponderance in both regions especially in the GS where there are twice as many males as females. (WB 1.4:1, the GS 1.75:1)

### **19.1.4 Inheritance**

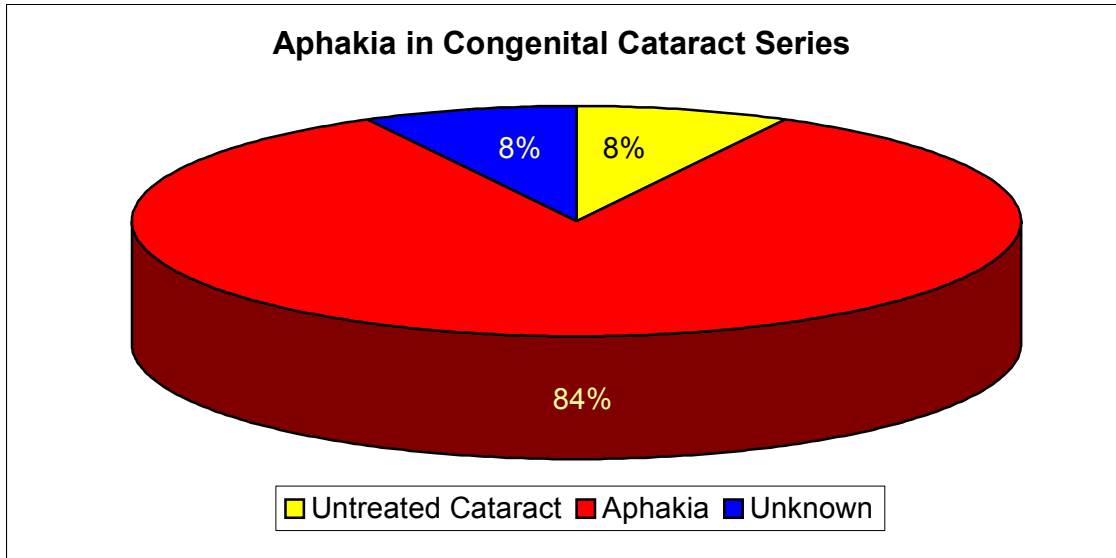
Of the CC cases, 61% are hereditary (81) and 9.8% non-hereditary (13); this leaves 28.8% (38) of cases of undetermined aetiology. Excluding the latter brings the hereditary cases to 86% of the CC. The hereditary group comprises primarily genetic congenital cataract. The modes of inheritance in these patients are AD in 11% (9), AR in 84% (68), 4 cases were isolated (simplex) cases and 1 uncertain. Among the AR cases, 4 resembled AD inheritances, 4 were also associated with AD myopia. (Table 19-4, which also show the inheritance and marriage pattern).

### **19.1.5 Aphakia**

Aphakia was registered under CC rather than as separate entity. It was present in 109 patients (187 eyes) leaving 23 patients (134 eyes) with untreated cataract (both as a primary and secondary condition). This is in addition to 12 other cases of aphakia belonging to other categories (whole globe 5, retina 4, cornea 2, and optic nerve 1) - Figure 19-1.

### **19.1.6 Posterior Capsular Fibrosis**

This was reported in 14 eyes. Several children underwent surgical capsulotomy with sufficient visual improvement that enabled their transfer to sighted schools with the appropriate visual aids (Plate 25).



**Figure 19-1: Proportions of aphakia and untreated cataract**

#### **19.1.7 Visual Acuities**

Visual acuities in the CC patients on whom such figures were available (rather than an estimate) were 4 (5%) in category '5', 21 (25%) in category '4', 10 (12.2%) in category '3', 39 (47.5%) in category '2' and 8 (9.8%) in category '1' (n=82). That is a total of 43% as SVI/BL.

#### **19.1.8 Prevalence and Incidence**

The prevalence of CC in the whole series averaged 10/100,000 with a significantly higher prevalence in the GS (12/100,000) than the WB (7.7/100,000). In the <16, the prevalence average was 15/100,000 with less obvious discrepancy between the two regions. (GS 15.3/100,000, WB 12/100,000)

Figures on live births were available from 1973 to 1986 in the WG and 1973 to 1979 the GS. The average net live birth rate in the former for the same period was 21.1 thousands and for the latter were 14 thousands. The number of patients with CC per year in the same period was 3.3 cases per year and 2.82 cases per year in the two regions respectively. The incidence rate per 100,000 is, therefore, 15.6 and 20 in the WB and GS respectively. The rate for the following 7 years (between 1979 to 1986) in the WB remains unchanged at 16/100,000.

### 19.1.9 Association with Other Ocular Conditions (Table 14-4)

Congenital cataract was also found in patients with ectopia lentis (n=15, 7.4%), CG (n=12, 6%), retinal dystrophies (n=10, 5%) and microphthalmos (n=10, 5%). This tops up the number of patients with lens related conditions to 202 patients (30.2% of the series), 112 of the patients were aphakic.

### 19.1.10 Associated Systemic Findings

The commonest associated feature is mental retardation/subnormality. The distribution of this in the various congenital and cataract cases is shown in Table 19-2a. The rest of the associated conditions in congenital and other cataract cases are listed in Table 19-2b.

Mental Subnormality in Cataract Cases					
Cataract Group	Cohort	Total		Hereditary cases	
As a primary pathology	132	8	<b>6</b>	5	<b>62</b>
As a primary and secondary pathology	164	10	<b>6</b>	7	<b>70</b>
All cases with cataract	185	18	<b>19</b>	13	<b>72</b>

Percentages in bold *Italic*

**Table 19-2a: Mental subnormality in patients with cataract**

Conditions Associated with Congenital Cataract			
A) Congenital cataract/Lens as a primary condition			
	Sex	Age	Findings
WB	F	15.9	Very slow mentation, very shy
	M	10.8	Slow mentation, undescended testicles
	M	3.7	Bat ears, extra digit, undescended testes, bright
	M	7.2	Mentally subnormal
GS	F	19.6	Mentally subnormal
	M	16.9	Hypoplastic maxilla, stuttering speech

	M	7.2	Mentally subnormal, extra digit, bulgy sternum, undescended testes
	F	2.9	Mentally subnormal, Down syndrome
	F	8.9	Allergic rhinitis
<b>A) Congenital cataract/Lens as a primary condition</b>			
<b>(1) Retinal dystrophies</b>			
West Bank	M	4.1	Trichomegaly, nail abnormality
	M	41.7	Mentally retarded, spastic, unilateral CDH, small for age
	3 M	12 to 15	Mentally subnormal
	1 F	10.0	
IL	M	7.8	Prominent first incisor
<b>(2) Congenital glaucoma</b>			
WB	F	3.2	Limbs weakness
	M	6.0	Spastic
GS	M	0.8	Mentally retarded
	M	0.9	Mentally retarded, ? Homocystinurea
IL	F	9.4	MR, epileptic; grand and petit mal
<b>(3) Other Conditions</b>			
WB	M	7.4	Mentally subnormal
	F	13.4	Very bright child, IDDM

**Table 19-2b: Conditions associated with congenital cataract**

### 19.1.11 Family Data

The number of patients with congenital cataract per year in the same period was 3.3 cases per year and 2.82 cases per year in the 2 regions respectively. The incidence rate per 100,000 is, therefore, 15.6 and 20 in the WB and GS respectively. The rate for the following 7 years (from 1979 to 1986) in the WB remains unchanged at 16/100,000 (Table 19-4).

## 19.2 Ectopia Lentis

In the small subgroup of ectopia lentis (EL) (n=13), 9 were from the WB and 4 from GS with a ratio of 2.25:1. The M/F ratio was 1.6:1 but in the GS, all patients were male. The group consisted of 9 sibships from 7 pedigrees. All the conditions associated with ectopia lentis were AR and are shown in Table 19-3.

<b>Clinical Conditions with Ectopia Lentis</b>			
<b>Condition</b>	<b>No.</b>	<b>%</b>	<b>Sibships</b>
Isolated AR ectopia lentis	3	23	1
High myopia	3	23	2 <sup>a</sup>
Infra-quadrantic iris anomaly, dysmorphic features, unilateral arthritis in ankle and fingers in one.	2	15.9	1
Syndromatic: hypoplastic scrotum, undescended testicles, feminine complexion, coarse scalp hair (absent in other siblings), flat feet, educationally subnormal (brother undescended testicles) - (Plates 26 to 29)	1	7.7	1
Marfanoid features	1	7.7	1
Homocystinurea	3	23	3 <sup>b</sup>
Total	13	100	9

<sup>a</sup> Same pedigree. <sup>b</sup> 2 pedigrees, 2 cousins from 1 pedigree.

**Table 19-3: Conditions associated with ectopia lentis**

Patients Sequence in Congenital Cataract				
Patient No.	Sequence *	Ratio**	Cons. †	Mode <sup>ϕ</sup>
<b>West Bank</b>				
CC-02-1-1 to 5	<b>MFmFMM</b>	5:6	NR	AR
CC-02-2-1	<b>F<sup>a</sup> mFmfm</b>	2:7	C1A	AR
CC-02-3-1	<b>M<sup>a</sup> fm-m-m-m-</b>	1:2	NR	AR
CC-03-1-1	cmfcc <b>F</b> afp	1:4	R-SF	IUD?
CC-04-2-1& 2	a <b>F</b> m-m <b>M</b> f-mf	2:8	C1D	AR
CC-04-1	<b>Mffm<sup>b</sup> ff</b>	2:7	R-SF	AR
CC-05-1-1	f-mf-f-m-m-m-mff <b>F</b>	1:11	SV	AD
CC-05-2-1 to 6	mf-m- <b>FMMFcM</b> cfm <b>M</b>	6:11	NR	AD
CC-06-1-1	fmm <b>F</b> mfmfm	1:9	SV	IUI
CC-08-1-1	fccmfmm <b>F</b> mm	1:8	C2	?AR
CC-10-1-1	n/a	1:4	C1	AR
CC-12-1-2	mc <b>F</b> cfcfmm <b>M</b> m	2:9	C1A	AR
CC-13-1-1	mfmm-{m-m-}mcc <b>F</b> ffm	1:8	C1hA	IU?
CC-14-1-1	f <b>F</b> mfmfmfc	1:8	C1A	SX
CC-15-1-1	mm-f <b>M</b> mf-fmfm	1:8	C1hA	SX
CC-16-1-1 to 3	<b>FfM</b> ffm <b>M</b>	3:7	C1A	AR
CC-18-1-1	mcmmffmfm <b>F</b>	1:9	R-SF	IUI
CC-19-1-1	mmmm <b>M</b> cfc	1:6	NR	UD
CC-20-1-1 to 3	f-f-f-f-ff-f <b>MM</b> f-c <b>F</b> mm	3:7	C1A	AR
CC-21-1-1	{f-} <sup>c</sup> mffmf <b>M</b> c{f-}fcd <sup>d</sup> m	1:11	C2A	IUI
CC-22-1-1 & 2	f[m-] <sup>e</sup> <b>FfMF</b> - <sup>f</sup> f <b>F</b> f	4:8	R-SF	AR
CC-23-1-1	f-ff-f[m] <sup>g</sup> <b>M</b> mm-mfcm{f} <sup>h</sup>	1:9	C1B	IUI
CC-62-1-1-my	ffff <b>M</b> <sup>i</sup>	1:7	UA	n/a
<b>Gaza Strip</b>				
CC-01-1-1 to 4	<b>FfM</b> mmm <b>MM</b> mffc	4:11	C1A	AR
CC-01-2-1 to 4	f- <b>MF</b> m <b>F</b> m <b>M</b> cfm <b>M</b> <sup>j</sup>	5:11	C1A	AR
CC-01-3-1 & 2	<b>MF</b>	2:2	C1A	AR

Patients Sequence in Congenital Cataract				
Patient No.	Sequence *	Ratio**	Cons. †	Mode $\Phi$
CC-07-1-1 to 5	f <sup>-k</sup> MMFf <sup>-k</sup> mMmMm	5:10	C1A	AR
CC-11-1-2	mfcMMc	2:4	C1A	SX
CC-11-2-3	Mf-f-Mf-f-f-mMmcF	4:11	C1C	AR
CC-17-1-1	ffmFmfmm	1:8	C1C	IUI
CC-24-1-1, 2	MfMMf <sup>L</sup>	2:5	SV	AR
CC-25-1-1, 2	mmf-ffFmsmcF <sup>P</sup>	2:9	C1A	AR
CC-26-1-1, 2	FMmmff	2:6	C3	AR
CC-27-1-1	M{f}cmfmmfff <sup>m</sup>	1:9	SV	SX
CC-28-1-1	mMMF	3:4	C1B	AR rAD <sup>v</sup>
CC-28-2-1	fmmM <sup>p</sup> fmff	1:8	NR	AR rAD?
CC-30-1-1	F <sup>n</sup> fmmmm	1:7	R-SF	AR
CC-30-2-1 to 3	mF-FMMFmf	4:7	C1hA	AR
CC-30-3-1 & 2	mfFffMf	2:7	C2A	AR
CC-30-4-1	cffM	1:3	C2A	AR
CC-45-1-1& 2	ffmfFM	2:7	NR	AD
CC-47-1-1	mmf(Ff-) fmfmf <sup>o</sup>	1:10	C2	? IUI
CC-28-1-1 & 2	mMMF	3:4	C1B	AR rAD?
CC-48-1-1	UUUUUUUF <sup>q</sup>	1:9	UA	IUI
CC-29-1-1	MF???? <sup>r</sup>	2:?	n/a	AR
CC-46-1-1	ff{m}f{{M <sup>s</sup> }}mf{f} <sup>t</sup>	1:8	C2hA	IUI
SY-03-1-1	m <sup>-d</sup> smmsmffmfmF	1:10	NR	CH
106/365 = 1:3.4				

\* Refer to codes used in sibships notation section 6.3 for the key to symbols used. \*\*

Affected to total living siblings or living and dead siblings if affected with the same condition.

† Cons.: consanguinity, refer to section 6.4 for key.  $\Phi$  Mode of inheritance.

<sup>a</sup> Parents of 02-1. <sup>b</sup> Case 04-2's parent <sup>c</sup> infancy death, spina bifida, <sup>d</sup> post pyrexia mortality.

<sup>e</sup> [m-] premature. <sup>f</sup> died age 5 yrs. <sup>g</sup> proteinurea. <sup>h</sup> squint. <sup>i</sup> not in sequence. <sup>j</sup> died 6m of

small pox <sup>k</sup> died age 13 days and 4 weeks from gastroenteritis. <sup>L</sup> mother with CC, non-con-

sang. <sup>m</sup> hemiplegics, grandmother has MC, a 1<sup>st</sup> cousin with harelip. <sup>n</sup> mother of CC-30-2. <sup>o</sup>

died in labour. <sup>p</sup> father of 28-1. <sup>q</sup> all U are normal, father has CC. <sup>r</sup> the rest n/a. <sup>s,t</sup> ONH

coloboma: <sup>s</sup> bilateral, <sup>t</sup> unilateral CC in in the same sibship <sup>v</sup> rAD: resembles AD inheritance.  
SX: Simplex: isolated or sporadic. UA: data unavailable.

**Table 19-4: Patients' sequence, ratios, and mode of inheritance in congenital cataract**

### **19.3 Congenital Glaucoma**

#### **19.3.1 Prevalence**

Congenital glaucoma ranks third among the causes of childhood blindness and is the second major congenital conditions surgically treated at SJOH. It represents 10.2% of patients in the whole series.

#### **19.3.2 Demography**

Congenital glaucoma encompasses 68 patients, 32 from the WB, 29 from the GS, 6 unidentified and 1 from Israel. These patients originate from 45 pedigrees, 20 from the WB, 18 from the GS and 7 from either region of the OPT. There were an additional 2 patients in whom buphthalmos was a secondary pathology.

The prevalence of CG . The prevalence in all the OPT is 5/100,000 (WB 3/100,000, GS 6.6/100,000). In the <16, the figures are 6, 4, 8 / 100,000 respectively.

#### **19.3.3 Age Distribution**

The age distribution in the CG cohort is 43 patients <16 years and 25 adult patients; a ratio of 1.72:1.

#### **19.3.4 Gender**

There are a total of 40 males and 28 females in the CG group giving rise to a M/F ratio of 1.43:1 for the total and 1.38:1 for the <16. Among those whose family history is known (n=62), the ratio drops to 1.2:1 (1.1:1 general population, 0.9:1 in the CG sibships (n=224 sibs). Ratios between the two regions are comparable and the above male predominance is maintained with the exception of the <16 cohort in the WB where it is 1:1.

### 19.3.5 Clinical Characteristics (Plates 30-31)

It is possible that 50 cases (74%) are primary CG (PCG) and 10 (15%) are ACS including 7 which are probably Peter's anomaly and 2 with Reiger's syndrome. One case is probably non-genetic.

There is considerable ocular morbidity in these conditions which made ascertainment of clinical details and type difficult. Twenty two eyes were phthisical or atrophic and one removed, 7 with corneal scarring and some probably Peter's anomaly.

### 19.3.6 Visual Acuities

These are listed in Table 19-5 which shows severe visual morbidity in CG cases.

<u>VA Category</u>		
'5' NLP	14	20%
'4' Blind	21	31%
<hr/>		
Total blind	<b>35</b>	<b>51%</b>
<b>SVI/BL</b>		
'3', '4', '5', '7'	51	79%
'3' + '6' VI	13	19%

### 19.3.7 Inheritance

It was possible to establish the hereditary nature of CG in 57 cases, in 9 information were not available and in 2, the condition was non hereditary. In the hereditary cases, AR mode of inheritance was the norm in 90% of cases with known family history, and 3 were isolated cases. The percentage of affected sibs to the total sibship averaged 27.7%. The ratio within the gender was 32% and 24% of the affected male and females to the corresponding gender respectively.

**Table 19-5: Visual acuities in congenital glaucoma**

### 19.3.8 Associated Findings and Conditions

Several additional conditions were associated with CG. These are enumerated in the following Table together with the family sequence and other demographic data.

The associated findings and conditions in 68 Patients with CG together with the sequence of the patients in relation to the rest of the siblings and other clinical remarks are enumerated in Table 19-6.

<b>Associated Findings and Conditions in Congenital Glaucoma</b>				
<b>Case No.</b>	<b>Gender/age</b>	<b>Siblings *</b>	<b>Ratio</b>	<b>Clinical comments</b>
<b>1) Above average intelligence</b>				
CG-10-1-1	F 23 WB	m <u>F</u> mmmmfMff	2:9	CC, ? Rdet, Lt AE
CG-14-1-1	M 6 GS	c <u>M</u> ff	1:3	? Peter's, staph. graft.
CG-31-1-1	M 21 WB	{f-} <u>M</u> fMf[m-s]ff~f **	2:9	PCG
CG-26-1-1&3	F 15, M 23 WB	<u>M</u> cmffFc <u>F</u> fM	4:8	PCG: (1) gross, Rdet. (3) Rt mild, CC, IDDM
CG-04-1,2,3	F 11, 16 GS	f-ffm-ff <u>FF</u> ffFcm	3:12	PCG:(2) high myopia
<b>2) Deafness</b>				
CG-23-1-2	M 31 WB	<u>MM</u> ccffmcFf- <sup>**</sup> f	2:7	PCG, Rt phthisis, Lt AE. 70% deaf,
CG-19-1-1	F 39 WB	Fmffmm- <sup>**</sup> fmfm	1:10	? PCG: cystic globe, Rt phthisis, deaf.
<b>3) Syndromatic</b>				
(A) 1. hypoplastic maxilla. 2. abnormal dentition upper jaw. 3. long fingers with short nails. 4. allergic rhinitis.				
CG-15-1-1	F 11 WB	n/a	n/a	?PCG: Rt diffuse co., Lt clear cornea
(B) 1. trichomegaly. 2. nail abnormality.				
CG-26-1-4	M 5 WB	<u>M</u> cmffFc <u>F</u> fM	4:8	Dense co., sublux.CC, ?LCA
<b>4) Atopy</b>				
<b>(a) Allergic rhinitis</b>				
CG-07-1-1&2	F 3 GS F 10 GS	m <u>F</u> fc <u>M</u> <u>E</u>	2:5	? PCG (1) ?Peter's (2) photophobic, clear cornea, dense cataract
CG-27-1-1	F 8 WB	ffmm <u>E</u> fF	2:7	PCG: central co.
<b>(b) Food allergy</b>				

Associated Findings and Conditions in Congenital Glaucoma				
Case No.	Gender/age	Siblings *	Ratio	Clinical comments
CG-06-1-2	F 8 GS	FmFmcf	2:6	? PCG, ?Peter's.
(c) Drug allergy (see CG-26-1-3 above)				
<b>5) Paraplegia</b>				
CG-23-1-1	F 18 WB	mMccffmcFf-***f	2:7	PCG, phthisis
<b>6) Significant personality and mood disorder</b>				
CG-09-1-2	M 16 GS	mffMfF-ffMMffcc	4:12	PCG: Rt atrophy.CC
CG-06-1-1	F 11GS	FmFmcf	2:6	?PCG, ?Peter's.
CG-04-1-1	F 17 GS	f-ffm-ffEFffFcm	3:12	PCG.
<b>7) Subnormal mentation</b>				
CG-05-1-1	M 16 GS	ffmMmmf-fmmm	1:11	Burnt out CG, phth, Lt acq. leuc adh.
CG-21-1-1	M 9 WB	cmc{f} M <sup>a</sup> fm	1:5	PCG: MR, sister MR.
<sup>a</sup> MR noted post pyrexial illness age 11 month				
<b>8) Buphthalmos cases without associated findings</b>				
CG-01-1-1	M 13 GS	n/a	-	CG
CG-02-1-1	F 10 WB	n/a	-	CG
CG-03-1-1	M 2 WB	fFM	2:3	PCG
CG-03-2-1	M 28 WB	fmM) fmf	1:7	PCG
CG-03-3-1	F 20 WB	mEF-fmf{ff}f	2:8	PCG
CG-08-1-1,2	M 16 WB M 19 WB	MmmMM	2:5	PCG: (1) cataract (2) atrophie bulbae
CG-09-1-1	M 17 GS	mffMfF-ffMMffcc	4:12	?PCG: Rt co., Lt phth.
CG-10-1-2	M 13 WB	mFmmmMff	2:9	Bilateral phth.bulbae
CG-12-1-1	M 14 WB	ffMmfmf-f	1:8	PCG:Rt buph, Lt phth.

Associated Findings and Conditions in Congenital Glaucoma				
Case No.	Gender/age	Siblings *	Ratio	Clinical comments
CG-13-1-1	M 5 GS	f <u>M</u> p	1:2	PCG: central co (scar)
CG-16-1-1	F 9 WB	smfm <sup>a</sup> fcm <sup>a</sup> mmf <u>E</u> m <sup>b</sup>	1:11	ACS, Reiger. Rt phth.
<sup>a</sup> squint. <sup>b</sup> delayed speech.				
CG-17-1-1	F 36 GS	f-m <sup>a</sup> f-f-m <u>E</u> [m] <sup>b</sup> mmm <sup>c</sup> <u>M</u> <sup>d</sup> <u>M</u>	3:10	? PCG: Rt AE, Lt co.
<sup>a</sup> glaucoma age 44yr. <sup>b</sup> MR, <sup>c</sup> Unilat. RTA. <sup>d</sup> glaucoma age 12 yrs.				
CG-18-1-1	M 22 OPT	fmff <u>M</u> mMf	2:8	PCG, CC
CG-22-1-1, 2	F 3 WB M 9 WB	<u>M</u> m <u>E</u>	2:3	PCG: (1) buph. (2) CC
CG-24-1-1	F 12 WB	mf <u>E</u> m	1:4	PCG: Rt phthisis, Lt high iop. ChR scars
CG-25-1-1	M 3 WB	c <u>MM</u> -	2:2	?ASD/Peter's (atypical), ?PCG cornea decomp.
CG-26-1-2	F 13 WB	<u>M</u> cmff <u>F</u> c <u>E</u> f <u>M</u>	4:8	PCG: gross buph.
CG-27-1-2	F 4 WB	ffmm <u>F</u> f <u>E</u>	2:7	?PCG, ?CCO: Rt corneal haze, Lt co.
CG-28-1-1	M 2 WB	<u>M</u>	1:1	PCG
CG-29-1-1, 2 & 3	F 14 GS M 17 GS M 31 GS	m <u>M</u> -mmmm <u>M</u> f <u>M</u> <u>E</u>	4:10	PCG (3) Rt phth.
CG-29-2-1	F 9 GS	<u>E</u>	1:1	PCG
CG-31-1-2	M 24 WB	{f-} <u>M</u> f <u>M</u> F[m-f-]ff~f	2:9	PCG
CG-32-2-1 & 2	F 17 WB F 30 GS	<u>M</u> <sup>b</sup> -f- <u>E</u> mmmf <u>E</u> cf m cc	3:9	(2) Reiger, Rt AE
<sup>a</sup> Father of of 32-1. <sup>b</sup> died from RTA. <sup>c</sup> died age 3 months.				
CG-34-1-1	M 9 OT	n/a	-	PCG
CG-35-1-1	F 3 OT	n/a	-	PCG, myopia

Associated Findings and Conditions in Congenital Glaucoma				
Case No.	Gender/age	Siblings *	Ratio	Clinical comments
CG-37-1-1	M 3 OT	n/a	-	PCG
CG-38-1-1	M 4 OT	n/a	-	PCG: L>R
CG-36-1-1	M 5 OT	n/a		CC
CG-40-1-1	M 9 GS	n/a		PCG
CG-41-1-1	M 3 GS	n/a		PCG: buph
CG-42-1-1	M 3 GS	n/a		PCG: buph
CG-43-1-1	M 3 OT	n/a		PCG
CG-44-1-1	M 1 GS	n/a		PCG
CG-45-1-1	M 4 WB	n/a		?PCG
CG-46-1-1	M 3 GS	An affected sister	-	Lg cd , high iop
CG-47-1-1	M 5 GS	n/a	-	cd 14/12.5
CG-32-1 <sup>a</sup>	M 60 WB	fff <u>M</u> (the Father)	1:4	ACS
CG-30-1-1, 2	M 22 GS F 24	f- <sup>**</sup> mf <u>FM</u>	2:5	ACS/Peter's: essential iris atrophy.
AS-02-1-1	M 8 GS	ff-f-mff <u>M</u> ff-msf	1:7	Peter's + CC. global weakness
ACQ-56-1-1	M 16 WB	<u>M</u> mmffmmccm	1:8	Phth.co., AE (Tr)

\* Refer to codes used in sibships notation section 6.3 for the key to symbols used.

\*\* Affected to total living siblings or living and dead siblings if affected with the same condition. \*\*\* Infancy death. (1), (2) indicate patient number from the first column when more than one person is involved. ACS: anterior cleavage syndrome. AE: artificial prosthetic eye. Buph: buphthalmic. CC: congenital cataract. CCO: congenital corneal oedema. cd: corneal diameter. ChR: chorioretinal. co.: corneal opacity. decomp: decompensation. Gl: glaucoma. Lt: left. PCG: primary congenital glaucoma. Phth. Phthisis. Rdet: retinal detachment. Rt: right eye. RTA: road traffic accident. staph.: staphyloma. Tr. Trauma.

**Table 19-6: Congenital glaucoma: associated finding and patients' sequence**

## **19.4 Microphthalmos/Anophthalmos**

Small eyes, microphthalmos, (as defined by the WHO as eyes with a corneal diameter of less than 11mm), are the fourth largest genetic group of conditions.

### **19.4.1 Clinical Types**

### **19.4.2 Clinical Types and Regional Distribution**

The total number of patients with MC is 60. This includes those in whom the condition was the primary site of pathology (n=38) and secondary contributor to the visual impairment (n=28). The primary cohort formed 4.3% of the WB cohort, 7.6% of the GS cohort and 5.5 of the total cohort (Table 16-11). All MC cases, however, form 8%, 10.7% and 9% from the total series in the regions.

On the basis of aetiology all the MC are subgrouped into 3 categories as shown in Table 19-7a.

Group A: MC is the primary cause of blindness (WHO anatomical classification) in 33 patients. The VA is in the SVI/BL category in 30 patients (91%) with 23 blind (70%); and 17 (51%) with NLP. Three patients from 3 unrelated sibships had anophthalmia. Five patients from one pedigree from the WB have an appearance of anterior cleavage syndrome. Colobomas were part of the microphthalmia in 7 patients (21%). In 2 patients out of 3 from one sibship from the GS, total absence of the iris identical to aniridia was seen with ACS. Group A also showed a wide interfamilial and intrafamilial variability in the phenotypic expression in the MC patients with a clinical picture that varies from a rudimentary eye bud that can be detected moving behind the conjunctiva, to a well-formed eyeball.

Group B: MC is a secondary pathology contributing to the visual problem in 20 patients. In the majority of these patients (n=16, 80%), CC was the primary pathology, and in the remaining 4 (20%), uveal coloboma was the primary cause of visual loss. SVI/BL in this group was present in 9 cases (47%), Blind in 5 (26%) with none in the NLP category. Seven (37%) were in the visual impairment category (<6/18 to 6/60).

Group C: MC in the non-hereditary cases was present in 7 cases. Six of the patients are blind; half with NLP.

<b>Small Eyes Total Cohort</b>			
	<b>Patients</b>	<b>Sibships</b>	<b>Pedigrees</b>
<b>Primary MC</b>			
West Bank	13	9	8
Gaza Strip	20	10	6
All OPT	33	19	14
WB/GS	0.7	0.9	1.3
<b>Secondary MC</b>			
West Bank	13	5	4
Gaza Strip	6	5	3
All OPT*	20	11	8
Total hereditary	53	30	22
WB/GS	2.2	1.0	1.3
<b>Non-hereditary (all prenatal)</b>			
West Bank	2	2	2
Gaza Strip	5	5	5
All OPT	7	7	7
WB/GS	0.4	0.4	0.4
<b>All MC cases</b>			
West Bank	28	16	14
Gaza Strip	31	20	14
All OPT	60	37	29
WB/GS	0.9	0.8	1
WB/GS total survey **	1.75	1.5	1.2
Total MC	60	37	29

\* Includes 1 patient from either region. \*\* Average WB/GS population ratio is 1.78:1

**19-7a: Microphthalmia: Patients, Sibships and Pedigrees**

### 19.4.3 Age Distribution in MC

Children formed 62% of the series (23/37), 9 in the WB and 14 in the GS.

### 19.4.4 Gender in MC

Male predominance in observed in all the groups (table 19-8).

Groups	M/F <16		M/F All Ages	
	M	F	M	F
Group A	15	8	23	14
Group B	35	20	36	24

**Table 19-8: Gender in small eyes conditions**

### 19.4.5 Inheritance

Of the total group of 60 patients, 53 (88%) were hereditary, 7 (12%) were prenatal. Sixty three percent of sibships showed a definite familial occurrence (more than 1 affected sibling in the family).

The inheritance in the sub-groups are shown in Table 19-7b

Mode	AR	AR	SX
Primary MC (Group A)	100	-	-
Secondary MC (Group B)	65	27	7.7

\* SX: Simplex (Isolated)

**Table 19-7b: Mode of inheritance in microphthalmia/anophthalmia cases**

### 19.4.6 Prevalence and Incidence of MC

Table 19.4.6 depicts the incidence of the two MC genetic groups in the two regions.

Region	Prevalence		Incidence
	<19	Total Series	1 in 1000s
<b>Group A</b>			
West Bank	2	1	56
Gaza Strip	4	4	23
OPT	4	2	27
<b>Group B</b>			
West Bank	2	1	51
Gaza Strip	2	0	64
OPT	2	1	55
<b>All MC Cases</b>			
West Bank	5	3	22
Gaza Strip	7	5	15
OPT	5	4	18

**Table 19-7c: Prevalence of Microphthalmia/Anophthalmia Group**

#### **19.4.7 Associated Finding and Conditions in MC (Table 19-10)**

Six patients (6/38) with MC had other associations of special features as seen below. Group B is not associated with other systemic associations of unusual features. Patients and other siblings sequence are depicted in the box under each case. For the sequence of the siblings refer to Table 19-10.

1. Superior abilities (AR inheritance, first cousin marriage.)

This sibship is unique in their characteristics. All are of above average intelligence. One has exceptional abilities and a '6<sup>th</sup> sense' where he can cycle despite NLP vision. The other brother has superior photographic memory in addition to suicidal tendency; he had jumped twice from a high window (Patients MC-05-5-4-2 & 4, i and ii, Table 19-10).

2. Marfanoid features (above average height, high arched palate), and anterior open bite. (AR, second cousin marriage). (Patient MY-04-1-2, <sup>iii</sup> Table 19-10).
3. Muscular-skeletal associations: (a) Muscular dystrophy, hands weakness (b) kyphoscoliosis, (was operated on one foot) (c) telecanthus. Simplex (isolated) case, first cousin marriage. (Patient MC-15-1-1<sup>iv</sup>).
4. Mental retardation (AR, marriage pattern: not available) (patient MC-02-1-1<sup>vi</sup>).
5. Deafness and failure to thrive: feeble cry, spasticity, microcephaly, and myotonic jerks. Unrelated parents, IUI. (Patient ON-02-1-1<sup>vii</sup>).

<b>Microphthalmia and Anophthalmia as a Primary Cause of Pathology Patients</b>			
<b>Reference No.</b>	<b>Sequence *</b>	<b>Ratio**</b>	<b>Age</b>
<b>Anophthalmia</b>			
MC-02-01-1	<sup>c</sup> cc{sM <sup>vi</sup> }cc(F)mccmcfc <b>M-F</b> -cmm <b>M-f</b>	5:8	38
MC-11-01-1	ffm <b>F</b> m-m <b>M</b> -fcc <sup>g</sup>	2:8	11
MC-05-01-1 to 3	<b>F</b> <sup>*</sup> ff <b>M</b> fm <b>F</b> f	3:7	12-26
<b>Microphthalmia</b>			
CB-04-01-1 <sup>a</sup>	mm- <b>F</b> m <b>M</b>	2:5	35
MC-01-01-1	m-m-f-f-f <b>F</b> <b>M</b> <sup>b</sup>	2:7	20
MC-03-01-1	ffm <b>M</b> cff	1:6	5
MC-04-01-1,2,3	<sup>d</sup> m <b>M</b> <b>F</b> mfc <b>M</b> cmccp	3:7	6-15
MC-05-02-1	f <b>M</b>	1:2	8
MC-05-03-1, 2	<b>FF</b> mm	2:4	3
MC-05-04-1 to 5	<b>M</b> f <b>M</b> <sup>i</sup> m <b>F</b> <b>M</b> <sup>ii</sup> <b>F</b> mmm-	5:10	18-33
MC-05-05-1	fff <b>F</b>	1:4	3
MC-06-01-1	mf- <b>F</b> -mmffm <b>M</b> <sup>e</sup>	2:9	17
MC-07-01-1	fmm[mm] <sup>f</sup> ffmff <b>F</b> f	1:12	8
MC-09-01-1	<b>M</b> fm	1:3	5
MC-09-02-1	fmfmm <b>M</b> mfmfm	1:11	13

MC-10-01-1,2	cccc <b>M</b> Fmff	2:5	5, 6
MC-12-01-1, 2	fm <b>M</b> Fcf	2:5	7, 9
MC-13-01-1	mm <b>F</b> ff-ccc	1:5	7
MC-15-01-1	fmc <b>M</b> <sup>iv</sup> ff	1:5	8
MC-16-01-1	f <b>M</b> ffffc <sup>h</sup>	1:6	15
MY-04-01-2	m-ccm-f <b>M</b> cccmcmfs <b>F</b> <sup>iii</sup> mfcc	2:8	20
ON-02-01-1	m[m] <sup>j</sup> m <b>F</b> <sup>vii</sup>	1:4	3
ASD-01-01-1 to 4	<b>MM</b> -fm- <b>F</b> -Fc <b>F</b> - <b>MM</b> fm <b>F</b>	8:12	8-19
ASD-01-02	m <b>M</b> <sup>k</sup> m <b>M</b> mf	2:6	45
	52:118	1:2	

\* Refer to codes used in sibships notation section 6.3 for the key to symbols used.

\*\* Affected to total living siblings or living and dead siblings if affected with the same condition. <sup>a</sup> First wife: 4:4 sibs, MR and mute. <sup>b</sup> all died ages 1yr, 2 yr, 2 m, 2 m. <sup>c</sup> All died in infancy from gastroenteritis, 3 yrs cause? 1 yr chest Infection. <sup>d</sup> father has mild MC (10.25 mm, VA 6/6). <sup>e</sup> all died age 6m of pyrexia, F- died 6m from measles. <sup>f</sup> [identical twins]. <sup>g</sup> died of cong. heart disease ? Patent ductus arteriosus. <sup>h</sup> from 2<sup>nd</sup> marriage. <sup>j</sup> [m] deaf-mute. <sup>k</sup> ASD-01-1 father.

**Table 19-10: Patients with small eyes: sequence, ratio and age**

## 19.5 Congenital Corneal Conditions

A small group of conditions with 14 patients from 9 sibships.

### 19.5.1 Clinical Patterns

They are distributed as follows:

- a. Congenital corneal oedema, 4. (Table 19-11, Plate 25)
- b. Peter's or suspected Peter's anomaly, 10. These can be divided into:
  - i. Uncomplicated Peter's (with no glaucoma).
  - ii. Definite Peter's anomaly with CG: 3 cases.
  - iii. Suspected Peter's with complicated CG.

### 19.5.2 Congenital Corneal Oedema (CCO) (Plate 25)

Four cases belonged to 2 unrelated sibships, with 2 patients each. Gender comprised 3 females and 1 male, a ratio of 1:3. In one sibship (CE-02), both patients were mentally retarded. In both, AR mode was obvious.

Vision in these patients is severely compromised with all patients in the SVI/BL category (Table 19-11, Figure 22-6).

Congenital Corneal Oedema Patients				
Ref. No.	Sequence*	Ratio	Ages	VA
CE-01-1, 2	fmFMffmf	2:8	21	3, 7
CE-02-1, 2	mf,(f-)mmffmfmcmFM <sup>a</sup>	2:12	16,17	4

\* Refer to page xi for symbol key

**Table 19-11: Sibships in congenital corneal oedema.**

## 19.6 Hypopigmentation: Albinism and Albinoidism (Table 19-12)

### 19.6.1 Prevalence

Albinism made up 28 of the genetic retina cases out of the 315 retina cases, thus forming as a primary pathology 2.3% (n=8) of the total series in the WB and 6.6% (n=19) in the GS, averaging 4.1% in both regions. These patients belonged to 12 sibships (WB 5, GS 7) and 11 pedigrees. Including other affected members of the sibships who were not examined (WB 18/45 GS 20/60) the total is 38 affected out of the 105 siblings, that is a ratio of 0.33:1.

Prevalence based on the numbers of all the affected in the sibships studied per 100,000 populations were at least WB 1.7 (n=19), GS 3.5 (n=21) and OPT 2.4 (n=40).

### 19.6.2 Gender

Male/female ratio in the total hypopigmentation series was 1.25:1 with marked variation between the two Palestinian regions. In the WB the ratio was 0.3:1 (n=8) and in the GS 2.2:1 (n=19) (Table 22-14).

### 19.6.3 Clinical Types and Associated Conditions with MC

Three clinical entities are identified in Table 19-12.

- Oculo-cutaneous albinism (9 patients).
- Ocular albinism (9 patients).
- Albinoidism (2 cases).

Hypopigmentation				
Reference No.		Sequence *	Ratio	Clinical Aspects
<b>Oculo-cutaneous Albinism</b>				
ALB-02-1	WB	<b>F<sup>a</sup>EMfF</b>	4:5	<sup>a</sup> failure to thrive died age 1 yr
ALB-06-1		<b>FffffFFFmMf</b>	5:11	
ALB-08-1		<b>mEm<sup>b</sup>mFf-ffcfmcc</b>	2:11	<sup>b</sup> accidental death
ALB-03-1 <sup>c</sup>	GS	<b>MffffFffMFmca</b>	3:11	<sup>c</sup> ? related to 04-1
ALB-04-1		<b>ffM-ffff-M-MMMM<sup>d</sup></b>	6:12	<sup>d</sup> all males ?related to 03-1
ALB-07-1		<b>m-mmfmM</b>	1:6	Night blindness and skin lesions
ALB-09-1		<b>MFffmmmcm</b>	2:8	
29:7,7 average 1:3				
<b>Ocular Albinism</b>				
ALB-01-1	GS	<b>FFfMfmfFfMFc</b>	5:11	tyrosinase +ve.
ALB-05-1		<b>mMmf-f-cm-mMmm</b>	2:10	ocular - partial with fair hair <sup>a</sup>
<b>Albinoids</b>				
SY-16-1	WB	<b>M{M}mfm</b>	2:5	albinoid fundus, blue iridis, Waan-derburg features (+white forelock).
SY-23-1	GS	<b>FMc</b>	1:2	cong. blindness ?LA, large head circumference ?hydrocephaly, delayed milestones
10:27, average 1:2.7				

- \* Refer to codes used in sibships notation section 6.3 for the key to symbols used.
- \*\* Affected to total living siblings or living and dead siblings if affected with the same condition.
- <sup>a</sup> Absent in the rest.

**Table 19-12: Sibships with hypopigmentation**

#### 19.6.4 Visual Morbidity in Hypopigmentation

Twenty (57%) of the patients with hypopigmentation were visually impaired (category '2'), 4 (14%) had SVI (category '3') and a further 4 had good visual acuity (category '1'). The remaining (14%) 4 were in category '6' ie most likely to be in category '2'.

#### 19.6.5 Inheritance of Hypopigmentation Cases

Of the total group of 60 patients, 53 (88%) were hereditary, 7 (12%) were prenatal. Sixty three percent of sibships showed a definite familial occurrence (more than 1 affected sibling in the family).

The inheritance in the sub-groups are shown in Table 19-7b

Mode	AR	AR	SX
Primary MC (Group A)	100	-	-
Secondary MC (Group B)	65	27	7.7

\* SX: Simplex (Isolated)

**Table 19-7b: Mode of inheritance in microphthalmia/anophthalmia cases**

#### 19.7 Retinal Dystrophies

Retinal dystrophies comprised 250 patients out of the 304 patients with hereditary retinal conditions, thus forming 80% of the total retina series. These patients were spread out over 109 pedigrees/148 sibships. There are more sibships per pedigree in the GS (ratio 1.8) than in the WB (ratio 1.2) – (Table 19-13). Several clinical and morphological patterns were demonstrated (Table 19-26). The prevalence of RD per 100,000 population in the <16 population in the WB, GS and the total region was 18, 24 and 21 respectively and in the total population the prevalence was 13, 17 and 15. (Two

cases of atypical syndromatic CRD in association with optic atrophy, one of whom also had Friedreich Ataxia, cardiomyopathy, and vitreous condensation have not been included in the above figures.

## 19.8 Progressive Cone and Cone-Rod Dystrophies

### 19.8.1 Patients and Pedigrees

The total number of patients affected in the progressive types of photoreceptors disorders; cone dystrophies (CD) and cone-rod dystrophies (CRD) was 70 thus forming 28% of retinal cases. Of these, 27 came from the WB, 42 from the GS. The M/F ratio averaged 1:1 (Table 19-14). These patients were distributed among 20 pedigrees forming 40 sibships suffered from progressive cone and cone-rod disorders. Of these, 18 sibships (13 pedigrees) were from the WB, 21 sibships from the GS (6 pedigrees) and 1 uncertain.

### 19.8.2 Prevalence of Cone Disorders

The prevalence of CD and CRD combined per 100,000 population in the WB, GS and the total OPT was 4, 9, 6 in the <16 and 2, 7, and 4 in all ages respectively. For CRD and CD individually, the figures are 1, 7.7 and 3.5 for the former and 1, 0.73, 0.9 for the latter for the above regions respectively. This represents a WB/GS ratio of 0.6:1.

Retinal Dystrophies														
	West Bank				Gaza Strip				Whole Series				WB/GS	
	M	F	Both	M/F	M	F	Both	M/F	M	F	Both	M/F	RD	Pop*
<16	38	45	83	0.8	37	27	64	1.4	77	74	151	1	1.30	1.67
16+	25	36	61	0.7	18	19	37	0.9	43	56	99	0.8	1.65	1.79
Total	63	81	144	0.8	55	46	101	1.2	120	130	250	0.9	1.43	1.76
Pedigrees				80				25				109	3.2:1	
Sibships				98				46				148	2.1:1	
S'ship/Ped ratio				1.2				1.8				1.4		

S'ship/Ped.: ratio of sibships/pedigrees \* Pop: general population ratio = n:1

**Table 19-13: Retinal dystrophies: numbers, gender and ratio by region**

### 19.8.3 Age Distribution and Gender in Cone Disorders (Table 19-14)

Ages in cone and CRD ranged from 3 months to 53 years, the M/F ratio being close to that of the general population except for the 16+ group.

Cone and Cone-Rod Dystrophies														
	West Bank				Gaza Strip				Whole Series				WB/GS	
	M	F	Both	M/F	M	F	Both	M/F	M	F	Both	M/F	CR	Pop*
<16	8	9	17	0.9	14	12	26	1.2	22	22	44	1	0.65	1.67
16+	3	7	10	0.4	10	6	16	1.7	13	13	26	1	0.63	1.79
Total	11	16	27	0.7	24	18	42	1.3	35	35	70	1	0.64	1.76
Pedigrees				13				6				20	2.2:1	
Sibships				18				21				40	0.85:1	
S'ship/Ped. Ratio**				1.4				3.5				2		

\* Pop: general population ratio. \*\* S'ship/Ped.: sibships/pedigrees Ratios = n:1.

**Table 19-14: Progressive cone and CRD by gender, age and region.**

### 19.8.4 Visual Acuities in Cone Disorders

These varied between visual impairment (category '2'), 28 cases, svi (category '3'), 11 cases, blindness (category '4'), 29 cases; 1 case with NLP (category '5'); and 1 cannot see (category '7') (Table 19-15).

	Cat '1'	Cat '2'	Cat '3'	Cat '4'	Cat '5'	
	NVI	VI	SVI	BL	NLP	SVI/BL*
Nos.	0	28	11	29	1	43
%	-	<b>40</b>	<b>16</b>	<b>41</b>	<b>1.4</b>	<b>61.4</b>

\* Includes 1 case in category '7': cannot see

**Table 19-15: Visual acuities in cone and cone-rod dystrophies**

### 19.8.5 Clinical Subtypes of Cone Disorders

Three progressive types of cone disorders were identified including cone degenerations without electrophysiological evidence of rod involvement,

cone-rod dystrophies and congenital amaurosis of the cone and rods. Each of these categories is further subdivided into syndromic and non-syndromic versions. This is in addition to the stationary form, achromatopsia (see Tables 19-16, 19-26).

### 19.8.6 Inheritance of Cone Disorders

Among the 70 patients, 67 (96%) were inherited in an AR manner. In 2 (3%) an AD mode was suspected and in 1 (1%) the mode was uncertain.

### 19.8.7 Types, Ocular and Systemic Associations in Cone Disorders

(Table 19-16)

These are highlighted in Table 19-18 which also show patients' sequence within their sibships and the ratio of affected to total number of the sibship together with the mode of inheritance.

All Cone Disorders				
Patient No.	Sequence/Rank*	Ratio**	Age	Remarks
<b>(A) Cone Dystrophies</b>				
<b>(1) Syndromic: Hypoplastic maxilla, stuttering speech (West Bank)</b>				
CD-05-01-1 to 4	M * fFmMM	4:6	17 to 4	* unilat. cataract
<b>(2) Non-Syndromic (The Gaza Strip)</b>				
CD-01-01-1-F	n/a	1:?	55	Father of 01-02
CD-01-02-1, 2	FMmMFM-	4:6	31, 16	
CD-02-01-1 & 2	ffM* mmf[sm)M	2:8	13, 4	* displaced teeth
CD-03-01-1	mfffm-fMm-fm	1:8	20	delayed walking
CD-04-01-1 & 2	FfffmFFmf-	2:8	18, 16	
Affected to total sibships and ratio in CD subtotal 14:36 = 1:2.7 excluding 01				
<b>(B) Cone-Rod Dystrophies</b>				
<b>(1) Syndromic</b>				
<b>(a) BBS: MSN, speech defect, extra digit, myopia (WB)</b>				
CR-08-01-1 & 2	m{f}MfMf *	2:6	9, 5	* Left esotropia
CR-10-01-1	f-mf-mF(cf)[f]^ffp	1:5	7	* extra digits

<b>(b) CRDAI – Congenital Onset with macular degeneration (GS)</b>				
CR-01-01-1 to 3	<b>MfFfmMF</b>	3:7	22 to 10	
CR-01-02-1	ccmccm <b>M</b> ccc	1:3	8	
CR-01-03-1 to 4	{m} <sup>*</sup> mf <b>FF</b> m <b>MM</b>	4:8	8 to 0.9	* vernal catarrh
CR-01-04-1	m- <b>M</b> <sup>*</sup>	1:1	50	* 01-05 's parent
CR-01-05-1, 2	[sf]Fm{mm-}m <b>M</b>	2:5	8, 2	
CR-01-06	f-f-f <b>F</b> <sup>*</sup> m <b>FFMM</b>	5:6	32 to 22	* not assessed
CR-01-07	F <b>F</b> Mm	1:4	45	
CR-01-08	<b>FMF</b>	3:3	14 to 11	
CR-01-09	F <b>f</b> M	1:3	0.6	
CR-01-10	<b>F</b> -mmfffm-f-f <b>M</b> mc	2:11	18	
CR-01-11	<b>F</b> fff <b>M</b>	1:5	2	
CR-01-12	<b>F</b> m <b>F</b> mm <b>M</b>	3:6	11 to 2	
CR-01-13	<b>MF</b> mfcmf	2:6	10, 9	
CR-01-14	f <b>M</b> f-mm <b>f</b>	1:6	12	
CR-01-15	m-ffm-f-f-f-cc <b>M</b> f	1:4	19	
CR-01-16	f-mffm <b>F</b> mm-mf	1:8	20	
CR-03-01-1	Fmm-m <b>M</b> fcf-f-m	1:6	18	
<b>(c) CRDAI – Childhood Onset without macular involvement (GS)</b>				
CR-02-01-1 to 3	<b>M</b> mf- <b>FF</b> cmcf	3:6	22 to 10	
<b>(d) CRD with Mental retardation (in 2/3 sibs)</b>				
CR-04-01- 1 & 3	m <b>F</b> m-m-m-f-f- <b>M</b> <u>f</u> <b>E</b> mm	3:7	21-24	
Affected to total sibships and ratio in CRD 53:160 = 1: 3				
<b>(2) Non-syndromatic</b>				
CR-05-01-1	<b>M</b> f <b>M</b>	1:3	2	Childhood onset
CR-05-02-1	<b>M</b> ffffm mmmm <b>M</b>	2:11	40	? new mutation
CR-06-01-1	m-fmmm-m- mm <b>F</b> mcmc{f-}c	1:9	18	
CR-06-02-1	C <b>f</b> <b>F</b>	1:2	1	
CR-07-01-1	<b>MF</b> mfmfm	2:7	11	

CR-11-1-1-	mff-MmmM*[F]fmmm	4:12	21	* also MR
<b>(C) Congenital Amaurosis of the Cone-rod (Only CD 05 from GS)</b>				
<b>(1) Syndromatic: with congenital hypertrichosis and trichomegaly</b>				
CACR-01-01-1-F	MFffmfmp	1:8	20	Cousins
CACR-01-02-1	fmFfmmmm	1:8	14	
<b>(2) Non-Syndromatic with dull mentation</b>				
CRCA-02-01-1	fM-fmffMm-ff	2:10	8	
CRCA-02-02-1 to 3	FmMfMf	3:6	9, 6, 3	
CRCA-02-03-1 to 3	fMfmmFmmFffm	3:12	19 to 14	
CRCA-03-1-1 & 2	m(m-)ffmf(m)Fm	2:10	9, 6	
Affected to total sibships in CACR and ratio 11:36 = 1:3.6 (excluding CD 01)				

\* Refer to codes used in sibships notation section 6.3 for the key to symbols used.

\*\* Affected to total living siblings or living and dead siblings if affected with the same condition.

**Table 19-16: Types, associations and sequence in cone disorders**

## 19.9 Stationary Cone Disorders (Achromatopsia, Rod-Monochromatism)

### 19.9.1 Patients and Prevalence in Achromatopsia

This group comprised 33 patients who fell within 12 pedigrees and 19 sibships. Table 19-17 shows their distribution between the WB and the GS and demonstrates the preponderance of the condition in the latter. The prevalence of RM per 100,000 including all reported cases was 1 in the WB and 3.6 in the GS averaging 2 in both regions. The corresponding figures in the <16 are 1.5, 5.5 and 3.

<b>Achromatopsia</b>					
	<b>WB</b>	<b>GS</b>	<b>Total *</b>	<b>WB/GS</b>	<b>Population ratio</b>
Patients	9	23	33	0.4:1	1.78:1
Pedigrees	5	6	12	0.86:1	
Sibships	7	11	19	0.64:1	
Sibship/Pedigree	1.4:1	1.8:1	1.58:1		

\* Includes one from either of the OPT regions.

**Table 19-17: Patients, sibships and pedigrees in achromatopsia.**

**19.9.2 Gender (Table 19-18)**

Gender differences in achromatopsia are shown in Table 19-18. Male to female ratios are 0.3:1, 0.8:1 in the WB and GS respectively.

	West Bank				Gaza Strip				Total OPT				WB/GS	
	M	F	Both	M/F	M	F	Both	M/F	M	F	Both	M/F	Cases	Pop *
<16	2	5	7	0.4	7	8	15	0.9	10	13	23	0.8	0.47	1.67
16+	0	2	2	-	3	5	8	0.6	3	7	10	0.4	0.25	1.79
Total	2	7	9	0.3	10	13	23	0.8	13	20	33	0.7	0.4	1.76
Pedigrees	5				6				12				0.86:1	
Sibships	7				11				19				0.64:1	
S'ships/Pedig ratio**	1.4:1				1.8:1				1.6:1					

\* Pop: general population ratio. \*\* S'ship/Ped. sibships/pedigrees. Ratio = n:1

**Table 19-18: Gender and age distribution of achromatopsia by region**

**19.9.3 Visual Acuities in Achromatopsia (Table 19-19)**

Nearly three quarters of the achromatopes were visually impaired (category '2'), 2 were in the NVI category '1' and the remaining 7 had either SVI or were blind. The lowest visual acuity was 2/60 and the mode was 6/60. The mean visual acuity was approximately 6/36.

	Cat * '1'	Cat '2'	Cat '3'	Cat'4'	Cat 5'	Cat 7'	SVI//BL
Nos.	2	24	4	3	0	0	7
%	6	73	12	9	0	0	21

\* cat.: category

**Table 19-19: Visual acuities in achromatopsia**

**19.9.4 Associated Findings in Achromatopsia**

There were no associated findings in any of the RM patients, however other siblings exhibited the following: extra digit in 1 male, deaf-mutism in 1 female, patient and MR and paraplegia in 1 female. All patients had normal mentation, if not above average academic performance.

### 19.9.5 Sequence and Ranks of Patients in Achromatopsia (Table 19-20)

### 19.9.6 Inheritance in Achromatopsia

All cases in achromatopsia were inherited in an AR manner.

### 19.10 Rod-Cone Disorders

#### 19.10.1 Distribution of Patients in RCD

The RC disorders comprised 112 cases out of the 250 retinal cases (45%) spreading across 59/110 pedigrees and 69/149 sibships. Of those, 87 were from the WB, 22 from the GS and 3 from other OPT regions.

#### 19.10.2 Age Range in RCD

This ranged from 18 months to 43 years (Table 19-22).

<b>Achromatopsia (Rod-Monochromatism) Patients</b>			
	<b>Reference No.</b>	<b>Birth Sequence*</b>	<b>Ratio *</b>
<b>West Bank</b>	RM-03-1-1 & 2	fc <b>F</b> cc <b>F</b> ffm <b>F</b> f	3:9
	RM-06-1-1	mf- <sup>a</sup> fmam <b>F</b> fmm	1:8
	RM-06-2-1,2	n/a	2:?
	RM-06-3-1	mm <sup>b</sup> m <b>F</b> m	1:5
	RM-08-1-1	ff[f] <sup>c</sup> <b>F</b> cmff	1:7
	RM-10-1-1	mfff <b>F</b> cm{m} <sup>d</sup> f	1:6
	RM-12-1-1,2	mfm <b>FM</b>	2:5
	WB subtotal (excluding 06) 11: > 40 = 1:4.4		
<b>Gaza Strip</b>	RM-01-1& 2	<b>M</b> m-ff-fmm <b>F</b> cfm	2:8
	RM-02-1-1 to 4	mf <b>M</b> f <b>F</b> ffmm <b>MF</b>	4:12
	RM-02-2-1	mm <b>F</b>	1:4
	RM-02-3-1	<b>F</b> afam[am]mf[am]fcc	1:6
	RM-02-4-1	ff- <b>F</b> fff-mmm-	1:6
	RM-02-5-1	ffmf <b>F</b> f	1:6
	RM-04-1-1 to 5	<b>M</b> f-fmf-f- <b>MF</b> m- <b>MF</b> f <b>M</b>	6:9
	RM-05-1-1	<b>F</b> {f} <sup>e</sup> [f] <sup>f</sup> <b>F</b> f	2:5

	RM-07-1-1	n/a	1:?
	RM-07-2-1, 2	mfff-fMMac	2:6
	RM-09-1-1	fmFm[f] <sup>g</sup> m-f	1:6
	GS subtotal (excluding 07) 22:> 68 = 1:3		
<b>Others</b>	RM-11-1-1	ffMm	1:4
	Total (excluding 06 & 07)34:> 112 = 1:3.5		

\* Refer to codes used in sibships notation section 6.3 for the key to symbols used.

\*\* Affected to total living siblings or living and dead siblings if affected with the same condition.

<sup>a</sup> f- died from measles age 15m. <sup>b</sup> [m]: extra digit. <sup>c</sup> [f:] deaf mute. <sup>d</sup> vernal catarrh.

<sup>e</sup> epileptic, ear discharge. <sup>f</sup> squint. <sup>g</sup> [f] paralysed and MR.

. **Table 19-20: Sequence and ranks of patients in achromatopsia**

### 19.10.3 Gender in RCD

The proportion of sexes in RCD is shown in Table 19-21 which demonstrates a higher females presence in the WB cohort. The gender ratio between the two regions is 3.4:1, 5:1 and 4:1 in the WB, GS and OPT (Table 19-22).

	West Bank				Gaza Strip				Whole Series				WB/GS	
	M	F	Both	M/F	M	F	Both	M/F	M	F	Both	M/F	RC	Pop*.
<16	21	26	47	0.8	8	6	14	1.3	30	33	63	0.9	3.4	1.67:1
16+	16	24	40	0.7	4	4	8	1	20	29	49	0.7	5.0	1.79:1
Total	37	50	87	0.7	12	10	22	1.2	50	62	112	0.8	4	1.76:1
	Pedigrees 48				9				60				3.3:1	
	Sibships 57				10				69				5.7:1	
	S'ship/Ped. ratio** 1.2				1.11				1.15					

\* Pop. : Population ratio \*\* S'ship/Ped.ratio: Ratio of sibships/pedigree M/F ratio

**Table 19-21: Rod and rod-cone dystrophies by age, gender and region**

### 19.10.4 Prevalence of RCD

The prevalence of RCD per 100,000 populations was 10.5, 3.6 and 8.2 in WB, GS and the total OPT.

### 19.10.5 Clinical Types of RCD

According to their time of onset, they can be divided into 2 subcategories; congenital (infancy) onset and childhood onset. The distribution, sex ratios and pedigrees/sibships in the each subgroup and both combined are shown in Tables 19-22 and 19-23.

Congenital Onset Rod Cone Dystrophies (LCA)														
	West Bank				Gaza Strip				Whole Series				WB/GS	
	M	F	Both	M/F	M	F	Both	M/F	M	F	Both	M/F	Pat.*	Pop*
<16	20	24	44	0.8	7	5	12	1.4	27	30	57	0.9	3.6	1.67
16+	14	15	29	0.9	3	4	7	0.7	17	20	37	0.9	4	1.79
Total	34	39	73	0.9	10	9	19	1.1	44	50	94	0.9	3.8	1.76
Pedigrees	37				7				45				5.3:1	
Sibships	46				8				55				5.7:1	
S'ship/Ped. ratio**	1.2				1.1				1.2					

\* Patients ratio. \*\* Population ratio. Ratios =  $n:1$ . \*\* S'ship/Ped: ratio of sibships/pedigree.

**Table 19-22: Congenital onset rod-cone disorders by gender, age and region**

Childhood Onset Rod Cone Dystrophies (RP)														
Age	West Bank				Gaza Strip				Whole Series				WB/G	
	M	F	Both	M/F	M	F	Both	M/F	M	F	Both	M/F	Cases	Pop*.
<16	1	2	3	0.5:1	1	1	2	1:1	3	3	6	1:1	1.5:1	1.67:1
16+	3	11	14	0.3:1	1	0	1	-	4	11	15	0.36:1	14:1	1.79:1
Total	4	13	17	0.3:1	2	1	3	2:1	7	14	21	0.5:1	5.67	1.76:1
Pedigrees	13				2				16				6.5:1	
Sibships	13				2				16				6.5:1	
S'ship/Ped.ratio**	1:1				1:1				1					

\* Pop. : Population ratio      \*\* S'ship/Ped.ratio: Ratio of sibships/pedigree

**Table 19-23: Childhood onset rod-cone disorders by gender, age and region**

### 19.10.6 Visual Acuties

These ranged between NVI (category '1') to NLP in the following proportions (Table 19-24).

VA Categories	'1' NVI	'2' VI	'3' SVI	'4' BL	'5' NLP	'7'	Total	SVI/BL
Congenital	0	1	9	64	9	5	88	87
%	<b>0</b>	<b>1.1</b>	<b>10.2</b>	<b>72</b>	<b>10.2</b>	<b>5</b>	<b>100</b>	<b>99</b>
Childhood	2	2	2	14	1	0	21	17
%	<b>9.5</b>	<b>9.5</b>	<b>9.5</b>	<b>66.6</b>	<b>4.7</b>	<b>-</b>	<b>100</b>	<b>81</b>
Total	2	3	10	79	10	5	109	104
%	<b>1.8</b>	<b>2.7</b>	<b>9.2</b>	<b>72</b>	<b>9.2</b>	<b>4.6</b>	<b>100</b>	<b>95.4</b>

**Table 19-24: Visual acuities in rod-cone dystrophies**

### 19.10.7 Inheritance

All cases were inherited in AR mode.

### 19.10.8 Birth Rank and Sequence of Patients

Table 19-26 enlists the rank and sequence of RC patients, and the ratio of affected to the total number of the sibship.

### 19.11 Vitreo-Retinopathies

This is a heterogeneous group of conditions which shared the presence of vitreo-retinal pathology. Each pedigree has its characteristic features with marked intra sibship variability in the extended pedigree (no. VR-04). The group comprised 12 patients belonging to 7 sibships part of 6 pedigrees. These are mainly concentrated in the WB as 10 with the patients coming from there. Only one pedigree with 1 sibship originates from the GS. Five of the patients belonged to a single pedigree with 2 sibships. There is also male predominance with 9 out of the 12 patients being males. Ten of the patients were <16.

Rod Disorders			
Patient No.	Rank and Sequence *	Ratio**	
<b>(A) Classical Leber's Congenital Amaurosis</b>			
<b>(1) Syndromatic</b> (West Bank except RC-38 from GS)			
RC-01-1,2	<b>MFm</b>	2:3	Slow mentation
RC-38-1-1& 2	fm-fcmmmmmf <b>MF</b> fm	2:12	Slow mentation
RC-03-1-1 &2	{m} <sup>*</sup> F <sup>**</sup> cc[f] <sup>c</sup> ccF <sup>**</sup> c	2:4	* cong. inguinal hernia **MSN
RC-02-1-1 & 2	ffmfc <b>FM</b> *	2:6	* mute, poor speech
RC-02-2	f <sup>c</sup> <b>M-M*M</b> -fc <b>M-M</b> -mccm	1:5	* abnormal dentition
<b>(2) Non syndromatic</b>			
RC-04-1	m <b>M</b> mfc	1:4	All from West Bank except RC 14 and RC18 from GS)  No. of affected to total sibships in LCA 25:77 = 1:3
RC-09-1	m <b>F</b> Fmfcf	2:7	
RC-13-1	mfm <b>F</b> mc	1:6	
RC-15-1	fff <b>F</b>	1:4	
RC-16-1	cmccfc <b>afMM</b> Ca	3:8	
RC-40-1	f <b>MF</b> Mmfc	3:6	
RC-14-1	<b>FF</b> mmffcm <b>F</b>	3:8	
RC-14-2	missing	n/a	
RC-18-1	f-mm <b>MF</b>	2:4	
<b>(B) Congenital Rod-Cones with Retinal Changes</b> (All from WB except RC-10, RC-25 and RC-34 from GS)			
<b>(1) Syndromatic/other associated</b>			
RC-08-1	f-f-fcff-mcm <b>MF</b> c	1:5	Slow mentation, very shy
RC-11-2-1 & 2	<b>F</b> f-f <b>MF</b> cm	3:5	Slow mentation, very shy
RC-36-1	Mmf <b>M</b>	1:4	slow learner, poor memory
RC-34-1	<b>M</b> - <sup>a</sup> (sm) <b>F</b> - <sup>a</sup> <b>M</b> <sup>ab</sup>	3:4	<sup>a</sup> delayed milestones <sup>b</sup> MR
RC-40-1- 1 to 3	f <b>M</b> <sup>ab</sup> <b>FM</b> <sup>ac</sup> mfc	3:6	<sup>a</sup> undescended testes <sup>b</sup> slow mentation <sup>c</sup> bright, bat ears, extra digit in hand
RC-32-1-1 &2	<b>M</b> *fm <b>F</b>	2:5	* sits at corner with hands

			between thighs
RC-37-4- 1 to 4	<b>M*cmfMFF</b>	4:6	*bad tempered, undisciplined
RC-33-1	Cccc <b>M*mfmfmf-F- mmfM</b>	3:10	* pectus cavus, long thin webbed digits, hyperextended joints, hypertelorism
RC-35-1- 1 to 3	<b>MMfmM*fF*</b>	3:7	* very obese
RC-11-1	fm-m <b>Ffmmfmf</b>	1:9	prominent teeth
RC-21-1	c <b>F*M</b> (sf)	2:2	* cleft palate
RC-19-1-1 & 2	<b>FMcF*</b> cfm-m	2:5	* atopy
RC-33-2	m-m(fccmf-fm <b>F*</b>	2:7	
RC-10-1	f-mfff <b>MF*</b> mmf <b>Mf</b>	3:11	* excessive hands/feet sweating
RC-25-1, 1 to 5	<b>MF</b> ffmmf <b>FfMF</b> mfcf	5:15	All trichomegaly
<b>(2) With no associations</b>			
RC-05-1-1 to 3	ffm-ffc <b>mfMMmF</b>	3:10	
RC-07-1	fmfc <b>FmFf</b>	2:7	
RC-11-3	<b>FmF</b>	2:3	
RC-12-1	<b>FMFf</b>	1:4	
RC-16-1	cmccfc <b>afMMcFa</b>	3:6	
RC-17-1-1	<b>M</b>	1:1	
RC-39-2	<b>F</b>	1:1	
RC-20-1	Fff <b>mFF</b>	2:6	
RC-21-2	ff <b>mFf</b> -m	1:5	
RC-22-1	N/a	n/a	
RC-23-1	<b>FMF</b> mff	2:6	
RC-24-1	cmm- <b>MfmMcFm</b>	3:8	
RC-27-1	c <b>Mm</b>	1:2	
RC-30-1- 1 to 3	smacff <b>mfFFM</b> ccfm	3:10	
RC-30-2- 1 & 2	<b>MM</b> cccccc	2:2	
RC-30-3-1	mfmfmffmm <b>cM</b> cccc	1:9	
RC-31-1- 1 to 3	<b>MM</b> mfssmm <b>fMf</b>	3:9	

RC-37-1-1 & 2	m-mf-ffm <b>MM</b> mmcm-	2:8	
RC-37-2-1 & 2	m-mcmcf- <b>F</b> mmfcm <b>F</b>	2:11	
RC-37-3-1	<b>F</b>	1:1	
RC-47-1	<b>MmFmM</b>	2:5	
No. of affected to total sibships ratio in cong. RC 83:231= 1:2.8			
<b>(B) Childhood onset rod-cone dystrophies</b>			
RC-31-1	<b>M*</b> Mmfssmmf <b>Mf</b>	3:9	* mentally subnormal, hysteric
RC-40-1-1 & 2	<b>FMF*</b> Mmfc	3:6	* dull mentation
RC-41-1	mmmf- <b>Ff</b> -mf	1:6	MSN, slow speech, extra digit
RC-43-1	<b>M*</b> mmf <b>F*</b> Mccfm	2:8	* obese. SNM, hypertelorism
RC-52-1	ffmm <b>M</b> fff	1:8	deaf, dull
RC-51-1	FM- <b>FMFf</b>	3:6	deaf mute
RC-54-1 to 4	m <b>FF</b> mmfm <b>FmM</b>		deaf mute
RC-45-1-1 & 2	mf <b>M</b> fff	1:6	deaf mute
RC-42-1	n/a	n/a	facial asymmetry
RC-44-1	{f}*m-m-m-{m}*{f-}m{m}* {f}*( <b>F</b> ){ <b>M</b> }*(m)m <b>F</b> {m}*	3:11	* accidental death
RC-28-1	<b>FmFm</b> ff-f-f-mm*	2:7	* died: several causes, measles
RC-48-1	<b>Mm</b> <sup>j</sup> f- <sup>*</sup> mff	1:4	* cot death age 3 months
RC-49-1	m <b>Fm</b> f{mm} <sup>*</sup> f	1:7	* myopic twins.
RC-50-1	{ <b>F</b> }f{f-}{m} <sup>a</sup> <b>M</b> -{ <b>F</b> -}{ <b>F</b> -}[ <b>M</b> -] ]m[ <b>M</b> ] <sup>*</sup> fff	6:12	* cause undocumented <sup>a</sup> albino
RC-46-1	mcf-m-m-f- <b>M</b> mmf <b>FmFf</b> <sup>i</sup>	3:10	Affected to total sibships and ratio in childhood onset RC 36:117 = 1:3
RC-55-1	f-f <b>M</b> ff- <b>Mm</b>	2:5	
RC-29-1	fm <b>M</b> cccffmcc <b>M</b>	2:7	
RC-29-1	fm <b>M</b> cccffmcc <b>M</b>	2:7	
Affected to total sibships numbers and ratio in the total 144:425 = 1:3			

\* Refer to codes used in sibships notation section 6.3 for the key to symbols used.

\*\* Affected to total living siblings or living and dead siblings if affected with the same condition

**Table 19-25: Rod cone dystrophies: patients' sequence, ratios**

### 19.12 Isolated Macular Degenerations

In this group the macula is affected in isolation in the absence of any generalised psycho-physiological and morphological photoreceptor involvement. It comprises 12 pedigree and 13 sibships with 22 patients affected with different types of macular degeneration of congenital and childhood onset. The following clinical patterns were exhibited in these 22 patients.

1. Congenital-onset central chorioretinal dystrophy associated with high myopia, <sup>696</sup> (5 siblings).
2. Childhood onset MD with high myopia ranging from -6.00 to -14.00 dioptries in 3 siblings.
3. Atrophic MD with localised pigment clumping in 5 patients from three unrelated sibships.
4. Vitelliform macular degeneration showing 'fried egg appearance'.
5. Stargard MD in 3 patients from 2 unrelated sibships (All from the WB).
6. Juvenile MD
  - (a) With macular flecks (1 patient),
  - (b) Without macular flecks (1 patient).
7. Macular degeneration with ultra thin RPE showing the choroidal vessels (1 patient).
8. Macular degeneration secondary to idiopathic macular pucker (1 patient).

The majority of these patients (77%) presented with visual impairment. They had better visual acuities than the rest of the RD with the mode and average in category '2'. Two patients were in category '3' and a further 2 in category '4'.

The age of these patients ranged from a few months to 45 years. 17 of the patients presented with visual impairment.

Orthoptically, 7 patients had concomitant squint. In 5 this was divergent and associated with limitation of movement. In one case with convergent squint, Duane's retraction syndrome type 1 was found. None of the patients had nystagmus.

## Retinal Dystrophies

### **I. Generalised disorders of the cone and rod systems**

#### **A. Predominantly cone disorders**

1. Cone dystrophies
  - i. Syndromatic: maxillary hypoplasia
  - ii. Non-syndromatic
2. Cone-rod dystrophies
  - i. Syndromatic
    - a. amelogenesis imperfecta
      - i. Congenital onset with macular degeneration
      - ii. Childhood onset without macular degeneration
    - b. Mental subnormality
  - ii. Non-syndromatic
3. Congenital amaurosis of the cone-rod<sup>681</sup>
  - i. Syndromatic: congenital hypertrichosis
  - ii. Non-syndromatic
4. Stationary disorders (achromatopsia)

#### **B. Predominantly rod dystrophies**

1. Rod Cone Disorders
  - i. Congenital onset
    - a. Classical Leber's congenital amaurosis (LCA)
    - b. Congenital onset with retinal changes
  - ii. Childhood-onset rod-cones
2. Stationary and undetermined

### **II. Macular dystrophies/degenerations (MD)**

1. Congenital-onset central chorioretinal dystrophy with myopia<sup>696</sup>
2. Childhood onset MD with high myopia
3. Atrophic MD with localised pigment clumping
4. Vitelliform MD
5. Stargard MD
6. Juvenile MD (several phenotypes)
7. MD secondary to macular pucker

### **III. Vireo-retinopathies**

**Table 19-26: Clinical phenotypes of retinal dystrophies.**

Types of Retinal Dystrophies												
Retinal Dystrophies	<16						All Ages					
	WB	GS	OPT	WB	GS	OPT	WB	GS	OPT	WB	GS	OPT
<b>Cone Dystrophies</b>												
CD	3	<b>3.6</b>	3	<b>4.7</b>	6	<b>4.0</b>	8	<b>5.6</b>	4	<b>4.0</b>	12	<b>4.8</b>
CRD	6	<b>7.2</b>	23	<b>35.9</b>	30	<b>19.9</b>	8	<b>5.6</b>	38	<b>37.6</b>	47	<b>18.8</b>
RM	7	<b>8.4</b>	15	<b>23.4</b>	23	<b>15.2</b>	9	<b>6.3</b>	23	<b>22.8</b>	33	<b>13.2</b>
Total Cones	16	<b>19.3</b>	41	<b>64.1</b>	59	<b>39.1</b>	25	<b>17.4</b>	65	<b>64.4</b>	92	<b>36.8</b>
<b>Mixed Types</b>												
CACR	8	<b>9.6</b>	0	<b>0.0</b>	8	<b>8</b>	11	<b>7.6</b>	0	<b>0.0</b>	11	<b>4.4</b>
Cong RCD	41	<b>49.4</b>	12	<b>18.8</b>	54	<b>41</b>	67	<b>46.5</b>	19	<b>18.8</b>	88	<b>35.2</b>
Total Mixed	49	<b>59.0</b>	12	<b>18.8</b>	62	<b>49</b>	78	<b>54.2</b>	19	<b>18.8</b>	99	<b>39.6</b>
<b>Rod Dystrophies</b>												
Child'd RCD	3	<b>3.6</b>	2	<b>3.1</b>	6	<b>4.0</b>	17	<b>11.8</b>	3	<b>3.0</b>	21	<b>8.4</b>
SNB	3	<b>3.6</b>	0	<b>0.0</b>	3	<b>2.0</b>	3	<b>2.1</b>	0	-	3	<b>1.2</b>
Total RCD	6	<b>7.2</b>	2	<b>3.1</b>	9	<b>6.0</b>	20	<b>13.9</b>	3	<b>3.0</b>	24	<b>9.6</b>
<b>Others</b>												
MD <sup>a</sup>	5	<b>6.0</b>	8	<b>12.5</b>	13	<b>8.6</b>	10	<b>6.9</b>	12	<b>11.9</b>	22	<b>8.8</b>
VR <sup>b</sup>	7	<b>8.4</b>	1	<b>1.6</b>	8	<b>5.3</b>	11	<b>7.6</b>	2	<b>2.0</b>	13	<b>5.2</b>
Total Others	12	<b>14.5</b>	9	<b>14.1</b>	21	<b>13.9</b>	21	<b>14.6</b>	14	<b>13.9</b>	35	<b>14.0</b>
<b>Total series</b>	83	<b>100</b>	64	<b>100</b>	151	<b>100</b>	144	<b>100</b>	101	<b>100</b>	250	<b>100</b>

<sup>a</sup> Macular degeneration. <sup>b</sup> Vitreoretinopathy. Percentages in bold italic

**Table 19-27: Proportions of the types of retinal dystrophies**

### 19.13 Degenerative Myopia

The third subgroup in the genetic retina cohort is degenerative myopia with 25 patients; 8 from the WB and 17 from the GS. Both gender were equally represented in the WB but there was male preponderance in the GS (ratio 0.3:1). The prevalence, per 100,000, was 1, 3.8 and 2 in the WB, GS and the total OPT respectively (Table 19-28).



**Conditions Associated with Myopic Refraction (Table 19-28)**

Reference No.		Age	Refr <sup>†</sup>	VA	Sequence **	Ratio**	Clinical Remarks/Keys to sequence
<b>1. Secondary corneal causes</b>							
ACQ-10	GS	17	-5.00	2	Mffmmmmmf <u>M</u>	1:10	Bilateral corneal scarring from VC
ACQ-20	WB	27	-16	4	Csf <u>E</u>	1:2	Iatrogenic/surgical corneal scar
ACQ-23	WB	7	-6	3	<u>F</u> f	1:2	ROP
<b>2. Anterior segment Dysgenesis</b>							
ASD-01-1-1&2	WB	10, 19	-5.5, -2.5	3, 3	<u>M</u> <sup>a</sup> <u>M</u> -fm-F-FcF- <u>MM</u> fmF	8:13	Also in 2 <sup>nd</sup> cousins. ACS, MC (10mm), Reiger-like. <sup>a</sup> also small ONH, VC.
<b>3. Microphthalmia, coloboma</b>							
CB-02-1-1	WB	16	-4	2	Fmmfm <u>EM</u> mfm	2:11	MC (R8/L9), total coloboma
CB-06-1-1	WB	5	-2.25	1	(c) <u>M</u> m	1:2	Rt incomplete uveal cb. Lt: ONH/macular cb.
MC-12-1-1 & 2	GS	8, 7	-20, -23	4, 7	Fm <u>M</u> <sup>a</sup> <u>F</u> bcf	2:5	MC, cataract. <sup>a</sup> Rt. faint post. cortical, Lt. dense subluxated. <sup>b</sup> unilateral cataract, MSN.
MC-13-2-1	GS	7	-3	3	mm <u>F</u> ff-ccc	1:5	MC (R9/L9), cornea plana, sclerasation, iop+

Reference No.		Age	Refr <sup>†</sup>	VA	Sequence **	Ratio**	Clinical Remarks/Keys to sequence
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#### 4. Congenital Glaucoma

CG-04-1-3	GS	11	-14	2	f-ffm-ff <b>FF</b> ff <b>F</b> cm	3:12	PCG, buphthalmos, ↑ iop
CG-08-1-2	WB	19	-17	3	mmm <b>MM</b>	2:5	PCG, buph., ectopia uveae, Lt cataract
CG-26-1-1	WB	15	-1.5	1	<b>M</b> cmff <b>E</b> c <b>F</b> f <b>M</b>	4:8	PCG: asymmetric buphthalmos
CG-31-1-2	WB	24	-3	2	{f-} <b>M</b> f <b>M</b> F[m-f]ff~f	2:9	PCG, buphthalmos
CG-40-1-1	GS	8	-2	2	n/a		PCG: bilateral drainage, glaucomatous OA
CG-42-1-1	GS	3	-4	1	n/a		PCG buph.
MY-04-1-2	WB	20	-6	1	m-ccm-f <b>M</b> cccmmcm (sf) <b>E</b> m cc	2:8	MC, muscular dystrophy, ksc (Brother <b>M</b> : myopia, bilat. ocular trauma ksc, club feet
MY-05-1-1	GS	12, 7	-4, -11	4, 4	f({ <b>E</b> )} <sup>a</sup> m-[f*] <b>F</b> fm[f] <sup>b</sup> .	2:8	<sup>a</sup> albinoid, green iris <sup>b</sup> no vi, nldo
MY-05-2-1	GS	34	-11	1	ff <b>M</b> <sup>a</sup> fmfm	1:8	<sup>a</sup> MY-05-1 father. Non-consanguineous Unilateral myopia, tilted disc, ?new mutation
MY-06-1-1 to 4	GS	20, 16, 12, 9	-49, -18, -12, -10	4	<b>M</b> <sup>a</sup> -f <b>F</b> f <b>M</b> fmm	4:9	<sup>a</sup> also msn
MY-07-1-1	WB	19	-18	1	mffffff- <b>{m}</b> <sup>a</sup> f- <b>F</b> [ff] <sup>b</sup>	1:9	<sup>a</sup> esotropia. <sup>b</sup> twins died age 9yr post pyrexia

Reference No.		Age	Refr <sup>†</sup>	VA	Sequence **	Ratio**	Clinical Remarks/Keys to sequence
MY-08-1-1	GS	17, 14, 9	-10, -12, -11	1, 2, 2	f(f-)mmMMmmfMm	3:11	<b>M</b> : also CC, msn ?aetiology and inheritance
MY-09-1-1	WB	14	-20	1	fmmmm{sss} <sup>a</sup> mM	1:7	<sup>a</sup> triplet stillbirth. No consanguinity
MY-10-1-1	GS	24	-22	4	fffffffffmmM	1:15	LE: glaucoma, trauma. Rt phth. non-consang
MY-13-1-2	WB	21	-23	4	MmmFf{Em-} <sup>a</sup>		<sup>a</sup> cong. blindness, AE, inflamm. aetiology
MY-20-1-1 to 3	WB	8, 6, 4	-10, -10, -15	7, 4, 3	mfMMcMm	3:6	With VR, flat ERG ? Wagner, hypoplastic macula. Patient (3) also Lt Rdet
MY-21-1-1	GS	18	-11	2	ffmmmf-MM	2:8	Myopia , hypoplastic macula, ONH cb
MY-CC-45-1-1	GS	83	-5	4	n/a		CC, AD
NY-01-1-4-	GS	11	-3	3	sf-FMff{f} <sup>a</sup> {m}Fm	3:9	CIN, myopic fundus. <sup>a</sup> mute
NY-03-1-1	OPT	19	-3	1	FffffffFmM <sup>a</sup>	1:11	CIN, Lt megalopapilla. <sup>a</sup> also had meningitis
<b>5. Retinal Conditions</b>							
<b>a. Albinism</b>							
ALB-06-1&2	WB	10,12	-5, -9	2	FffffFfMf	5:11	OCA
<b>b. Cone and cone-rod dystrophies</b>							
CD-03-01-1	WB	20	8	2	mfffm-fMm-fm	1:8	CD with macular degeneration

Reference No.		Age	Refr <sup>†</sup>	VA	Sequence **	Ratio**	Clinical Remarks/Keys to sequence
CR-01-06-2	GS	29	-1	4	f-f-f[F]mFFMM	2:5	CRDAI
CR-01-12-1	GS	11	-5	3	<u>E</u> mFmmM	1:6	CRDAI
CR-01-15-1	GS	19	-1	3	m-ffm-f-f-f-cc <u>M</u> f	1:4	CRDAI
CR-04-01-2	GS	24	-2	3	mFm-m-m-f-f- <u>M</u> fFmm	1:7	CRD-CD with macular cb
CR-05-02-1	WB	40	-4	2	<u>M</u> ffffmmmmM	2:11	?MD with PR, ?CRD: adult onset
CR-08-01-1	WB	9	-2	2	m{f} <sup>a</sup> MfMf	2:6	CRD-BBS: NB, op atr, hypogonadism, polydactyly, obesity, MR. <sup>a</sup> cs/amblyopia
<b>c. Rod-monochromatism (achromatopsia)</b>							
RM-01-1-1	GS	41	-7	2	Mm-ff-fmmFcfm	2:8	RM: ?Perivascular rpea
cRM-02-1-1 & 2	GS	19, 3	-10, -5	2, 2	mfMfFffmmMF	4:12	
RM-02-4-1	GS	22.	-9	2	ff- <u>F</u> fff-mmm-	1:6	
RM-04-1-2	GS	10.7	-4	2	Mf-fmf-f-MFm-MFfM	6:9	
RM-06-1-1	WB	11	-5	3	mf- <sup>a</sup> fmamFfmm	1:8	<sup>a</sup> died from measles age 15months
<b>d. Rod-cone dystrophies</b>							
RC-11-2-1 to 3	WB	11, 5, 3	-4, -3, -4	4, 4, 7	Ff-fMFcm	3:5	AMD

Reference No.		Age	Refr <sup>†</sup>	VA	Sequence **	Ratio**	Clinical Remarks/Keys to sequence
RC-11-3-1	WB	24	-5	4	FmF	2:3	AMD
RC-25-1-2 & 5	GS	26	-1	4	<b>MF</b> ffmmf <b>FfMF</b> mfcf	5:15	AMD
RC-25-1-5	GS	11	-2	4	<b>MF</b> ffmmf <b>FfMF</b> mfcf	5:15	LCA
RC-28-1-1	WB	17	-4	4	FmFmff- <sup>a</sup> f- <sup>a</sup> [f-] <sup>b</sup> mm	2:7	AMD, child'd onset RP, mother and 3 aunts blind from the same condition. <sup>a</sup> cause of death unknown. <sup>b</sup> died from measles
RC-30-1-1	WB	19	-3	4	smacffmf <b>FFM</b> ccfm	3:10	AMD
RC-30-2-1 & 2	WB	9	-3	3	<b>MM</b> cccccc	2:2	AMD (other sibships with the condition)
RC-30-3-1	WB	16	-9	4	mfmfmffmmc <b>M</b> cccc	1:9	AMD
RC-35-1-1 to 3	WB	21, 20, 17	-1, -7,-4	4	m <b>M</b> fm <b>MfE</b>	3:7	AMD
RC-40-1-2	WB	8	-7	4	f <b>MF</b> Mmfc	3:6	AMD, ED, ?dull, CC (lens aspiration)
RC-42-1-1	WB	19	-2	4	n/a	1:7	AMD
RC-45-1-1	OT	12	-1	4	mf <b>M</b> fff	1:6	AMD
RC-46-1-2	WB	20	-1	1	mcf-m-m-f- <b>M</b> <sup>a</sup> mmf <b>F</b> <sup>b</sup> fm <b>F</b> f	3:10	<sup>a</sup> Childhood RP, Lt amblyopia, tubular vision. <sup>b</sup> mild MD, Lt amblyopia, tubular vision
RC-52-1-1	WB	31	-2	4	ffmm <b>M</b> fff	1:8	Childhood onset RP

Reference No.		Age	Refr <sup>†</sup>	VA	Sequence **	Ratio**	Clinical Remarks/Keys to sequence
Rod-03-1-1	WB	12	-2	2	fEmmff	1:6	Stationery night blindness
<b>e. Macular degenerations</b>							
MD-04-1-1	WB	27	-2	2	mffmM	1:5	JMD, central rpea with pigment clumps
MD-05-1-2	WB	17	-1	2	ff-cm-cFcFffmcm	2:8	JMD with flecks, normal CV (? Stargard)
MD-06-1-1	WB	14	-1	2	mm(m-f)fmfmffF	1:11	JMD, few flecks, VC. () died from measles
MD-09-1-1 to 5	GS	12	-10	2	mFfFMfff-ccccMfM	6:12	Cong. central chorioretinal dystrophy <sup>696</sup>
MD-11-1-1	GS	9	-11	2	mfcMMc	1:4	Two visually impaired siblings from two separate conditions. 1 <sup>st</sup> Cousin marriage
MD-12-1-1 to 3	GS	20	-6	2	M <sup>a</sup> [f]m <sup>-b</sup> u <sup>-c</sup> mfmfM{f} <sup>d</sup> Mc mF	3:11	Early onset. <sup>a</sup> 7m prem. <sup>b</sup> died 3days, <sup>c</sup> died 2 hr, <sup>d</sup> ED
<b>f. Vitreo-retinopathies (VR)</b>							
VR-04-1-1	WB	16, 13	-15, -10	3, 3	MfMf	2:4	Marfan with VR
<b>6. Miscellaneous Syndromatic</b>							
SY-02-1-1	GS	18, 8	-16, -14	3, 3	MmmfmfmMff	2:10	EL, Rt advanced glaucoma, uncontrolled iop
SY-02-2-1	GS	43	-3	4	mF(m-)M <sup>a</sup>	2:3	<sup>a</sup> 02-1's father. EL, Lt phthisis, Rt glaucoma
SY-04-1-1	GS	24	-2	5	FMmccc	1:3	Glaucoma with macular coloboma

Reference No.		Age	Refr <sup>†</sup>	VA	Sequence **	Ratio**	Clinical Remarks/Keys to sequence
SY-08-1-1	WB	8	-4	2	uuuuuu	2:6	
SY-10-1-1	GS	30	-21	4	m-ccm-fMcccmm fsF m fcc	3:10	Plus ocular trauma, kyphoscoliosis, club feet
SY-11-1-1	GS	6	-20	4	mffmmffmmcmMm	1:12	Apert syndrome
SY-13-1-1	WB	6	-10	7	mmmF	1:5	EL: HCU, msn, +ve nitroprusside test.
SY-16-1-1	GS	8	-9	3	ccmf{f-} <sup>a</sup> mfm- <sup>b</sup> mM <sup>c</sup> fcf f-	1:8	<sup>a</sup> cot death 8m, ED. <sup>b</sup> died 3m. <sup>c</sup> dysmorphic, msn, Rt undesc.testes, ED, bulgy sternum
SY-20-1-1	WB	13	-2	4	MmmmMff	2:7	(1) Tower skull, OA, CC (aphakia), corneal opacity, ?LCA. (2) buphthalmos
SY-24-1-1	WB	13	-10	2	Mmmf{m} <sup>a</sup> fm	1:7	EL, hypoplastic scrotom and testicles, flat feet, feminine complexions, course scalp hair (absent in other sibs) <sup>a</sup> abnormal testes

† refr: refraction. \* Refer to codes used in sibships notation section 6.3 for the key to symbols used.

\*\* Affected to total living siblings or living and dead siblings if affected with the same condition.  
opt atro: optic atrophy. refrac: refraction.

**Table 19-28: Conditions associated with myopia**

### 9.14 Summary of Associated Conditions in the Whole Series

Associated genetic conditions and medical problems were commoner in the hereditary cohort than the acquired conditions. Tables 19-29, 19-30 and 13-31 show some of the important associations in the series.

Categories of Associated Genetic Condition in 669 Patients						
	Hereditary		Childhood		Total Series	
	Cohort = 519		Cohort = 54		Cohort 669	
Mentation	44	<b>8.5</b>	2	<b>3.7</b>	51	<b>7.6</b>
Neuromuscular	34	<b>6.5</b>	1	<b>1.8</b>	38	<b>5.7</b>
Dentition	52	<b>10</b>	0	-	55	<b>8.29</b>
Skeletal	23	<b>4.4</b>	1	<b>1.8</b>	25	<b>3.8</b>
Head/Facial	44	<b>8.5</b>	0	-	46	<b>6.9</b>
Medical Problems	37	<b>7</b>	1	<b>1.8</b>	40	<b>6</b>
Total	234	<b>45</b>	5	<b>9.3</b>	255	<b>38</b>

Percentages in bold italic

**Table 19.29: Types and numbers of the associated conditions**

Case No.	Sex	Age <sup>a</sup>	VA	Clinical Remarks
ON-24-1-1	M	1.6	4	Epileptic, impaired speech, spastic, hydrocephaly (shunted) poor thrive
RD-RC-05-1-1	M	15	4	Epileptic
RD-RC-41-1-1	F	10	4	Epileptic, slow speech, MSN, extra digit
RD-RC-45-1-1	M	11	4	Epileptic
RD-CR-09-01-1	F	9	4	Epileptic; grand and petit mal, MR, ?Batten disease

<sup>a</sup> Age at examination

**Table 19-30: Cases with epilepsy**

<b>Associated Genetic and Medical Condition in 669 Patients</b>		
<b>Condition</b>	<b>Nos.</b>	<b>%</b>
<b>General Development</b> – developmental delay	4	<b>0.57</b>
<b>Mentation</b> Ranged from educational subnormality to marked MR	9	<b>1.35</b>
<b>Hearing and speech</b>		
Deaf mutism	3	-
Hearing deficit	7	-
Mutism	1	-
Speech disorders	4	-
Subtotal	15	<b>2.2</b>
<b>Dentition</b>		
Amelogenesis imperfecta (associated with CRD)	34	<b>5</b>
<b>Skeletal</b>		
Microcephaly	1	<b>0.15</b>
Tower skull	2	<b>0.3</b>
Large head circumference	2	<b>0.3</b>
Small head circumference	1	<b>0.15</b>
Hypertelorism	3	<b>0.45</b>
Hypoplastic zygoma and proptosis	1	<b>0.15</b>
Hypoplastic maxilla	8	<b>1.2</b>
High arched palate	2	<b>0.3</b>
Cleft plate	1	<b>0.15</b>
Kyphosis (1 with club foot, 1 short stature, 1 ksc)	3	<b>0.45</b>
Long fingers (1 with hyperextensible joints)	3	<b>0.45</b>
Stubby fingers	2	<b>0.3</b>
Distal phalanx malformation	1	<b>0.15</b>

Proximal/distal IP joints nodules both hands, convex nails	1	<b>0.15</b>
Congenital dislocation of the hip	2	<b>0.3</b>
Subtotal	33	<b>5</b>
<b>Neuromuscular</b>		
Muscle dystrophy	2	<b>0.3</b>
Limb weakness	2	<b>0.3</b>
Spasticity	4	<b>0.6</b>
Paraplegia	1	<b>0.15</b>
Meningocele	1	<b>0.15</b>
Waddling gait and poor balance	1	<b>0.15</b>
Choreotic hand movement and lateral head movements	1	<b>0.15</b>
Friedreich ataxia	1	<b>0.15</b>
Epilepsy 3	3	<b>0.45</b>
Subtotal	16	<b>2.4</b>
<b>Skin and Appendices</b>		
Pre auricular skin tags	1	<b>0.15</b>
Skin appendices on face	1	<b>0.15</b>
Trichomegaly, 2 of them with congenital hypertrichosis	6	<b>0.9</b>
White forelock	1	<b>0.15</b>
Sublingual cyst	1	<b>0.15</b>
Subtotal	10	<b>1.5</b>
<b>Genitalia</b>		
Hypoplastic scrotum and testicles 1	1	<b>0.15</b>
Total	122	<b>18.2</b>

**Table 19-31: List of the associated genetic and medical conditions in the series**