CHAPTER 2

CORNEAL TRANSPLANTATION

Editors:
Dr. Shamala Retnasabapathy
Dr. Choong Yean Yaw
Dr. Michael Law Sie Haur

Expert Panel:
Dr. Shamala Retnasabapathy (Chair)
Dr. Choong Yean Yaw (Co-chair)
Dr. Jonathan Choon Siew Cheong
Assoc. Prof. Dr. Cordelia Chan Mei Lan
Dr. Chuah Kay Leong
Dr. Michael Law Sie Haur
Dr. Mariam Ismail
Assoc. Prof. S C Reddy
Dato' Dr. Veera Ramani
Dr. Sahimi Sulaiman

Contents

List of Tables

List of Figures

2.0 INTRODUCTION

Cornea transplantation surgery allows restoration of vision in patients with corneal blindness. Corneal transplantation in Malaysia dates back to the 1970's. Today it is widely performed by ophthalmologists throughout the country both in the government and private sectors with each centre maintaining its own data. Until recently there was no central data collection on a standardised format.

The National Transplant Registry (NTR) was established in November 2003. The cornea transplant section of the NTR was given the task of establishing a systematic centralised data collection centre for all cornea transplantation performed in the country.

A total of 43 centres registered and agreed to provide information on retrospective and prospective cornea transplant activities. A total of 30 contributing surgeons participated in the NTR – Corneal Transplant section. Participation was voluntary.

Retrospective data (from 1998 to 2003) on cornea transplant activities were collected to identify the trend of cornea transplant surgery in the past few years. Retrospective data collected was recorded on the **Retrospective Cornea Transplant Notification Form**. This was limited to *minimal data set* which were i) demographic data, ii) type of cornea transplant surgery and iii) primary diagnosis for cornea transplantation. All surgeons agreed to provide all information required in the retrospective cornea transplant notification form.

Prospective data (from the year 2004) on cornea transplant activities involved gathering information on all cornea transplants performed in Malaysia on two forms. The i) **Cornea Transplant Notification Form** is completed at the time of surgery and the ii) **Cornea Transplant Outcome Form** is completed at the end of 12 months and annually thereafter. Most surgeons sent a complete data set in 2004 as required in the prospective Cornea Transplant Notification Forms. Some surgeons chose to provide only minimal data set as per the retrospective cornea transplant notification forms.

The Corneal section of the NTR will be discussed under **3** sections.

Section 2.1 and *Section 2.2* will cover data over 7 years from 1998 to 2004. Effort was made to ensure that all cases of cornea transplantation were reported. To the best of our knowledge, this report provides information on all cornea transplants.

Section 2.3 will only cover prospective data (*from 2004*) from surgeons who sent a complete data set.

2.1 CORNEA TRANSPLANT ACTIVITIES AND TRENDS (1998 – 2004)

The number of cornea transplants performed showed an increasing trend from 119 in 1998 to 221 in 2001, following which there was a slight decline in 2003 and 2004 (Table 2.1.1).

Penetrating keratoplasty was the most frequent type of cornea transplant surgery and was performed in 94% of cases (Table 2.1.2).

Table 2.1.1: New Transplant Rate per million population (pmp), 1998– 2004

Year	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
New transplant	119	122	126	221	203	165	174
New transplant rate pmp	5	5	5	9	8	7	7

Figure 2.1.1: New Transplant Rate per million population (pmp), 1998-2004

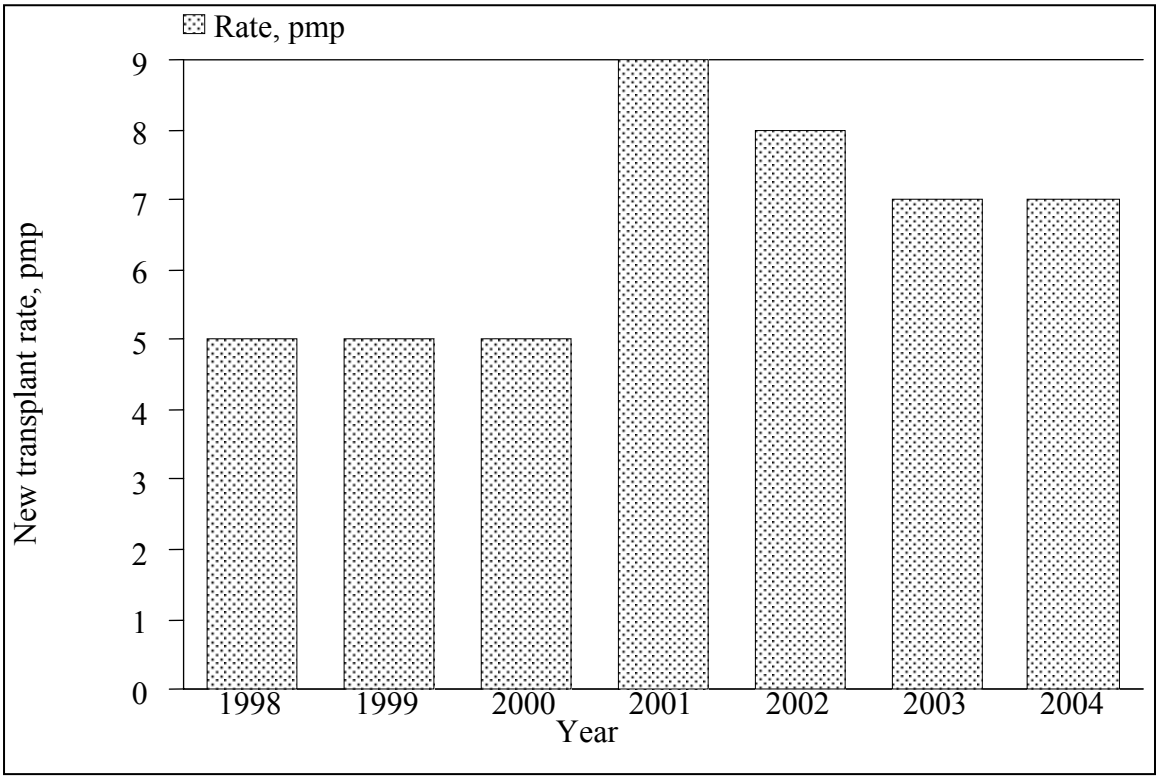


Table 2.1.2: Types of Cornea Transplant, 1998-2004

Year	**1998**		**1999**		**2000**		**2001**	
	No.	%	No.	%	No.	%	No.	%
Penetrating Keratoplasty	114	96	116	95	120	95	206	93
Lamellar Keratoplasty	1	1	5	4	4	3	14	6
Others	0	0	1	1	1	1	1	1
No data	4	3	0	0	1	1	0	0
TOTAL	119	100	122	100	126	100	221	100

Year	**2002**		**2003**		**2004**		**TOTAL**	
	No.	%	No.	%	No.	%	No.	%
Penetrating Keratoplasty	196	97	156	95	156	90	1064	94
Lamellar Keratoplasty	5	2	8	5	10	6	47	4
Others	0	0	1	0	8	4	12	1
No data	2	1	0	0	0	0	7	1
TOTAL	203	100	165	100	174	100	1130	100

2.2 RECIPIENTS' CHARACTERISTICS

There was a preponderance of male recipients each year and this ranged from 60% to 69% (Table 2.2.1, Figure 2.2.1).

Ethnic Chinese (39%) were the predominant race undergoing cornea transplant surgery followed by Malays (32%) and Indians (23%) (Table 2.2.2, Figure 2.2.2).

The mean age was 45 years (SD 21) with a range from as young as 2 months of age to as old as 92 years (Table 2.2.3, Figure 2.2.3).

The primary indications for surgery were cornea scars (17%), keratoconus (16%), microbial keratitis (16%), other (non-pseudophakic) bullous keratopathy (14%), cornea perforation (11%), pseudophakic bullous keratopathy (10%) and failed previous cornea grafts (9%). Corneal dystrophy (5%) and congenital opacity (1%) were the least common indications (Table 2.2.4, Figure 2.2.4).

Table 2.2.1: Gender distribution, 1998-2004

Year	**1998**		**1999**		**2000**		**2001**		**2002**		**2003**		**2004**		**TOTAL**	
Gender	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	78	66	80	66	81	64	143	65	122	60	114	69	105	60	723	64
Female	41	34	42	34	45	36	78	35	81	40	51	31	69	40	407	36
TOTAL	119	100	122	100	126	100	221	100	203	100	165	100	174	100	1130	100

Figure 2.2.1: Gender distribution, 1998-2004

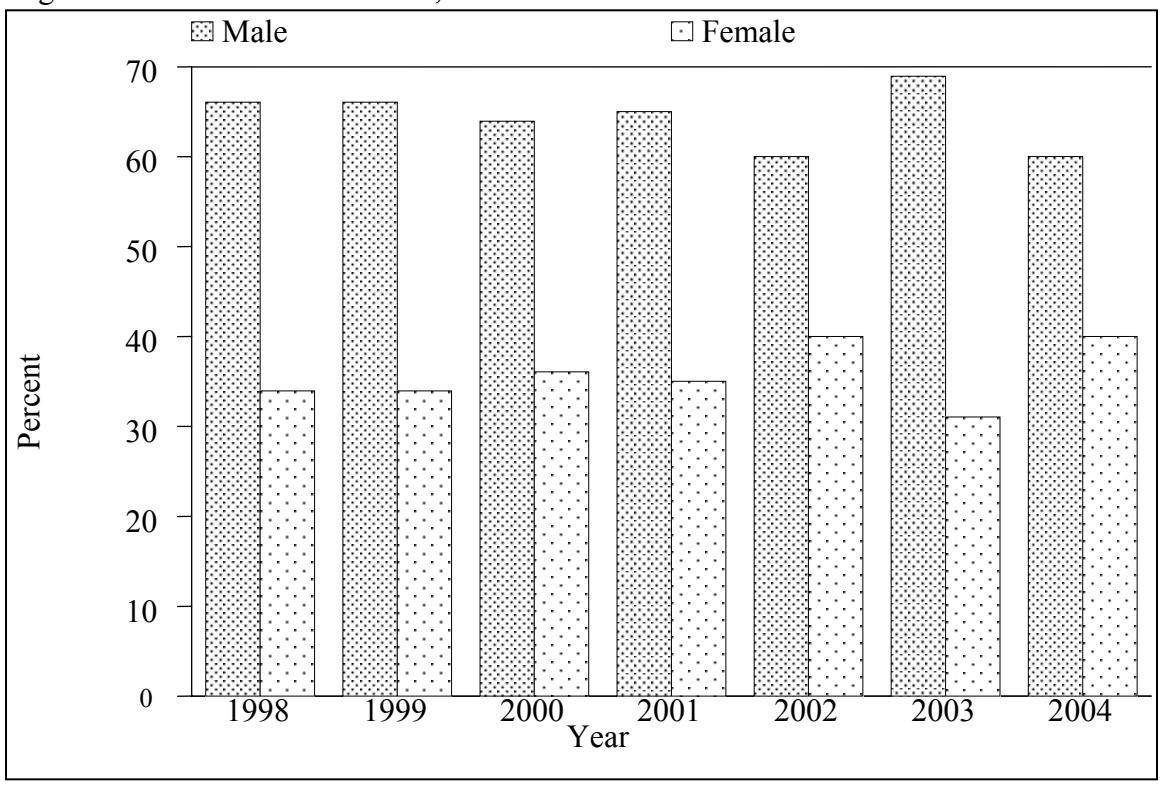


Table 2.2.2: Ethnic distribution, 1998-2004

Year	1998		1999		2000		2001	
Ethnic group	No.	%	No.	%	No.	%	No.	%
Malay	28	24	34	28	41	32	70	32
Chinese	47	39	46	38	50	40	92	42
Indian	36	30	35	28	28	22	49	22
Bumiputra Sabah	0	0	0	0	0	0	0	0
Bumiputra Sarawak	0	0	0	0	0	0	1	0
Others*	8	7	7	6	6	5	5	2
No data	0	0	0	0	1	1	4	2
TOTAL	119	100	122	100	126	100	221	100

Year	2002		2003		2004		TOTAL	
Ethnic group	No.	%	No.	%	No.	%	No.	%
Malay	74	36	52	31	65	37	364	32
Chinese	83	41	67	40	52	30	437	39
Indian	35	17	34	21	40	23	257	23
Bumiputra Sabah	0	0	0	0	1	1	1	0
Bumiputra Sarawak	0	0	0	0	4	2	5	0
Others*	9	5	11	7	10	6	56	5
No data	2	1	1	1	2	1	10	1
TOTAL	203	100	165	100	174	100	1130	100

*Others: Non Malaysian

Figure 2.2.2: Ethnic distribution, 1998-2004

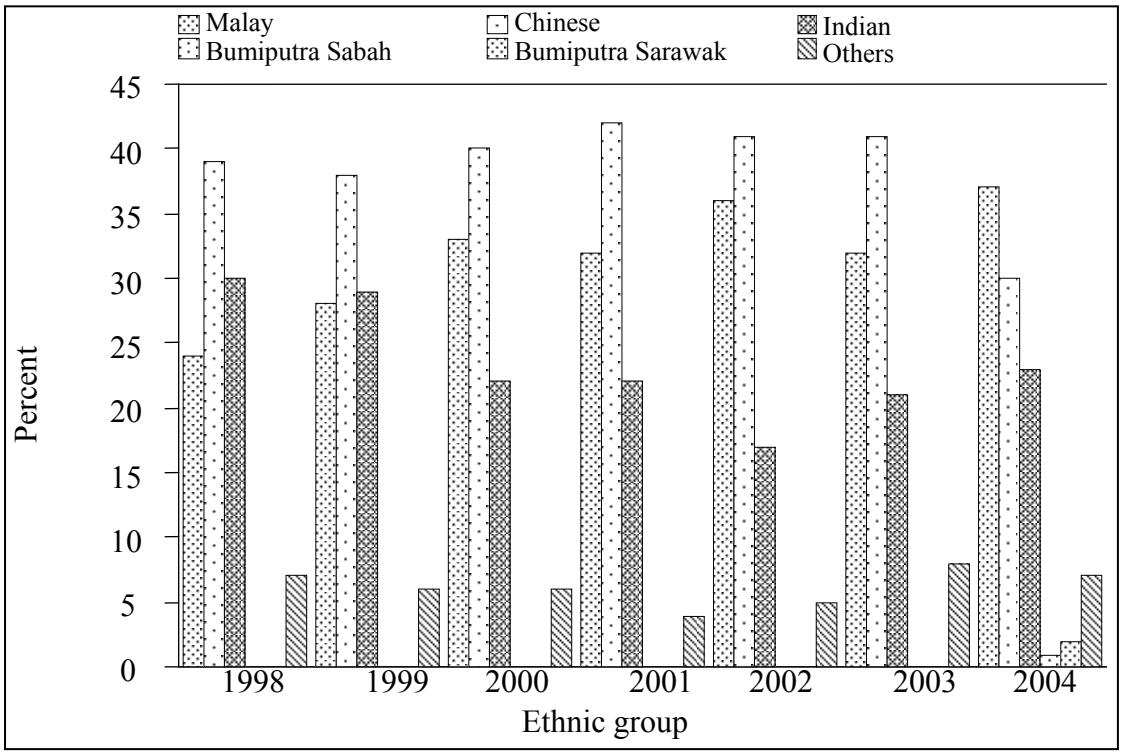


Table 2.2.3: Age distribution of cornea transplant recipient patients, 1998-2004

Year	**1998**		**1999**		**2000**		**2001**		**2002**		**2003**		**2004**		**TOTAL**	
Age group (years)	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-9	4	3	5	4	9	4	6	4	6	3	44	4	6	5	8	4
10-19	13	11	17	14	16	8	21	13	14	8	119	11	9	7	29	13
20-39	28	24	34	28	53	26	36	22	51	29	285	25	34	27	49	22
40-59	38	32	32	26	57	28	51	31	50	29	329	29	40	32	61	28
>=60	36	30	34	28	68	34	51	31	53	31	353	31	37	29	74	33
TOTAL	119	100	122	100	203	100	165	100	174	100	1130	100	126	100	221	100
Mean	45		43		44		45		46		45		45		45	
SD	21		22		20		21		21		21		21		21	
Median	45		43		45		50		46		46		45		45	
Minimum	4 months		5		3 months		5 months		1		5 months		2 months		2 months	
Maximum	82		92		86		85		86		84		86		92	

*Age=date of transplant - date of birth

Figure 2.2.3: Age distribution of cornea transplant recipient patients, 1998-2004

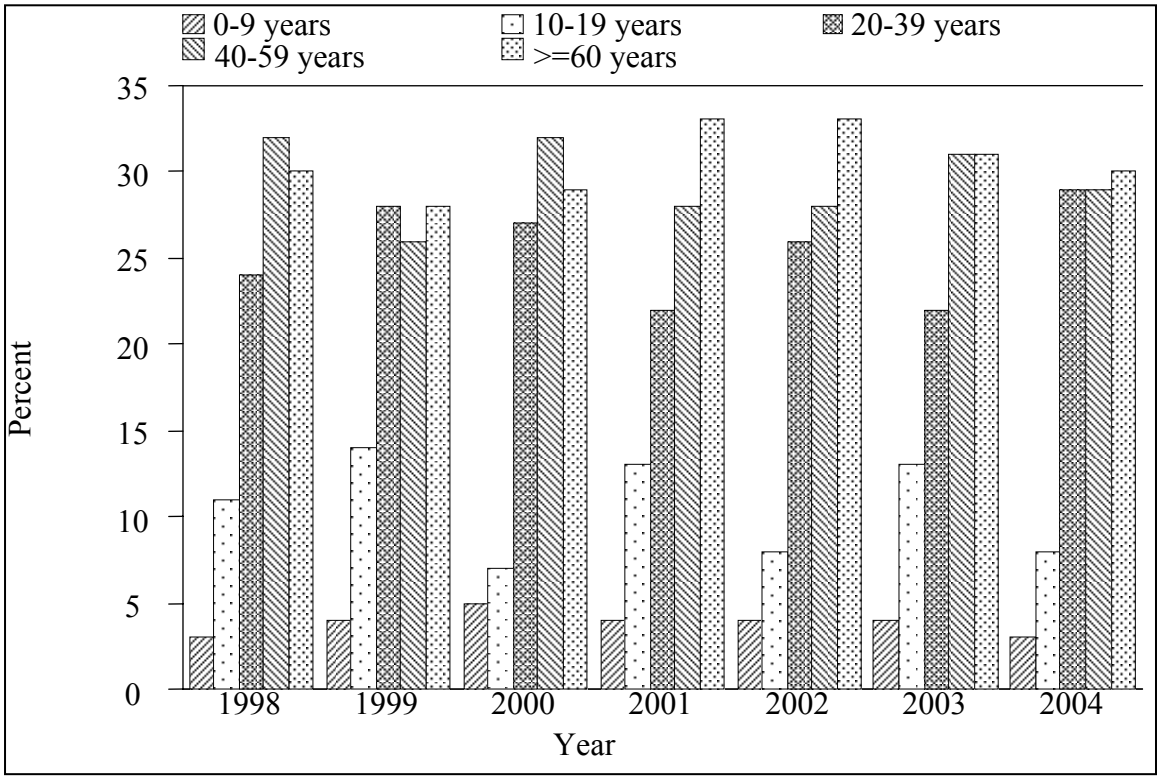


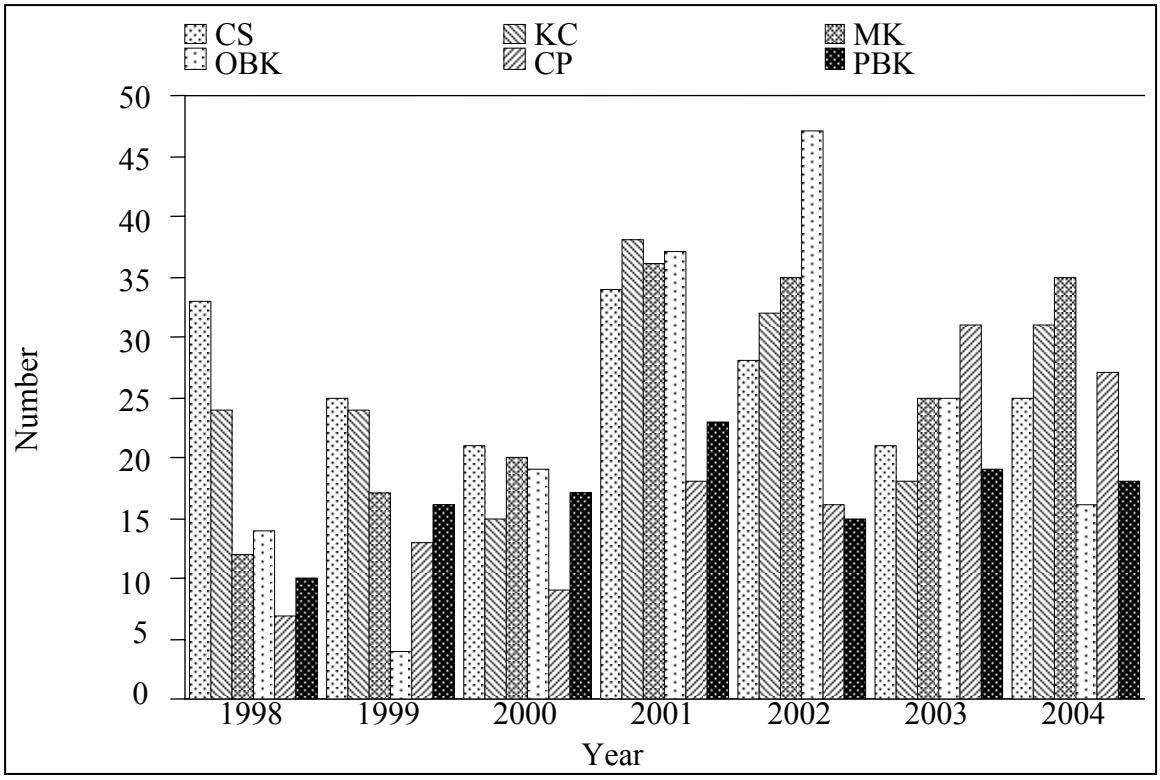
Table 2.2.4: Primary diagnosis, 1998-2004

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)	
Primary Diagnosis	No.	%	No.	%	No.	%	No.	%
Corneal scar	33	28	25	20	21	17	34	15
Keratoconus	24	20	24	20	15	12	38	17
Microbial keratitis	12	10	17	14	20	16	36	16
Other (non pseudophakic) bullous keratopathy	14	12	4	3	19	15	37	17
Corneal perforation	7	6	13	11	9	7	18	8
Pseudophakic bullous keratopathy	10	8	16	13	17	13	23	10
Failed previous graft	14	12	12	10	13	10	17	8
Corneal dystrophy	5	4	6	5	5	4	12	5
Congenital opacity	1	1	1	1	1	1	1	0
Others	3	3	8	7	7	6	15	7
No data	0	0	2	2	1	1	1	0

Year	2002 (N=203)		2003 (N=165)		2004 (N=174)		TOTAL (N=1130*)	
Primary Diagnosis	No.	%	No.	%	No.	%	No.	%
Corneal scar	28	14	21	13	25	14	187	17
Keratoconus	32	16	18	11	31	18	182	16
Microbial keratitis	35	17	25	15	35	20	180	16
Other (non pseudophakic) bullous keratopathy	47	23	25	15	16	9	162	14
Corneal perforation	16	8	31	19	27	16	121	11
Pseudophakic bullous keratopathy	15	7	19	12	18	10	118	10
Failed previous graft	15	7	14	8	12	7	97	9
Corneal dystrophy	9	4	7	4	8	5	52	5
Congenital opacity	0	0	1	1	8	5	13	1
Others	14	7	10	6	29	17	86	8
No data	0	0	0	0	1	1	5	0

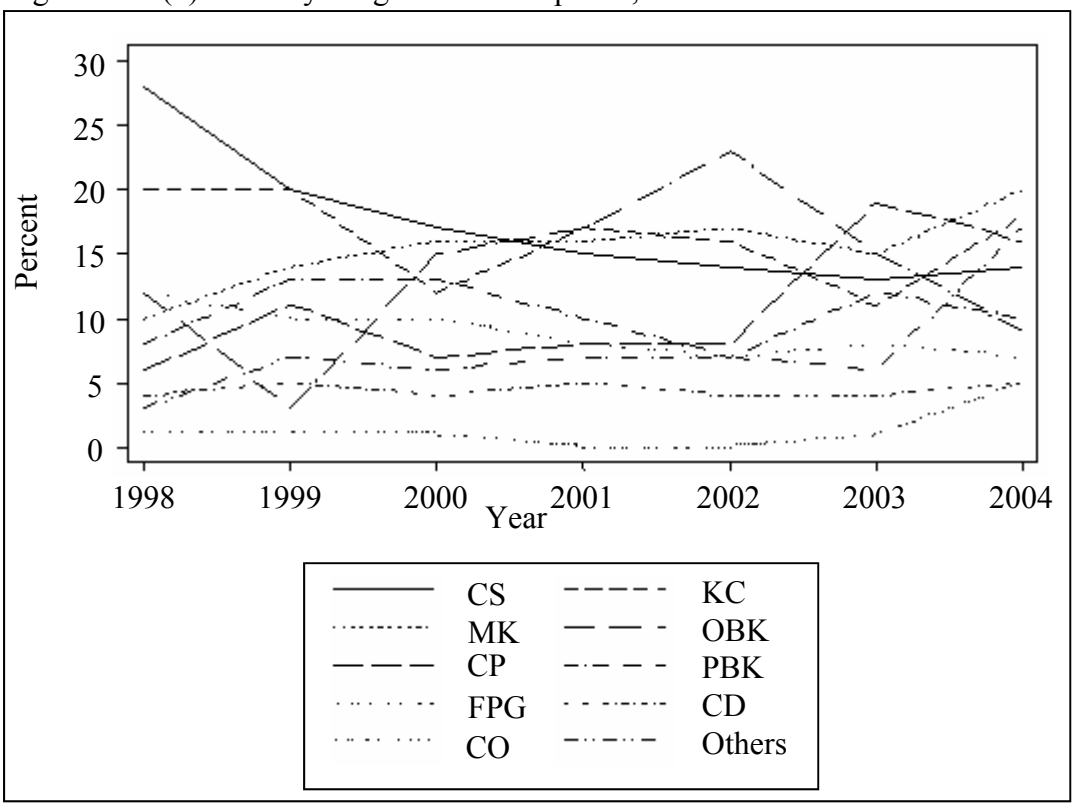
*1053 patients have 1 primary diagnosis, 71 have 2 primary diagnoses, 1 patient had 3 diagnoses

Figure 2.2.4(a): Primary Diagnosis in Recipients, 1998-2004



CS=Corneal Scar
KC=Keratoconus
MK=Microbial keratitis
OBK=Other (non pseudophakic) bullous keratopathy
CP=Corneal perforation
PBK=Pseudophakic bulluos keratopathy

Figure 2.2.4(b): Primary Diagnosis in Recipients, 1998-2004



CS=Corneal Scar
KC=Keratoconus
MK=Microbial keratitis
OBK=Other (non pseudophakic) bullous keratopathy
CP=Corneal perforation
PBK=Pseudophakic bullous keratopathy
FPG=Failed previous graft
CD=Congenital opacity
CO=Corneal dystrophy

2.3 TRANSPLANT DATA 2004

There were a total of 174 cornea transplants performed in the year 2004. This section reports a total of 138 cases (cases that provided a complete data set).

2.3.1: Pre - transplant data

There may be one or more indications for cornea transplant surgery. The most frequent indication was ***optical*** (62%), followed by ***tectonic*** (26%) and/or ***therapeutic*** indications (25%) (Table 2.3.1.1). *Re-grafts* were performed in 11% of cases (Table 2.3.1.2). *Corneal vascularisation* (57%) was the most frequently encountered pre-operative ocular co-morbidity. *Glaucoma (raised intraocular pressure)* was present in 22% of cases preoperatively. 30% of eyes had ocular inflammation at the time of surgery and 1% had a known history of prior blood transfusion (Table 2.3.1.3). *82% of cases were legally blind* (vision 3/60 or worse) prior to cornea transplantation (Table 2.3.1.4).

Table 2.3.1.1: Indications of cornea transplant, 2004

Indication of transplant	**No.**	**%**
Optical	85	62
Tectonic	36	26
Therapeutic	34	25

*121 patients have 1 indication for transplant, 17 patients have 2 indications

Figure 2.3.1.1: Indications of cornea transplant, 2004

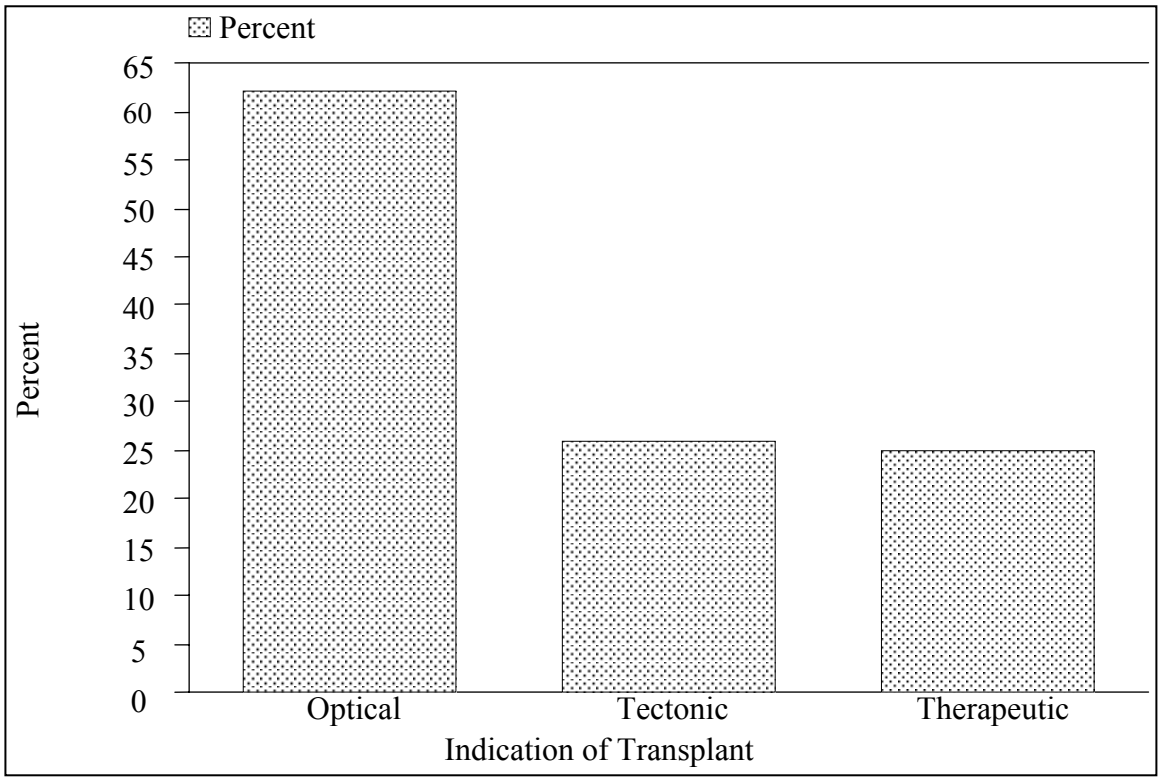


Table 2.3.1.2: Number of previous grafts in grafted eye, 2004

Graft Number (N=138)	No.	%
0	123	89.1
1	11	8.0
2	3	2.2
3	0	0.0
4	1	0.7

Figure 2.3.1.2: Number of previous grafts in grafted eye, 2004

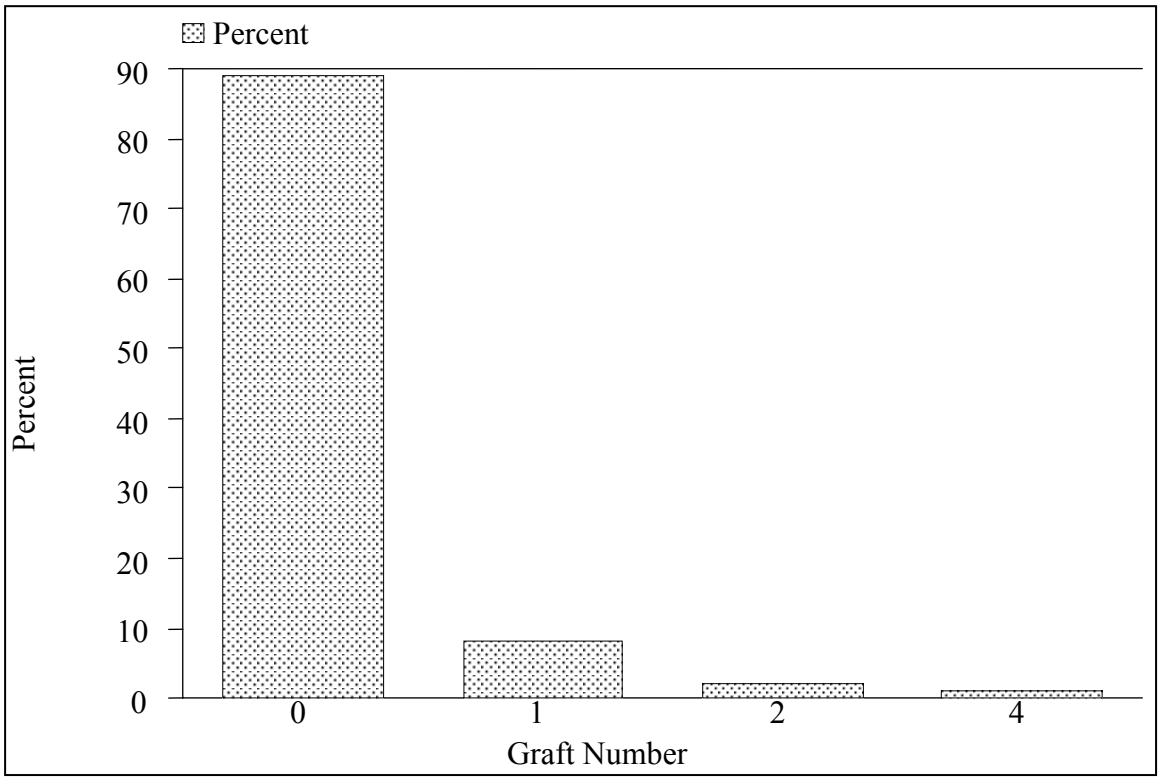


Table 2.3.1.3: Ocular co-morbidity, 2004

Ocular co-morbidity (N=138)	**No.**	**%**
Any ocular co-morbidity (a to d below)	90	65
a) Cornea vascularisation	79	57
• Superficial vascularisation	44	32
• Deep vascularisation	43	31
b) History of glaucoma	30	22
c) Current ocular inflammation	42	30
d) Previous blood transfusion	1	1

*patients have multiple ocular co-morbidity

Table 2.3.1.4: Pre-operative vision, 2004

Unaided VA (N=138)	**No.**	**%**
6/6	3	2.2
6/9	1	0.7
6/12	0	0.0
6/18	0	0.0
6/24	3	2.2
6/36	3	2.2
6/60	7	5.1
5/60	1	0.7
4/60	3	2.2
3/60	2	1.4
2/60	1	0.7
1/60	4	2.9
CF	45	32.6
HM	46	33.3
PL	15	10.9
No data	4	2.9

2.3.2: Donor details

Eye Banks in the United States of America (USA) were the most frequent sources, donating 69% of the corneal tissues (Table 2.3.2.1). The majority of donors were elderly patients with a median age of 59 years (Table 2.3.2.2). Optisol GS was the commonest cornea tissue storage medium used at 88% (Table 2.3.2.3). The major causes of death of the donors were related to the cardiac or circulatory system (33%) followed by causes related to the cerebrovascular system (15%) and malignancy (14%) (Table 2.3.2.4).

Table 2.3.2.1: Source of Donor Cornea Tissue, 2004

Source of donor (N=138)	**No.**	**%**
Local	20	14.5
USA	95	68.8
Sri Lanka	22	15.9
No data	1	0.7
If Local, ethnic group:		
• Malay	0	0
• Chinese	14	70
• Indian	5	25
• No data	1	5

Figure 2.3.2.1: Source of Donor Corneal Tissue, 2004

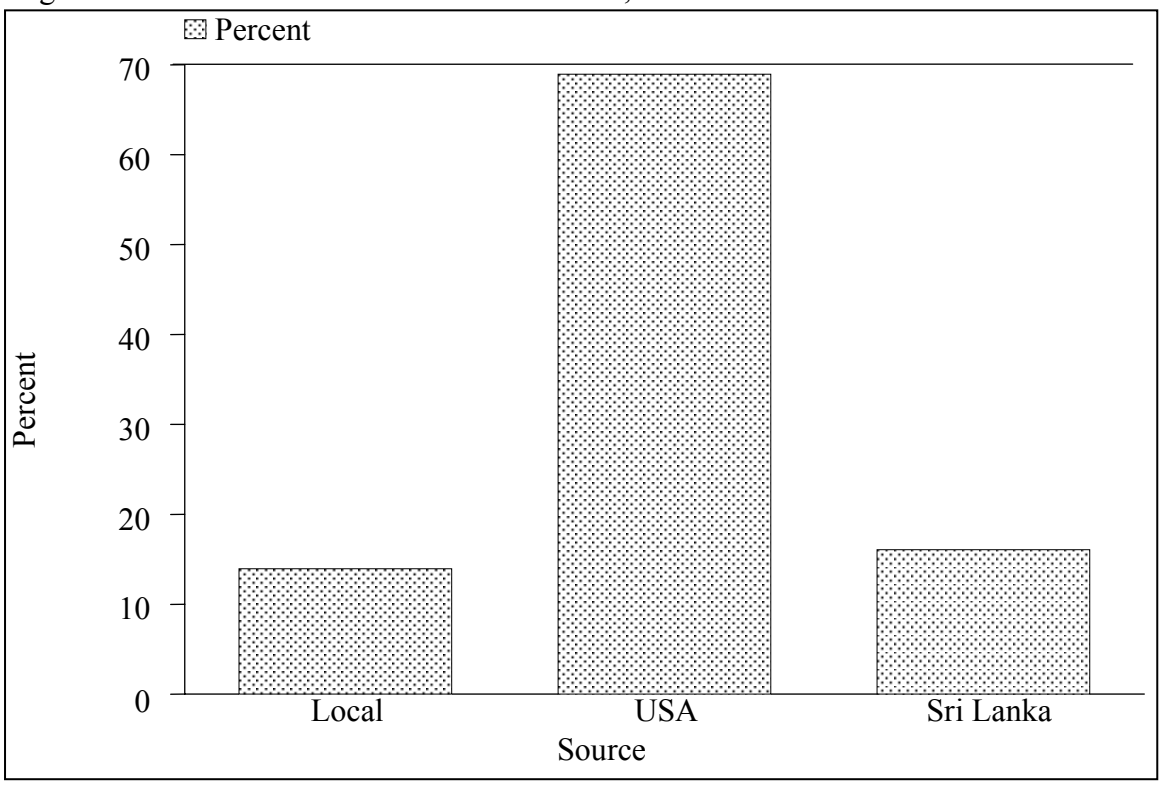


Table 2.3.2.2: Donor age distribution, 2004

Age group (years) (N=138)	**No.**	**%**
0-9	2	1.4
10-19	6	4.3
20-39	11	8.0
40-59	51	37.0
>=60	68	49.3
TOTAL	138	100
Mean	57	
SD	15	
Median	59	
Minimum	8	
Maximum	78	

Figure 2.3.2.2 (a): Donor age distribution, 2004

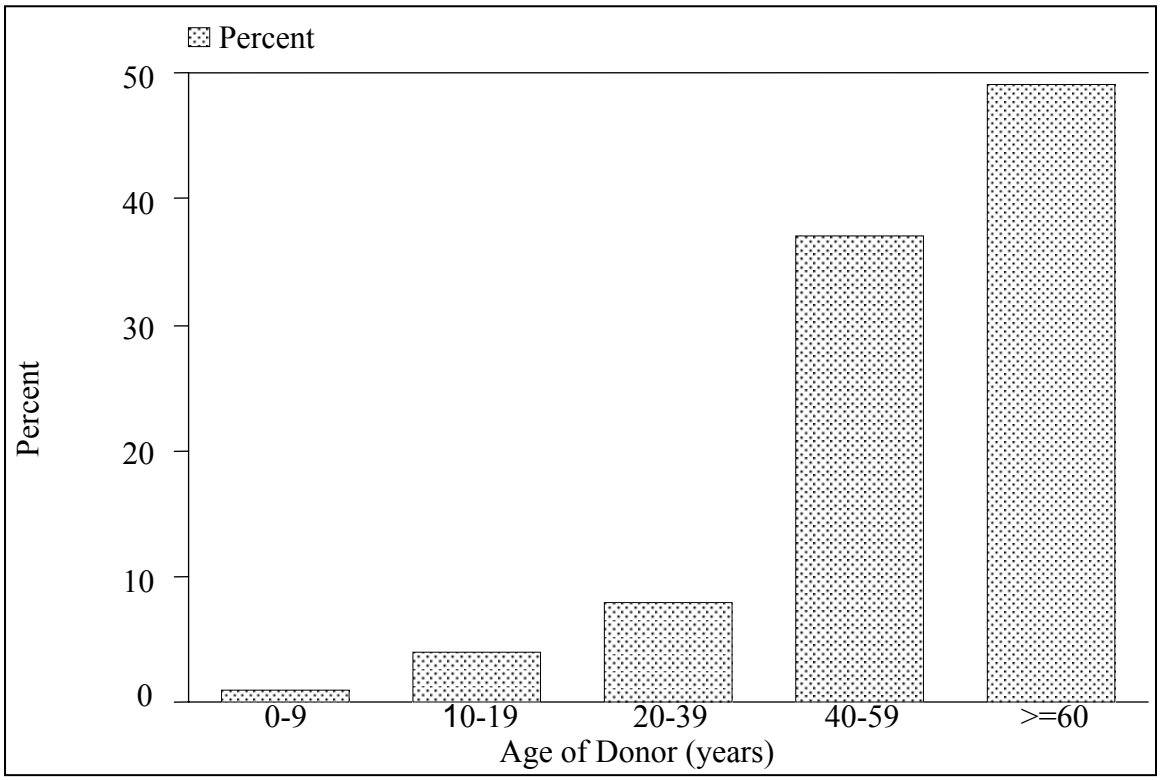


Figure 2.3.2.2 (b): Donor age distribution, 2004

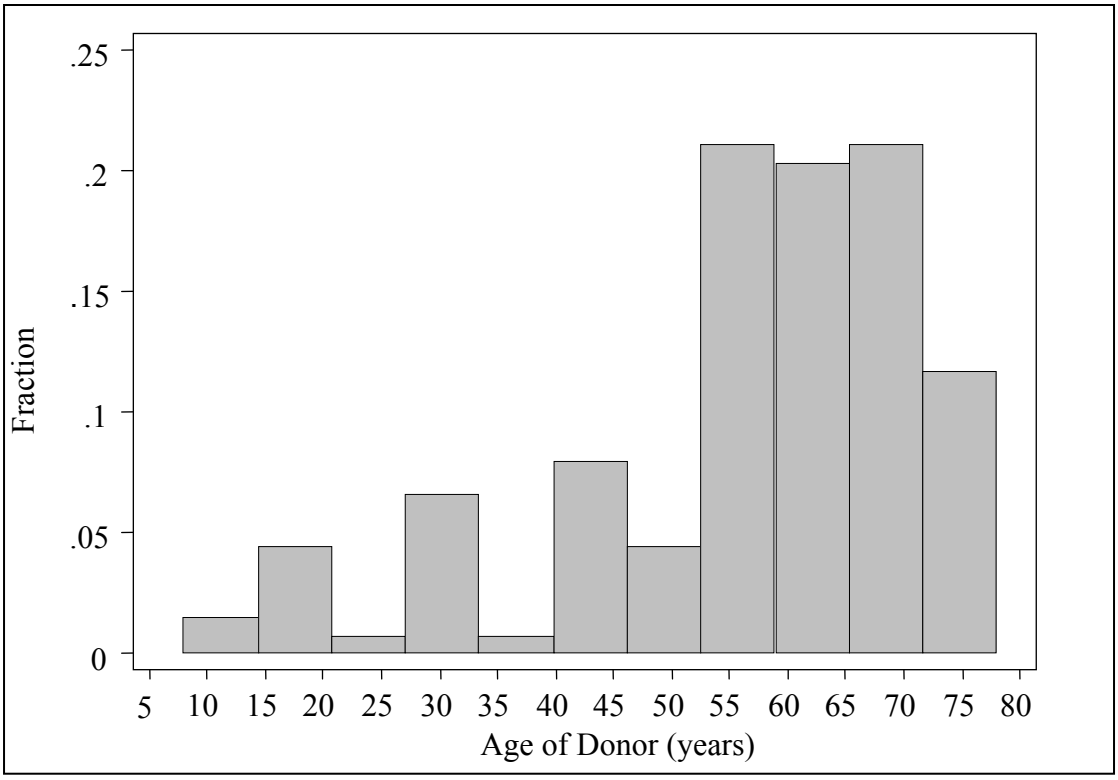


Table 2.3.2.3: Preservation media, 2004

Preservation media (N=138)	**No.**	**%**
Optisol GS	110	80
MK Medium	22	16
Moist Chamber	4	3
No data	2	1

Figure 2.3.2.3: Preservation media, 2004

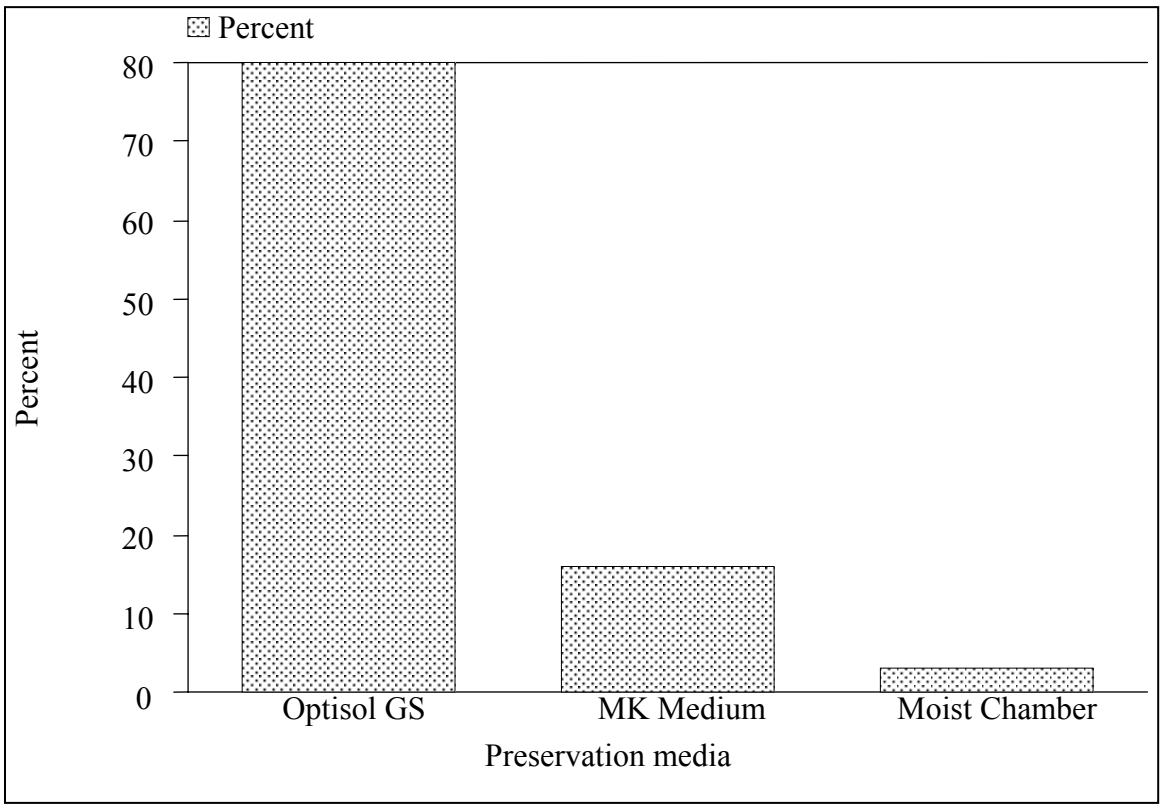
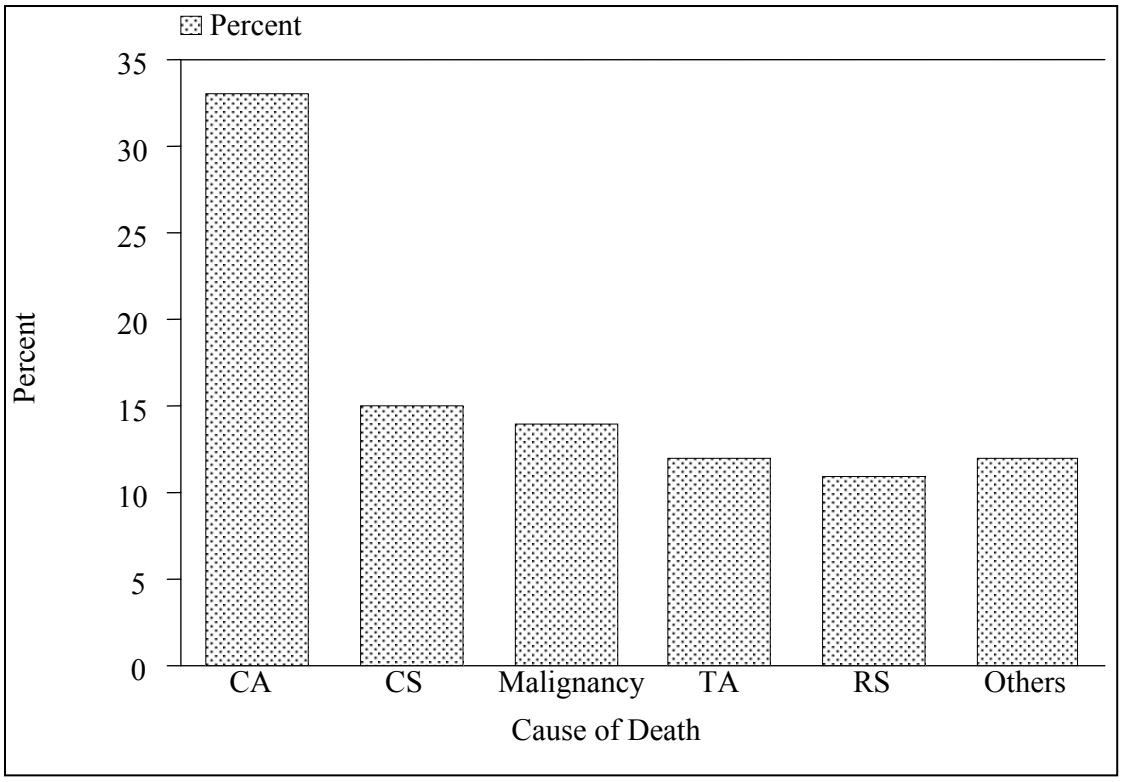


Table 2.3.2.4: Cause of death in cornea donors, 2004

Cause of death (N=138)	**No.**	**%**
Cardiac/Circulatory System	46	33.3
Cerebrovascular System	21	15.2
Malignancy	19	13.8
Trauma/Accident	17	12.3
Respiratory System	15	10.9
Others	17	12.3
No data	3	2.2

Figure 2.3.2.4: Cause of death in cornea donors, 2004



CA=Cardiac/Circulatory
CS=Cerebrovascular System
TA=Trauma/Accident
RS=Respiratory System

2.3.3: Transplant Practices

Penetrating Keratoplasty (PK) was the commonest type of surgery performed (87%) (Table 2.3.3.1). Cornea transplantation was performed in combination with other surgical procedures in 22% of cases. Cataract extraction, with or without intraocular lens implantation (IOL), was the commonest combined procedure (16 cases) (Table 2.3.3.2).

The recipient graft size ranged from 2mm to 10mm, with the mean recipient cornea graft size being 7.5mm (SD 1) (Table 2.3.3.3). 63.8% of cases had the donor tissue over-sized by 0.5mm (Table 2.3.3.4). The commonest suture technique was interrupted sutures (Table 2.3.3.5).

Table 2.3.3.1: Type of surgery, 2004

Type of surgery (N=138)	**No.**	**%**
Penetrating Keratoplasty	120	87.0
Lamellar Keratoplasty	13	9.4
Patch graft for cornea	3	2.2
Patch graft for sclera	2	1.4

Table 2.3.3.2: Type of Combined surgery, 2004

Combined surgery	**No.**
No. of patients with combined surgery	30 (22%)
(a) Glaucoma surgery	1
(b) Cataract extraction	16
(c) IOL	14
(d) Retinal surgery $\pm$ Internal tamponade	1
(e) Anterior vitrectomy	9
(f) Others	5

*14 patients had 2 other types of surgeries and 1 patient had 3 other types of surgeries, combined with the corneal transplant surgery

Table 2.3.3.3: Recipient Cornea Trephined Size, 2004

Graft size, mm	**No.**	**%**
2	1	0.7
3	0	0.0
4	1	0.7
5	0	0.0
5.5	1	0.7
6	3	2.2
6.25	0	0.0
6.50	2	1.4
6.75	1	0.7
7	25	18.1
7.25	10	7.2
7.50	35	25.4
7.75	10	7.2
8	19	13.8
8.25	4	2.9
8.50	6	4.3
8.75	0	0.0
9	9	6.5
9.25	0	0.0
9.50	0	0.0
9.75	0	0.0
10	1	0.7
No data	10	7.2
TOTAL	138	100
Mean	7.5	
SD	1	
Median	7.5	
Minimum	2	
Maximum	10	

Table 2.3.3.4: Difference in trephined sizes of recipient and donor corneas, 2004

Difference in Graft size, mm (N=138)	**No.**	**%**
Same size	9	6.5
0.25	28	20.3
0.5	88	63.8
0.75	1	0.7
1	1	0.7
2	1	0.7
No data	10	7.2

Table 2.3.3.5: Suture Technique, 2004

Suture Technique (N=138)	**No.**	**%**
Interrupted only	132	96
Continuous only	0	0
Combined	6	4

Figure 2.3.3.5: Suture Technique, 2004

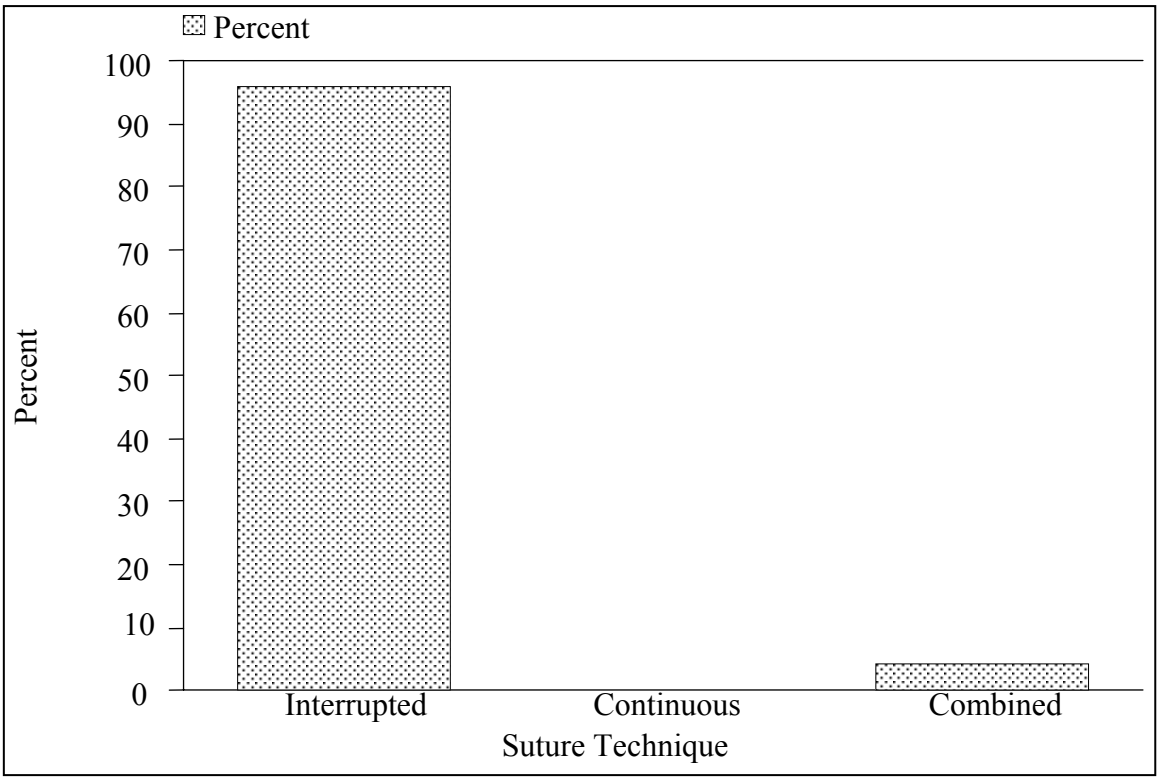


Figure 2.2.4 (b): Primary Diagnosis in Recipients, 1998-2004