

## **CHAPTER 2**

### **CORNEAL TRANSPLANTATION**

#### ***Editors:***

Dr Shamala Retnasabapathy  
Dr Chandramalar Santhirathelagan

#### ***Expert Panel:***

Dr Shamala Retnasabapathy (Chairperson)  
Dr Chandramalar Santhirathelagan  
Dr Choong Yean Yaw  
Dr Michael Law Sie Haur  
Prof Dato' Dr Veera Ramani  
Dr Thiageswari Umopathy  
Assoc Prof Dr Mohtar Ibrahim

#### **Contents**

#### **2.0 Introduction**

#### **2.1 Corneal Transplant Activities and Trends 1998-2009**

- Transplant Rates
- Type of Transplant

#### **2.2 Recipients' Characteristics 1998-2009**

- Demographics
- Primary Diagnosis

#### **2.3 Transplant Practices 2004 - 2009**

- Recipient Details
- Donor Details
- Transplant Practices

#### **2.4 Corneal Transplant Outcome 2004-2009**

- Outcome - Graft Survival
- Outcome – Vision

#### **2.5 Post Corneal Transplant Complications 2004-2009**

**List of Tables**

Table 2.1.1: Number of Corneal Transplantation and Transplant Rate per million population (pmp), 1998-2009 .....	4
Table 2.1.2: Types of Corneal Transplant, 1998-2009.....	4
Table 2.2.1: Gender Distribution, 1998-2009 .....	5
Table 2.2.2: Ethnic Distribution, 1998-2009.....	5
Table 2.2.3: Age Distribution of Corneal Transplant Recipient Patients, 1998-2009 .....	6
Table 2.2.4: Diagnosis, 1998-2009 .....	7
Table 2.2.5: Indications of Corneal Transplant, 2004-2009.....	8
Table 2.3.1.1: No of Previous Grafts in Grafted Eye, 2004-2009.....	9
Table 2.3.1.2: Ocular Co-morbidity, 2004-2009 .....	9
Table 2.3.1.3: Pre-operative Vision, 2004-2009 .....	10
Table 2.3.2.1: Source of Donor Cornea Tissue, 2004-2009.....	11
Table 2.3.2.2: Donor Age Distribution, 2004-2009 .....	12
Table 2.3.2.3: Preservation Media, 2004-2009 .....	12
Table 2.3.2.4: Cause of Death in Corneal Donors, 2004-2009 .....	13
Table 2.3.3.1: Types of Surgeries, 2004-2009 .....	13
Table 2.3.3.2: Types of Combined Surgeries, 2004-2009.....	13
Table 2.3.3.3: Recipient Cornea Trephine Size, 2004-2009 .....	14
Table 2.3.3.4: Difference in Trephined Sizes of Recipient and Donor Corneas, 2004-2009....	15
Table 2.3.3.5: Suture Technique, 2004-2009 .....	15
Table 2.4.1: Stock and Flow - Graft Status (Whole Database).....	16
Table 2.4.2.1: Graft Survival, 2004-2009.....	17
Table 2.4.2.2: Graft Survival by Optical and Non-optical Indication, 2004-2009.....	18
Table 2.4.2.3 Graft Success by Gender, 2004-2009.....	19
Table 2.4.2.4 Graft Survival by Age, 2004-2009 .....	20
Table 2.4.2.5: Causes of Graft Failure .....	21
Table 2.4.3.1: Availability of Data on Post Corneal Transplant Unaided Vision.....	22
Table 2.4.3.2 Unaided Visual Outcome After Cornea Transplant Surgery.....	22
Table 2.4.3.3 Unaided Vision for Optical and Non Optical Cases .....	23
Table 2.5.1: Post Transplant Complications .....	24
Table 2.5.2: Post Transplant Graft Rejection Types .....	24

**List of Figures**

Figure 2.3.2.1: Source of Donor Corneal Tissue, 2004-2009 .....	11
Figure 2.3.2.3: Preservation Media, 2004-2009 .....	12
Figure 2.4.2.1: Graft Survival, 2004-2009 .....	17
Figure 2.4.2.2: Graft Survival by Optical and Non-optical Indication, 2004-2009 .....	18
Figure 2.4.2.3 Graft Success by Gender, 2004-2009 .....	19
Figure 2.4.2.4 Graft Survival by Age, 2004-2009.....	20
Figure 2.4.3.2 Unaided Visual Outcome After Corneal Transplant Surgery .....	22
Figure 2.4.3.3 Cumulative Probability for Unaided Vision in Grafts .....	23

## 2.0 INTRODUCTION

Corneal transplantation surgery allows restoration of vision in patients with corneal blindness. Corneal transplantation in Malaysia dates back to the 1970's. Today it is performed by ophthalmologists both in the government and private sectors with each centre contributing data towards the National Transplant Registry.

The National Transplant Registry (NTR) was established in December 2003. The corneal transplant section of the NTR is a systematic centralised data collection of all corneal transplantations performed in the country.

A total of 46 centres registered and agreed to provide information on retrospective and prospective corneal transplant activities. A total of 75 contributing surgeons participated in the NTR – Corneal Transplant section. Participation was on a voluntary basis.

**Retrospective data** (from 1998 to 2003) on corneal transplant activities were collected to identify the trend of corneal transplant surgery in the recent past. **Prospective data** (from the year 2004) on corneal transplant activities involved gathering information on all cornea transplants performed in Malaysia on two forms. The first form is the i) **Corneal Transplant Notification Form (Form N-cds)** which is completed at the time of surgery and gathers information on the recipient, operative procedure and the donor. The second form is the ii) **Corneal Transplant Outcome Form (Form O-cds)** which is completed at the end of 12 months and annually thereafter. Follow-up only ceases upon failure of graft, death or loss to follow-up of the patient.

The Corneal section of the NTR will be discussed under 5 sections.

**Section 2.1** and **Section 2.2** cover notification data on corneal transplantation over 12 years from 1998 to 2009. Effort was made to ensure that all cases of corneal transplantation were reported. To the best of our knowledge, this report provides information on all corneal transplants performed in the country.

**Section 2.3** covers prospective notification data on corneal transplantation performed (from 2004 onwards)

**Section 2.4** covers prospective outcome data on corneal transplantation performed (from 2004 onwards).

**Section 2.5** covers prospective outcome data on corneal transplantation complications (from 2004 onwards).

**2.1 CORNEAL TRANSPLANT ACTIVITIES AND TRENDS (1998 – 2009)**

The annual number of corneal transplants performed between 1998 and 2009 ranged from 119 to 231. In 2009 the number of cases reported was 209 (Table 2.1.1). Penetrating keratoplasty was the most frequent type of transplant surgery performed (Table 2.1.2).

Table 2.1.1: Number of Corneal Transplantation and Transplant Rate per million population (pmp), 1998-2009

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
No. of new transplants	119	122	126	221	203	165	184	192	177	196	231	209
New transplant rate, pmp	5	5	5	9	8	7	7	7	7	7	8	7

Table 2.1.2: Types of Corneal Transplant, 1998-2009

Surgery type	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=2145)		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Penetrating Keratoplasty	114	96	116	95	120	95	207	94	196	97	156	95	165	90	173	90	153	86	175	89	189	82	173	83	1937	91	
Lamellar Keratoplasty	1	1	5	4	4	3	14	6	5	2	8	4	10	5	13	7	16	9	7	4	21	9	15	8	119	6	
Patch Graft for Corneal	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	1	5	3	10	5	12	5	9	4	41	2	
Patch Graft for Sclera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	2	1	1	0	4	0	
Cornea Scleral Keratoplasty	0	0	1	1	0	0	0	0	0	0	1	1	7	4	2	1	3	2	4	2	4	2	10	5	32	1	
Endothelial keratoplasty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	3	0	
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
No Data	4	3	0	0	2	2	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0

## 2.2 RECIPIENTS' CHARACTERISTICS

There was a preponderance of male recipients every year and this ranged from 60 % to 69% (Table 2.2.1). Ethnic Chinese (37%) were the predominant race undergoing corneal transplant surgery followed by Malays (32%) and Indians (22%) (Table 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 102 years (Table 2.2.3).

The commonest primary indication for surgery was keratoconus (17%) followed by corneal scar (14%), pseudophakic bullous keratopathy (14%), other non-pseudophakic bullous keratopathy (10%) and microbial keratitis (10%) (Table 2.2.4). There may be one or more indications for corneal transplant surgery. The most frequent indication was *optical*, followed by *tectonic* and/or *therapeutic* indications (Table 2.2.5).

Table 2.2.1: Gender Distribution, 1998-2009

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=2145)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	78	66	80	66	81	64	142	64	122	60	114	69	112	61	115	60	118	67	129	66	143	62	132	63	1366	64
Female	41	34	42	34	45	36	79	36	81	40	51	31	72	39	77	40	59	33	67	34	88	38	77	37	779	36

Table 2.2.2: Ethnic Distribution, 1998-2009

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=2145)		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Malay	28	24	34	28	41	32	70	32	74	37	52	31	66	36	62	32	60	34	64	33	79	34	61	29	691	32	
Chinese	47	39	46	38	50	40	92	42	83	41	67	41	58	31	73	38	59	33	70	36	84	36	69	33	798	37	
Indian	36	30	35	28	28	22	49	22	35	17	34	21	43	23	41	21	40	23	38	19	41	18	58	28	478	22	
Bumiputra Sabah	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	3	2	2	2	1	2	1	3	1	12	1
Bumiputra Sarawak	0	0	0	0	0	0	1	0	0	0	0	0	4	2	5	3	4	2	4	2	7	3	6	3	31	2	
Others	8	7	7	6	7	6	9	4	11	5	12	7	12	7	10	5	11	6	18	9	18	8	12	6	135	6	

Table 2.2.3: Age Distribution of Corneal Transplant Recipient Patients, 1998-2009

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=2145)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-9	4	3	5	4	6	5	8	4	9	4	6	3	6	3	8	4	7	4	4	2	5	2	6	3	74	3
10-19	13	11	17	14	9	7	29	13	16	8	21	13	15	8	14	7	23	13	13	7	20	9	27	13	217	10
20-39	28	24	34	28	34	27	49	22	53	26	36	22	55	30	59	31	53	30	48	24	68	29	54	26	571	27
40-59	38	32	32	26	40	32	61	28	57	28	51	31	52	28	45	24	41	23	66	34	69	30	64	30	616	29
≥60	36	30	34	28	37	29	74	33	68	34	51	31	56	31	66	34	53	30	65	33	69	30	58	28	667	31
Mean	45		43		44		45		46		45		45		46		44		47		46		44		45	
SD	21		22		20		21		21		21		21		21		22		21		20		20		21	
Median	45		43		45		50		46		46		44		49		43		49		48		45		46	
Minimum	4 month		5		2 months		5 month		1		5 month		2 month		2 month		2 month		3		1		3		2 month	
Maximum	82		92		86		85		86		84		86		84		96		102		87		86		102	

Table 2.2.4: Diagnosis, 1998-2009

Year	1998 (N=119)		1999 (N=122)		2000 (N=126)		2001 (N=221)		2002 (N=203)		2003 (N=165)		2004 (N=184)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=2145)			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Primary Diagnosis																												
Keratoconus	24	20	24	20	15	12	38	17	32	16	18	11	34	18	34	18	33	19	28	14	37	16	46	22	363	17		
Corneal scar	33	28	25	20	21	17	34	15	28	14	21	13	26	14	20	10	18	10	25	13	29	13	14	7	294	14		
Microbial keratitis	11	9	11	9	19	15	30	14	31	15	21	13	18	10	13	7	11	6	14	7	18	8	19	9	216	10		
Microbial keratitis+Cornea perforation	1	1	6	5	1	1	6	3	4	2	4	2	17	9	20	10	7	4	10	5	12	5	28	13	116	5		
Corneal perforation (non microbial)	6	5	7	6	8	6	12	5	12	6	27	16	13	7	18	9	20	11	21	11	18	8	19	9	181	8		
Pseudophakic Bullous keratopathy	10	8	16	13	17	13	23	10	15	7	19	12	19	10	35	18	30	17	36	18	46	20	28	13	294	14		
Other (non pseudophakic) bullous keratopathy	14	12	4	3	19	15	37	17	47	23	25	15	16	9	14	7	11	6	8	4	14	6	8	4	217	10		
Failed previous graft	14	12	12	10	13	10	17	8	15	7	14	8	12	7	14	7	10	6	23	12	16	7	12	6	172	8		
Corneal dystrophy	5	4	6	5	5	4	12	5	9	4	7	4	8	4	6	3	10	6	12	6	10	4	17	8	107	5		
Congenital opacity	1	1	1	1	1	1	1	0	0	0	1	1	8	4	4	2	1	1	1	1	1	1	5	2	2	1	26	1
Others	3	3	8	7	7	6	15	7	14	7	10	6	34	18	34	18	36	20	39	20	48	21	29	14	277	13		
No data	0	0	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	8	0

\* Each patient may have more than one diagnosis.

Table 2.2.5: Indications of Corneal Transplant, 2004-2009

Indication of transplant	2004 (N=184)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1189)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Optical	120	65	135	70	124	70	139	71	154	67	101	48	773	65
Tectonic	26	14	23	12	20	11	17	8	25	11	25	12	136	11
Therapeutic	27	14	19	10	17	9	24	12	24	11	42	20	153	13
Tectonic+Therapeutic	9	5	9	4	4	2	8	4	6	3	22	11	58	5
Optical+Tectonic	1	1	1	1	1	1	0	0	1	0	0	0	4	0
Optical+Tectonic+Therapeutic	0	0	1	1	0	0	1	1	1	0	2	1	5	1
Optical+Therapeutic	0	0	0	0	5	3	6	3	8	4	7	3	26	2
Optical+Others	0	0	0	0	1	1	0	0	1	0	0	0	2	0
Therapeutic+Others	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Others	1	1	4	2	4	2	1	1	9	4	7	3	26	2
No data	0	0	0	0	1	1	0	0	1	0	3	2	5	1

\* Each patient may have more than one indication.



## 2.3 TRANSPLANT DATA, 2004-2009

### 2.3.1 Recipient Data

Regrafts were performed in 12% of cases (Table 2.3.1.1). Ocular co-morbidity was noted in 53% of the patients and corneal vascularisation was the most frequently encountered (Table 2.3.1.2). From data available 63% of the eyes had a vision of 3/60 or worse prior to corneal transplantation (Table 2.3.1.3).

Table 2.3.1.1: No of Previous Grafts in Grafted Eye, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Graft Number														
0	123	89	171	89	160	90	161	82	203	88	188	90	1006	88
1	11	8	15	8	15	8	30	15	21	9	12	6	104	9
2	3	2	2	1	1	1	4	2	5	3	5	2	20	2
3	0	0	1	1	1	1	0	0	0	0	0	0	2	0
4	1	1	0	0	0	0	1	1	0	0	0	0	2	0
Not Available	0	0	3	1	0	0	0	0	2	0	4	2	9	1

\*In the year 2004 there are total of 185 corneal transplants performed but complete data set was only received for 138 patients.

Table 2.3.1.2: Ocular Co-morbidity, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ocular co-morbidity														
Any ocular co-morbidity (a to d below)	88	64	103	54	82	46	89	45	126	55	118	56	606	53
a) Superficial corneal vascularisation	44	50	48	47	44	54	53	60	70	56	62	53	321	53
b) Deep corneal vascularisation	43	49	39	38	22	27	28	31	31	25	38	32	201	33
c) History of glaucoma	29	33	36	35	36	44	39	44	68	54	54	46	262	43
d) Current ocular inflammation	42	48	50	49	41	50	39	44	66	52	63	53	301	50

\*Patient might have multiple ocular co-morbidities.

Table 2.3.1.3: Pre-operative Vision, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Unaided VA														
6/6	3	2	0	0	1	1	1	1	1	1	1	1	7	1
6/9	1	1	1	1	1	1	2	1	6	2	2	1	13	1
6/12	0	0	2	1	3	1	0	0	2	1	2	1	9	1
6/18	0	0	1	1	0	0	2	1	1	1	3	1	7	1
6/24	3	2	5	2	4	2	2	1	3	1	4	2	21	2
6/36	4	3	6	3	5	3	3	1	6	2	6	3	30	3
6/60	7	5	16	8	17	10	11	5	14	6	17	8	82	7
5/60	1	1	0	0	0	0	0	0	0	0	0	0	1	0
4/60	3	2	1	1	2	1	2	1	0	0	0	0	8	1
3/60	2	1	2	1	1	1	4	2	5	2	5	2	19	2
2/60	1	1	2	1	4	2	1	1	2	1	4	2	14	1
1/60	4	3	9	4	7	4	2	1	1	1	6	3	29	2
CF	47	34	47	24	45	25	43	22	40	17	70	33	292	25
HM	47	34	46	24	37	21	48	24	48	21	55	26	281	24
PL	13	10	15	8	12	7	17	9	20	9	15	7	92	8
NPL	2	1	1	1	0	0	1	1	0	0	1	1	5	1
Others	0	0	0	0	0	0	0	0	0	0	1	1	1	0
No data	0	0	38	20	38	21	57	29	82	35	17	8	232	20

### 2.3.2: Donor details

Eye Banks in the United States of America (USA) were the most frequent source 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 corneal tissue storage medium used at 76% (Table 2.3.2.3). The major cause of death of the donors were related to the cardiac/circulatory system (30%) followed by malignancy (15%) (Table 2.3.2.4).

Table 2.3.2.1: Source of Donor Cornea Tissue, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Local	20	14	19	10	36	20	31	16	41	18	41	20	188	16
USA	95	69	133	69	98	56	114	58	150	65	130	62	720	63
Sri Lanka	22	16	38	20	41	23	51	26	37	16	38	18	227	19
Others	0	0	0	0	2	1	0	0	2	1	0	0	4	1
No data	1	1	2	1	0	0	0	0	1	0	0	0	4	1
If Local, ethnic group:														
• Malay	0	0	4	21	1	3	5	16	0	0	0	0	10	5
• Chinese	14	70	8	42	12	33	16	52	22	54	29	71	101	54
• Indian	5	25	7	37	23	64	4	13	9	22	12	29	60	32
• Others	0	0	0	0	0	0	4	13	10	24	0	0	14	7
• Unknown	1	5	0	0	0	0	2	6	0	0	0	0	3	2

\* In the year 2004 there were a total of 184 corneal transplants performed but complete data set was only received for 138 patients.

Figure 2.3.2.1: Source of Donor Corneal Tissue, 2004-2009

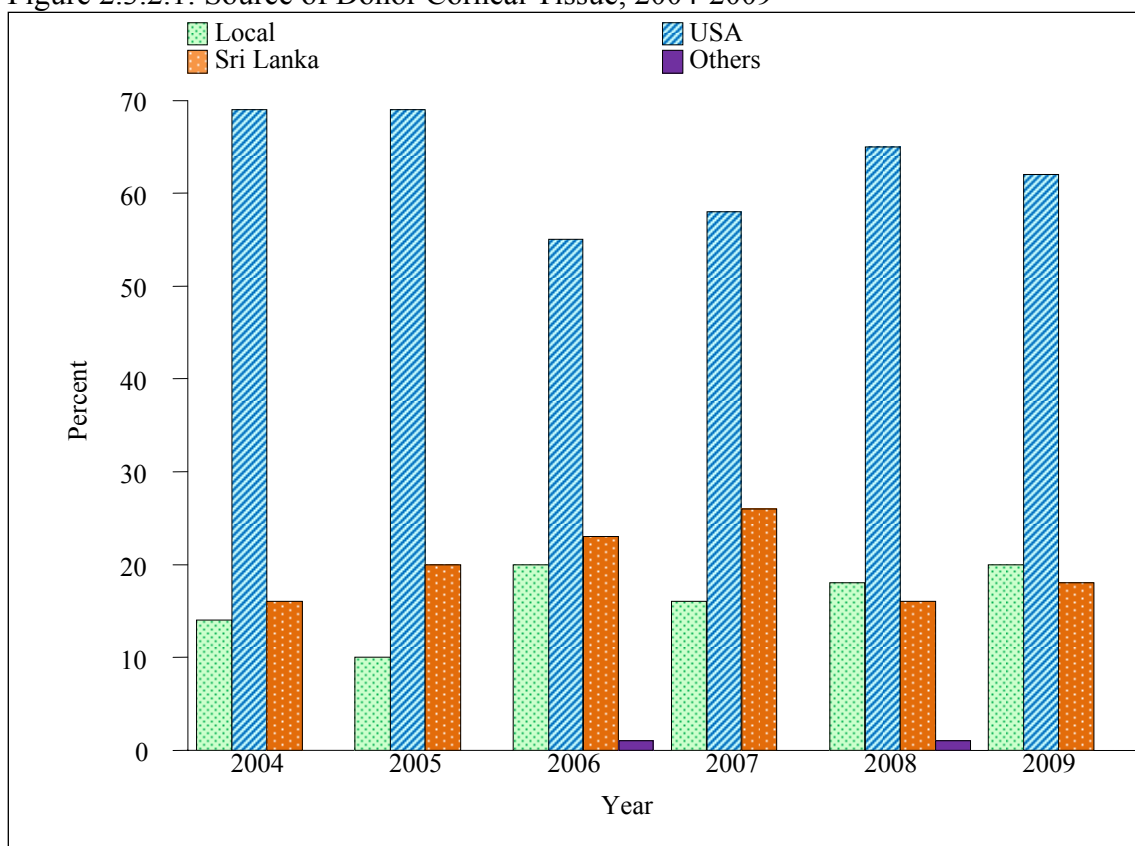


Table 2.3.2.2: Donor Age Distribution, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Age group (years)														
0-9	2	2	3	2	2	1	2	1	7	3	2	1	18	2
10-19	6	4	4	2	9	5	5	3	7	3	9	4	40	3
20-39	11	8	7	4	11	6	13	7	19	8	17	8	78	7
40-59	51	37	89	46	81	46	83	42	80	35	85	41	469	41
≥60	68	49	89	46	74	42	93	47	118	51	96	46	538	47
Mean	57		58		56		57		56		56		57	
SD	15		14		16		14		17		16		15	
Median	59		58		56		59		60		58		59	
Minimum	8		3		6		4		1		1		1	
Maximum	78		79		78		78		76		77		79	

Table 2.3.2.3: Preservation Media, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Preservation media														
Optisol GS	90	65	145	75	128	72	134	68	189	82	183	88	869	76
MK Medium	22	16	37	19	40	23	51	26	35	15	15	7	200	17
Moist Chamber	4	3	3	2	7	4	8	4	4	2	8	4	34	3
Others*	0	0	1	1	0	0	3	2	1	0	0	0	5	1
No data	22	16	6	3	2	1	0	0	2	1	3	1	35	3

\*Others (specify) Eusol-C

Figure 2.3.2.3: Preservation Media, 2004-2009

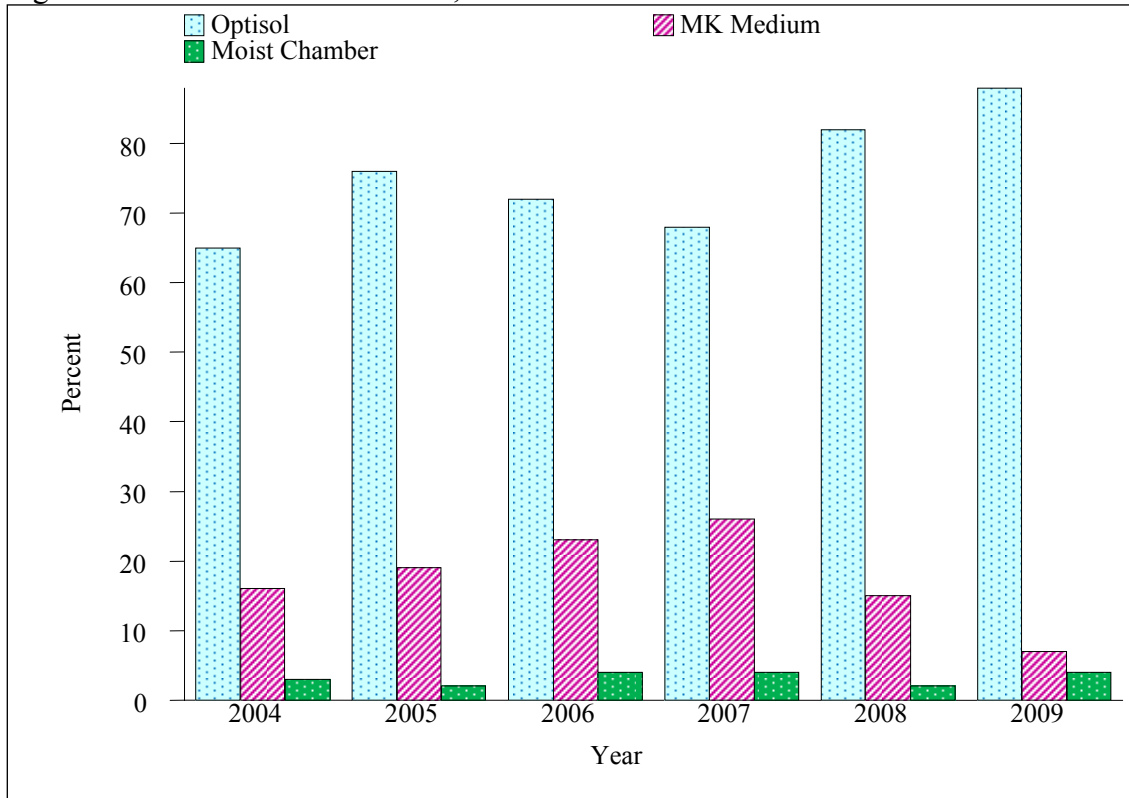


Table 2.3.2.4: Cause of Death in Corneal Donors, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Cardiac / Circulatory System	47	34	49	26	59	33	75	38	61	26	58	28	349	30
Cerebrovascular System	17	12	25	13	11	6	23	12	35	15	18	9	129	11
Malignancy	19	14	31	16	25	14	26	13	41	18	27	13	169	15
Trauma / Accident	20	15	13	7	19	11	24	12	21	9	28	13	125	11
Respiratory System	15	11	8	4	8	5	13	7	10	4	25	12	79	7
Others	17	12	21	11	27	15	32	16	59	26	49	23	205	18
No data	3	2	45	23	28	16	3	2	4	2	4	2	87	8

### 2.3.3: Transplant Practices

Penetrating Keratoplasty (PK) was the commonest type of surgery performed (86%) (Table 2.3.3.1). Corneal transplantation was performed in combination with other surgical procedures in 18% of cases. Cataract extraction, with or without intraocular lens implantation (IOL), was the commonest combined procedure (Table 2.3.3.2). The recipient graft size ranged from 2mm to 10mm, with the median recipient cornea graft size being 7.5mm.(Table 2.3.3.3). The majority of cases had the donor tissue over-sized by 0.5mm (Table 2.3.3.4). The commonest suturing technique was interrupted sutures (Table 2.3.3.5).

Table 2.3.3.1: Types of Surgeries, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Penetrating Keratoplasty	120	87	173	90	153	86	175	89	189	82	173	82	983	86
Lamellar Keratoplasty	10	7	13	7	16	9	7	4	21	9	15	7	82	7
Patch Graft for Corneal	2	2	3	1	5	3	10	5	12	5	9	4	41	4
Patch Graft for Scleral	0	0	1	1	0	0	0	0	2	1	1	1	4	0
Cornea Scleral Keratoplasty	6	4	2	1	3	2	4	2	4	2	10	5	29	3
Endothelial keratoplasty	0	0	0	0	0	0	0	0	3	1	0	0	3	0
Others	0	0	0	0	0	0	0	0	0	0	1	1	1	0

\* In the year 2004 there were a total of 184 corneal transplants performed but complete data set was only received for 138 patients.

Table 2.3.3.2: Types of Combined Surgeries, 2004-2009

Year	2004* (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
No. of patients with corneal transplant surgery combined with another surgical procedure	30	22	27	14	41	23	35	18	46	20	32	15	211	18
(a) Glaucoma surgery	2	7	3	11	1	2	0	0	3	7	2	6	11	5
(b) Cataract Extraction	15	50	13	48	21	51	13	37	17	37	15	47	94	45
(c) IOL	13	43	10	37	24	59	19	54	23	50	10	31	99	47
(d) Cataract extraction and IOL	9	30	8	30	15	37	10	29	16	35	9	28	67	32
(e) Retinal Surgery ± Internal Tamponade	1	3	1	4	2	5	4	11	10	22	0	0	18	9
(f) Anterior vitrectomy	9	30	3	11	4	10	10	29	6	13	9	28	41	19
(g) Others	5	17	8	30	8	20	16	46	14	30	11	34	62	29

\*Patients may have more than one combined surgery.

Table 2.3.3.3: Recipient Cornea Trephine Size, 2004-2009

Year	2004 (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2	1	1	1	1	2	1	1	1	0	0	1	1	6	1
3	0	0	1	1	2	1	1	1	1	1	2	1	7	1
4	1	1	2	1	1	1	5	2	2	1	1	1	12	1
5	0	0	0	0	0	0	1	1	1	0	1	1	3	1
5.5	1	1	0	0	0	0	0	0	0	0	0	0	1	0
6	3	2	0	0	5	3	4	2	4	1	7	3	23	2
6.25	0	0	1	1	0	0	0	0	0	0	0	0	1	0
6.5	2	1	5	2	4	2	8	4	7	3	9	4	35	3
6.7	0	0	0	0	0	0	0	0	1	1	0	0	1	0
6.75	1	1	3	1	2	1	1	1	1	1	2	1	10	1
7	25	18	36	19	25	14	29	15	38	16	35	16	188	16
7.2	1	1	0	0	0	0	0	0	1	1	0	0	2	0
7.25	9	7	10	5	14	8	5	2	5	2	10	5	53	5
7.5	36	26	18	9	26	15	37	19	50	21	33	16	200	17
7.75	8	5	11	6	6	3	12	6	14	6	47	22	98	8
7.8	2	1	0	0	0	0	0	0	0	0	0	0	2	0
8	18	13	7	4	13	7	19	10	26	11	25	12	108	9
8.15	0	0	0	0	0	0	0	0	1	1	0	0	1	0
8.25	4	3	4	2	5	3	4	2	4	2	4	2	25	2
8.5	6	4	6	3	2	1	11	5	10	4	5	2	40	3
8.75	0	0	1	1	0	0	0	0	0	0	0	0	1	0
9	9	7	3	1	1	1	4	2	3	1	6	3	26	2
9.5	0	0	2	1	0	0	0	0	1	0	2	1	5	1
10	1	1	0	0	0	0	0	0	2	1	3	1	6	1
10.5	0	0	0	0	0	0	0	0	0	0	1	1	1	0
11	0	0	0	0	0	0	0	0	1	1	2	1	3	1
12	0	0	0	0	0	0	0	0	1	1	0	0	1	0
No data	10	7	81	42	69	39	54	27	57	24	13	6	284	25
Mean	7.5		7.3		7.2		7.3		7.5		7.5		7.4	
SD	0.9		1		1.1		1.1		0.9		1		1	
Median	7.5		7.3		7.3		7.5		7.5		7.5		7.5	
Minimum	2		2		2		2		3		2		2	
Maximum	10		9.5		9		9		12		11		12	

Table 2.3.3.4: Difference in Trephined Sizes of Recipient and Donor Corneas, 2004-2009

Year	2004 (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Same Size	9	6	8	4	8	4	12	6	19	8	51	24	107	9
0.2	2	1	0	0	0	0	0	0	2	1	0	0	4	0
0.25	22	16	19	10	30	17	27	14	27	12	36	17	161	14
0.3	5	4	0	0	0	0	0	0	0	0	1	1	6	1
0.4	1	1	0	0	0	0	0	0	0	0	0	0	1	0
0.5	86	62	84	44	67	38	95	48	117	51	99	47	548	48
0.55	0	0	0	0	0	0	0	0	1	0	0	0	1	0
0.6	0	0	0	0	0	0	0	0	1	0	0	0	1	0
0.75	0	0	0	0	1	1	1	1	2	1	1	1	5	1
0.8	1	1	0	0	0	0	0	0	0	0	0	0	1	0
1	1	1	0	0	1	1	4	2	2	1	5	2	13	1
1.5	0	0	0	0	0	0	0	0	1	0	1	1	2	0
2	1	1	0	0	0	0	0	0	0	0	0	0	1	0
Not Available	10	7	81	42	70	39	57	29	59	26	15	7	292	26

Table 2.3.3.5: Suture Technique, 2004-2009

Year	2004 (N=138)		2005 (N=192)		2006 (N=177)		2007 (N=196)		2008 (N=231)		2009 (N=209)		TOTAL (N=1143)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Interrupted only	132	96	139	73	124	70	138	70	171	74	175	84	879	77
Continuous only	0	0	0	0	5	3	1	1	6	3	7	3	19	2
Combined	6	4	18	9	18	10	12	6	10	4	25	12	89	8
No data	0	0	35	18	30	17	45	23	44	19	2	1	156	13

**2.4 CORNEAL TRANSPLANT OUTCOME 2004-2009**

Table 2.4.1: Stock and Flow - Graft Status (Whole Database)

		<b>Optical</b>		<b>Non optical</b>		<b>Total</b>	
		<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>
<b>Number registered</b>		810	68	379	32	1189	100
<b>Number followed</b>		<b>327</b>		<b>156</b>		<b>483</b>	
	Total	327		156		483	
	1 year	201	62	121	78	322	67
	2 year	70	21	24	15	94	19
	3 year	42	13	7	5	49	10
	4 year	10	3	4	2	14	3
	5year	4	1	0	0	4	1
<b>Graft status</b>		<b>327</b>		<b>156</b>		<b>483</b>	
	Total	327		156		483	
	-Surviving graft	260	80	84	54	344	71
	-Failed graft	67	20	72	46	139	29
<b>Recipient status</b>		<b>810</b>		<b>379</b>		<b>1189</b>	
	Total	810		379		1189	
	-Recipient with complete follow up	99	12	78	20	177	15
	-Recipient deaths	3	0	1	0	4	0
	-Recipient loss - followed	224	28	77	21	301	25
	-Recipient loss - not followed	374	46	124	33	499	42
	-Graft not yet followed (Transplant duration less than 1 year)	110	14	99	26	209	18



### 2.4.2 Outcome – Graft Survival 2004-2009

Graft survival for both optical and non-optical indications at 12 months was 77.2% but this declined to 64.5% at 36 months (Table 2.4.2.1). The cases were grouped into two groups based on the indication for surgery – i) Optical and ii) Non-Optical. Graft survival was 86.8% at 12 months in the optical group and 57.1% in the non-optical group. This declined to 72.3% at 36 months in the optical group and 48.5% in the non-optical group (Table 2.4.2.2). Primary graft failure was the commonest cause of graft failure.(Table 2.4.2.5).

Table 2.4.2.1: Graft Survival, 2004-2009

Interval (months)	No.	% success	SE
0	483	100	-
12	375	77.2	2
24	161	70.4	2
36	67	64.5	3
48	18	53.4	6
60	4	47.5	8

Figure 2.4.2.1: Graft Survival, 2004-2009

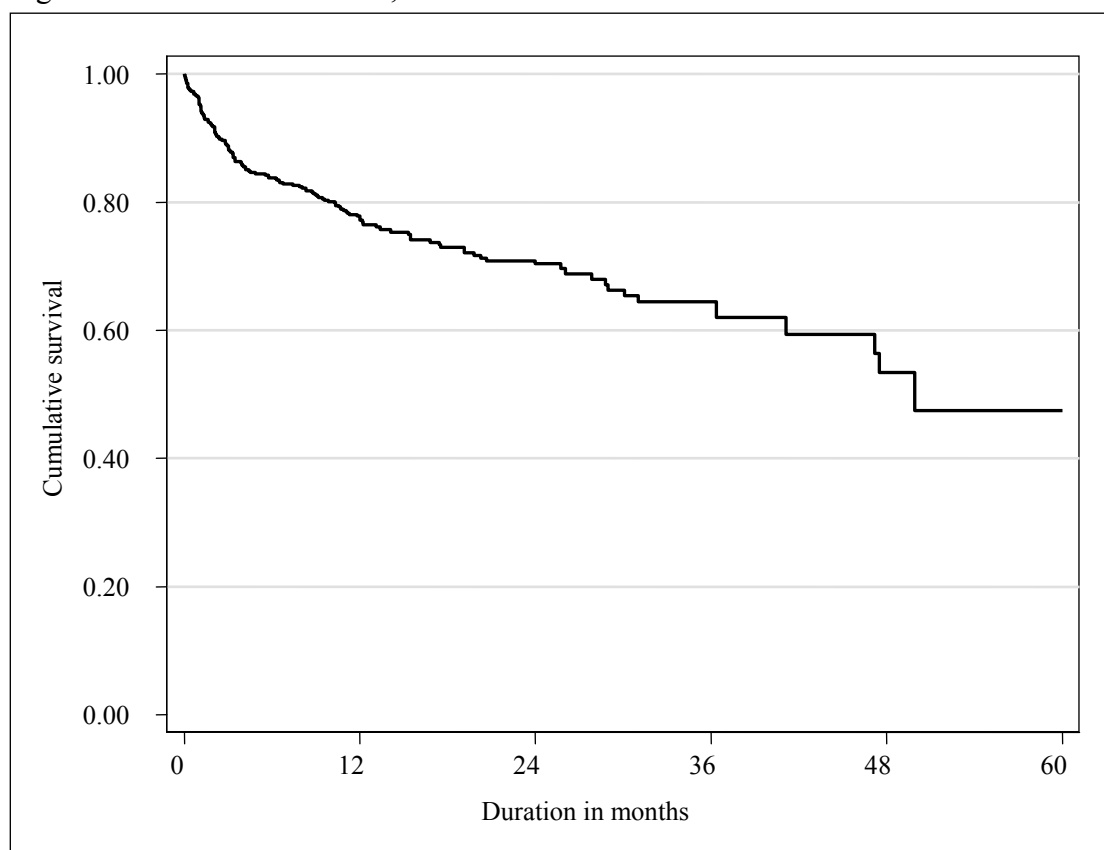


Table 2.4.2.2: Graft Survival by Optical and Non-optical Indication, 2004-2009

Interval (months)	Optical			Non-Optical		
	No.	% success	SE	No.	% success	SE
0	327	100	-	156	100	-
12	284	86.8	2	91	57.1	4
24	126	79.2	3	35	52.2	4
36	56	72.3	4	11	48.5	5
48	14	56.9	8	4	48.5	5
60	4	48.8	10	1	.	.

Figure 2.4.2.2: Graft Survival by Optical and Non-optical Indication, 2004-2009

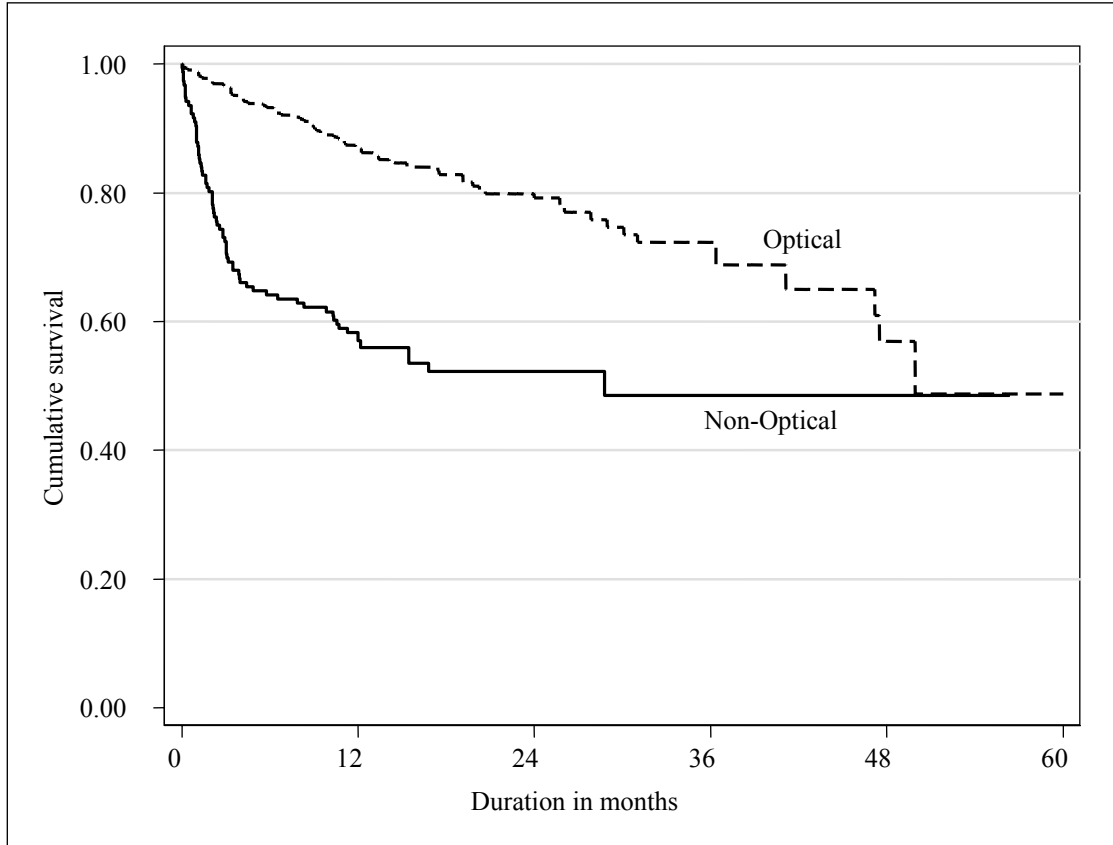


Table 2.4.2.3 Graft Success by Gender, 2004-2009

Interval (months)	Male			Female		
	No.	% success	SE	No.	% success	SE
0	303	100	-	180	100	-
12	231	75.9	2	144	79.4	3
24	91	69.2	3	70	72.5	4
36	42	62.6	4	25	67.9	5
48	13	58.7	5	5	48.1	12
60	3	58.7	5	1	21.5	16

Figure 2.4.2.3 Graft Success by Gender, 2004-2009

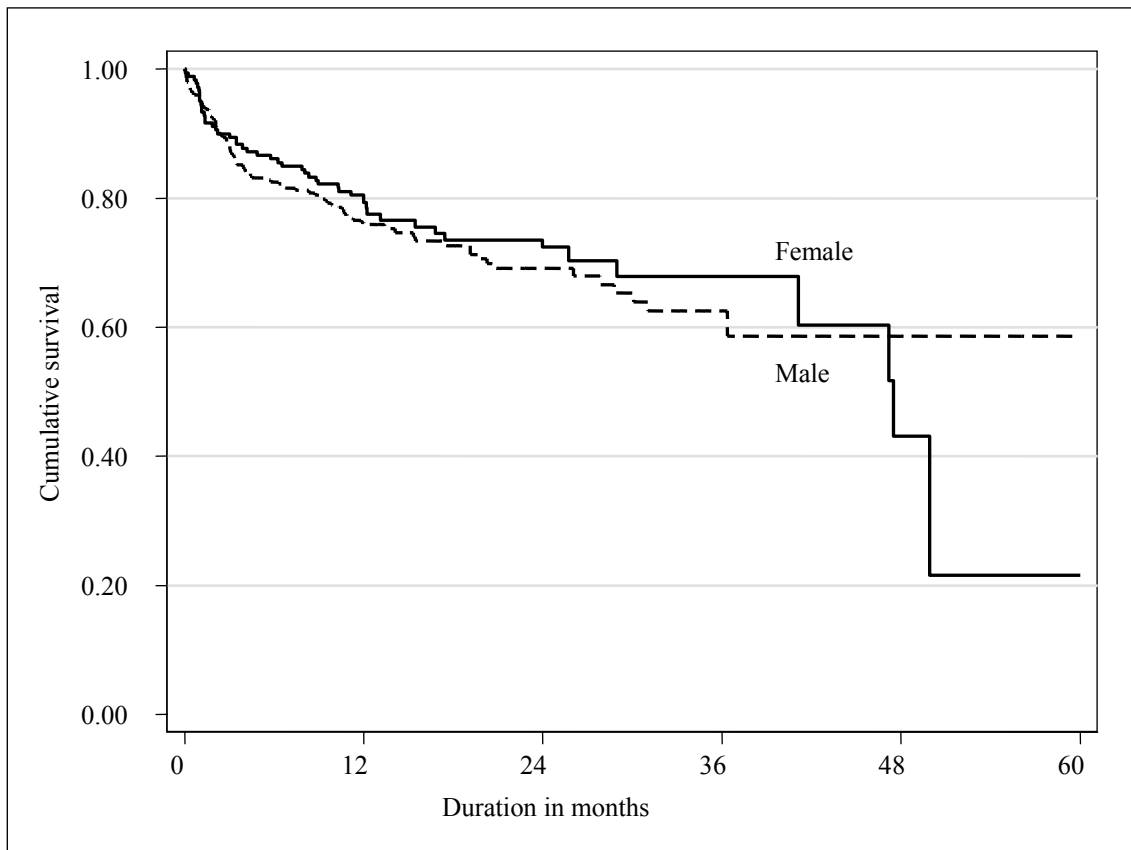


Table 2.4.2.4 Graft Survival by Age, 2004-2009

Interval (months)	0-9			10-19		
	No.	% success	SE	No.	% success	SE
0	7	100	-	21	100	-
12	6	85.7	13	18	85.7	8
24	3	42.9	22	14	85.7	8
36	3	42.9	22	11	85.7	8
48	1	42.9	22	1	.	.
60	1	.	.	1	.	.
Interval (months)	20-39			≥40		
	No.	% success	SE	No.	% success	SE
0	27	100	-	428	100	-
12	21	77.8	8	330	76.6	2
24	5	77.8	8	139	68.9	3
36	3	77.8	8	52	62.6	3
48	2	77.8	8	16	50.6	6
	1	.	.	4	44.2	8

Figure 2.4.2.4 Graft Survival by Age, 2004-2009

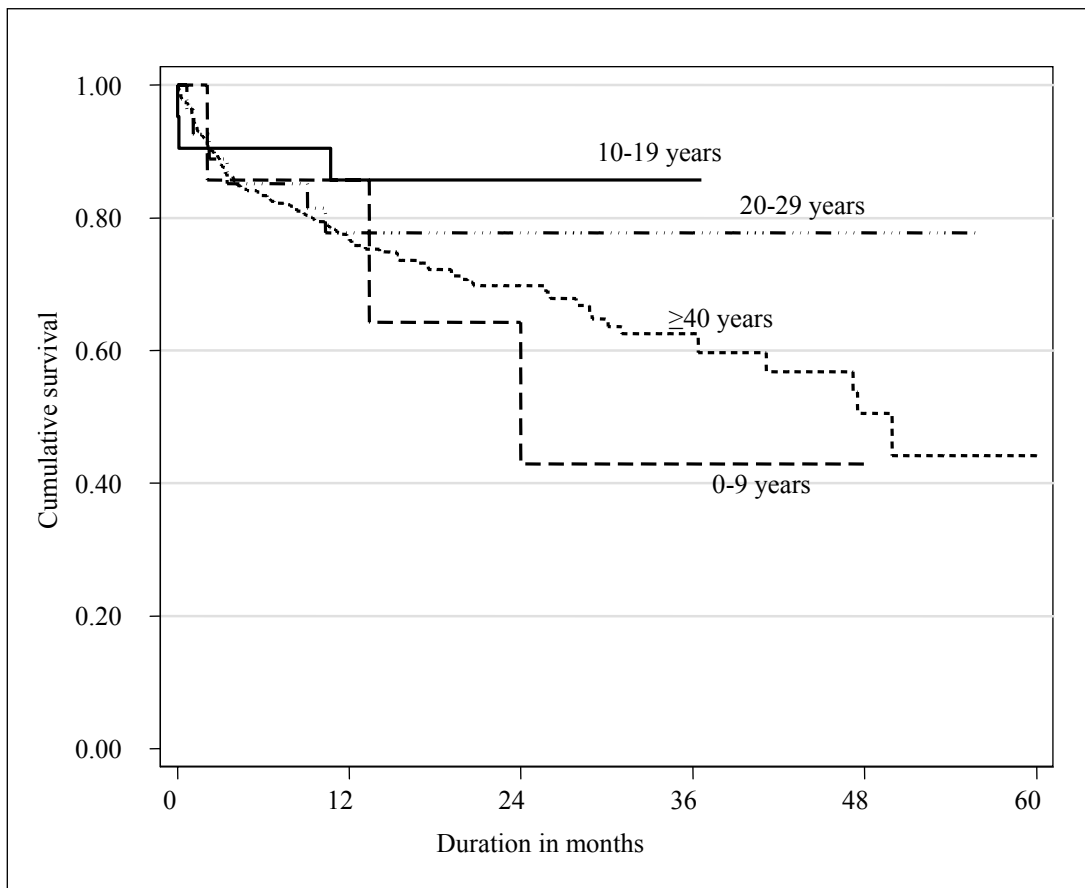


Table 2.4.2.5: Causes of Graft Failure

		<b>Total (N=139)</b>	
		<b>No.</b>	<b>%</b>
<b>Graft Failure</b>		139	30
Cause of Failure	Primary graft failure or Primary Endothelial decompensation	37	27
	Recurrence of primary disease	13	9
	Late Endothelial decompensation	23	17
	Glaucoma	29	21
	Infection	26	19
	Graft rejection	30	22
	Others	31	22
	No data	6	4

\*Each Patient may have more than one cause of graft failure.

### 2.4.3 Visual Outcome

Visual outcome of corneal transplants was analysed in cases where post corneal transplant unaided vision was available. Data on post corneal transplant best corrected vision was only available in a limited number of the cases (Table 2.4.3.1). Forty nine percent of optical and 41% of non-optical cases had improved unaided vision after surgery (Table 2.4.3.2).

Table 2.4.3.1: Availability of Data on Post Corneal Transplant Unaided Vision

	Unaided Vision (N =1189)	
	No.	%
Data available	451	38
Lost to follow up	699	59
No data	39	3

Table 2.4.3.2 Unaided Visual Outcome After Cornea Transplant Surgery

Reason for graft	Optical (n=313)		Non-optical (n=138)	
	No.	%	No.	%
Vision better	153	49	57	41
Vision same	55	18	37	27
Vision worse	47	15	33	24
Not known*	58	18	11	8

\*Either pre op vision and/or post op vision is not available

Figure 2.4.3.2 Unaided Visual Outcome After Corneal Transplant Surgery

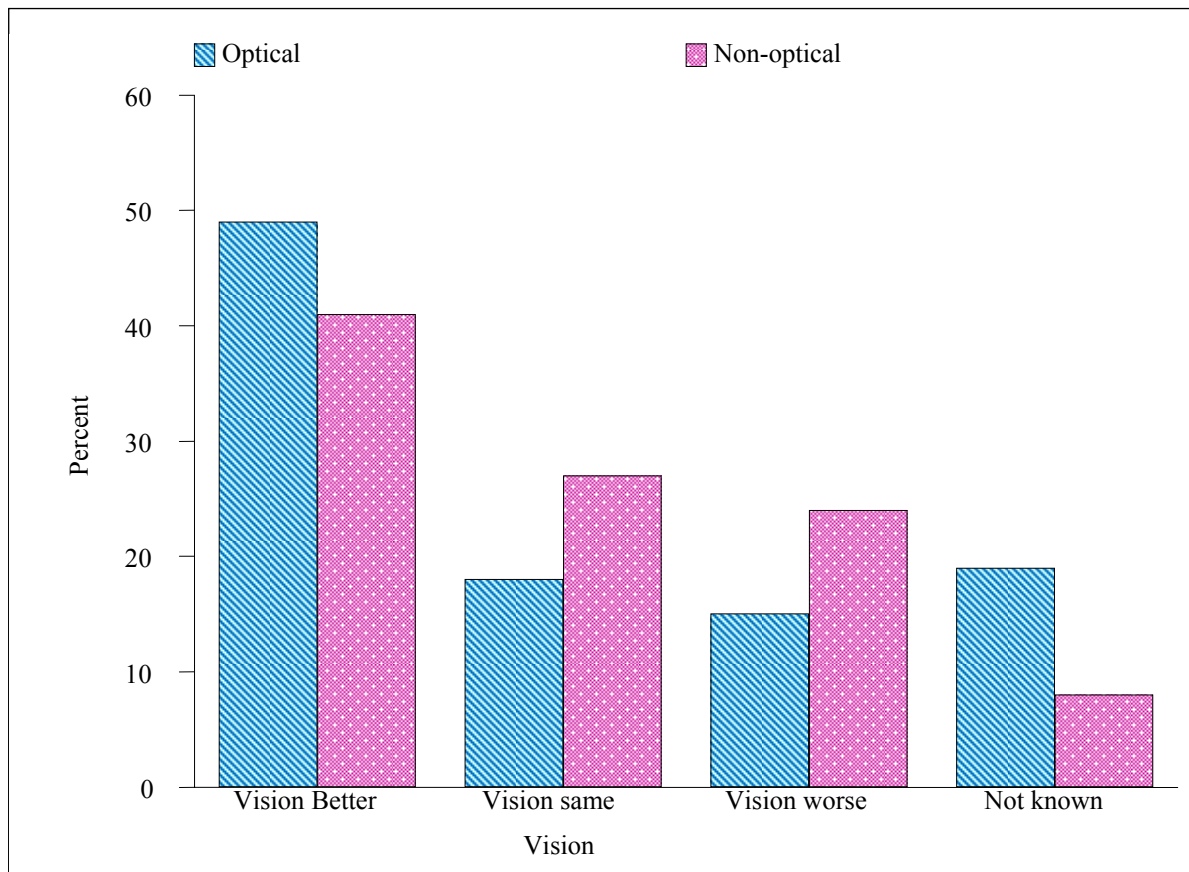
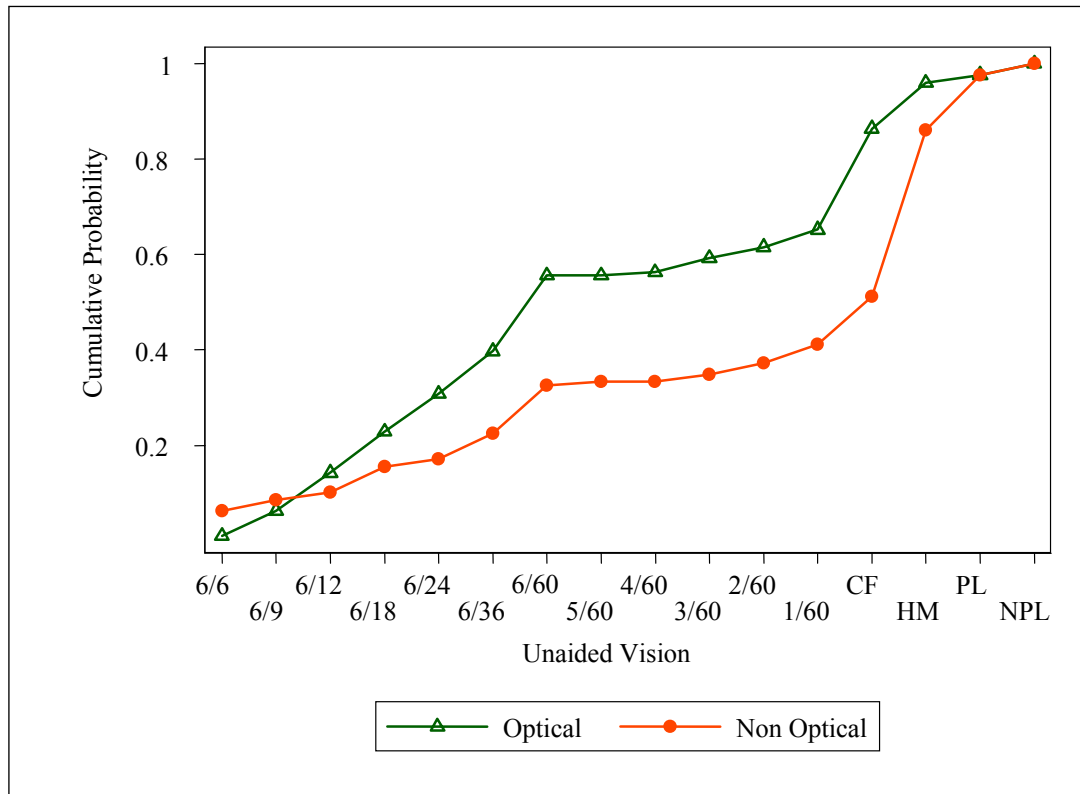


Table 2.4.3.3 Unaided Vision for Optical and Non Optical Cases

Vision	Optical				Non Optical			
	Graft Survival (253)		Graft Failure (60)		Graft Survival (76)		Graft Failure (62)	
	No.	%	No.	%	No.	%	No.	%
6/18 or Better	69	27	0	0	18	24	2	3
6/24 – 6/60	95	38	4	7	19	25	3	5
Less than 6/60	78	31	56	93	30	39	57	92
Data not available	11	4	0	0	9	12	0	0

Figure 2.4.3.3 Cumulative Probability for Unaided Vision in Grafts



## 2.5 POST CORNEA TRANSPLANT COMPLICATIONS

The common complications observed at one year were post-keratoplasty glaucoma, graft vascularisation, epithelial problems and graft rejection. Rejection was seen in 20% who were on follow-up (Table 2.5.1). Endothelial rejection was present in 39% of the patients on follow-up. (Table 2.5.2).

Table 2.5.1: Post Transplant Complications

		One year outcome (N=215)		2 <sup>nd</sup> year outcome (N=75)		3 <sup>rd</sup> year outcome (N=43)		4 <sup>th</sup> year outcome (N=11)		Total (N=344)	
		No.	%	No.	%	No.	%	No.	%	No.	%
<b>Any complications</b>		<b>157</b>	<b>73</b>	<b>48</b>	<b>64</b>	<b>28</b>	<b>65</b>	<b>7</b>	<b>64</b>	<b>240</b>	<b>70</b>
Complication	Epithelial Problem	43	27	13	27	10	36	4	57	70	29
	Wound Dehiscence	2	1	0	0	0	0	0	0	2	1
	Suture infiltration / abscess	27	17	6	13	5	18	2	29	40	17
	Endophthalmitis	1	1	1	2	0	0	0	0	2	1
	Microbial keratitis	26	17	6	13	2	7	0	0	34	14
	Vascularisation	55	35	18	38	11	39	3	43	87	36
	Post-keratoplasty glaucoma	63	40	21	44	13	46	2	29	99	41
	Graft Rejection	36	23	9	19	3	11	1	14	49	20
No data	58	37	27	56	15	54	4	57	104	43	

\* Each patient may have more than one complication

Table 2.5.2: Post Transplant Graft Rejection Types

		One year outcome (N=215)		2 <sup>nd</sup> year outcome (N=75)		3 <sup>rd</sup> year outcome (N=43)		4 <sup>th</sup> year outcome (N=11)		Total (N = 344)	
		No.	%	No.	%	No.	%	No.	%	No.	%
<b>Graft Rejection</b>		<b>36</b>		<b>9</b>		<b>3</b>		<b>1</b>		<b>49</b>	
Types	Epithelial	14	39	4	44	2	67	0	0	20	41
	Stromal	12	33	0	0	0	0	0	0	12	24
	Endothelial	13	36	4	44	1	33	1	100	19	39
	No data	4	11	1	11	0	0	0	0	5	10

\* Each patient may have more than one type of rejection