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Visual outcomes achieved post cataract surgery at St John Eye Hospital

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VISUAL OUTCOMES ACHIEVED POST CATARACT SURGERY AT ST JOHN EYE HOSPITAL

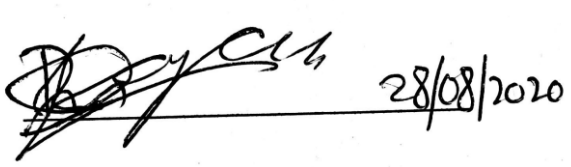
RAAKESH DAYARAM

A research report submitted to the Faculty of Health Sciences, University of Witwatersrand, Johannesburg, in fulfilment of the requirements of the degree of Master of Medicine in Ophthalmology.

Johannesburg, 2020

DECLARATION

I Raakesh Dayaram declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Medicine in Ophthalmology at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



The work reported in this dissertation was carried out at the Department of Ophthalmology at St John Eye Hospital, Chris Hani Baragwanath Academic Hospital.

I dedicate this work to the following persons:

Shiroma Dayaram

Vaishav Dayaram

Aranya Dayaram

Ishwarlal Dayaram

Meenakshi Dayaram (1950-2009)

A little piece of each of you resides in this work.

ABSTRACT

The World Health Organisation (WHO) estimates that up to 39% of all causes of reversible or avoidable blindness can be attributed to cataracts. Phacoemulsification with insertion of an IOL is the most commonly performed type of cataract surgery in developed countries. As surgeon skills improve and phacoemulsification gains ground, more patients affected by cataracts are being offered this form of surgery in developing countries. St John Eye Hospital is a tertiary hospital for the training of ophthalmologists. Of a total of 1985 cataract surgeries performed at St John Eye Hospital during 2014, the ratio of extracapsular cataract extraction to phacoemulsification performed is approximately 2:1.

OBJECTIVE: To evaluate the visual acuity outcomes achieved post operatively by patients that have undergone phacoemulsification with insertion of an IOL. To compare post phacoemulsification visual acuity outcomes to standards recommended by the World Health Organisation.

DESIGN AND METHOD: A retrospective clinical audit of 100 random patient records having undergone phacoemulsification with insertion of an IOL and meeting inclusion criteria between 01 February 2015 and 31 January 2016 at St John Eye Hospital, Chris Hani Baragwanath Academic Hospital was conducted.

RESULTS: A total of 100 records of patients with a history of uncomplicated phacoemulsification with insertion of an IOL were randomly selected. Of these patients, 58% (n=58) were female patients, 42% (n=42) were males. The average age of all patients was 66.7 years. A total of 93% (n=93) of the surgeries were conducted by junior surgeons (registrars undergoing training) and 7% (n=7) by senior (consultant ophthalmologists) surgeons. A total of 82% (n=82) of the total 100 participants achieved an uncorrected visual acuity of between logMAR 0-0.5 with an average vision of logMAR 0.28. Eighteen percent (n=18) of patients achieved an uncorrected visual acuity of between logMAR 0.6-1.0 with an average of 0.99 logMAR 0.99. The mean visual acuity of all 100 patients was logMAR 0.36.

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LIST OF ABBREVIATIONS

ECCE:	**E**xtra**c**apsular **C**ataract **E**xtraction
ESCRS:	The **E**uropean **S**ociety of **C**ataract and **R**efractive **S**urgeons
EUROQUO:	The **Eu**ropean **R**egistry **o**f **Qu**ality **O**utcomes for Cataract and Refractive surgery
IOL:	**I**ntra**o**cular **L**ens
LogMAR:	**Log**arithm of **M**inimum **A**ngle of **R**esolution
SD-OCT:	**S**pectral **D**omain **O**ptical **C**oherence **T**omography
SRK-T:	Formula for IOL calculation devised by Donald R. **S**anders, John A. **R**etzlaff and Manus C. **K**raff. **T** is for **T**heoretical
VA:	**V**isual **A**cuity
WHO:	**W**orld **H**ealth **O**rganisation

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CHAPTER 1

1. INTRODUCTION

1.1 General Introduction

Cataract formation remains the leading cause of visual impairment internationally.[1] Blindness attributed to cataract formation places a significant strain on society in terms of increased morbidity[2], mortality[3], as well as an added economic burden on affected individuals' families, societies and countries.[4]

Cataract formation is the opacification of the crystalline lens, thereby obscuring the eye's visual axis causing a decrease in visual acuity (quantification of vision) and reducing the quality of life of an affected individual.

Cataract surgery is one of the most common elective surgeries performed internationally. The aim of cataract surgery is to restore affected patients' vision, thereby improving their quality of life, and restoring them to a productive and independent life.[5]

Studies have demonstrated that a person's uncorrected visual acuity assessment post cataract surgery is an objective and therefore acceptable method of evaluating surgical outcomes.[1,5–9]

St John Eye Hospital is considered to be amongst the largest of eye hospitals in South Africa. A large number (a total of 1985 cataract surgeries were performed in 2014 alone) of phacoemulsification and extra-capsular cataract extractions (ECCE) with insertion of posterior chamber intraocular lenses (IOL) are routinely performed by senior (consultant) and junior (registrar) surgeons at St John Eye Hospital. The ratio of cases of extracapsular cataract extraction with IOL to phacoemulsification with IOL performed at St John Eye Hospital is approximately 2:1(according to statistics recorded in theatre logs).

This study has two aims, firstly to evaluate the visual acuity outcomes in patients undergoing phacoemulsification and insertion of IOL at St John Eye Hospital and

compare them to a standard set out by the World Health Organisation (WHO).[2] The second aim of this study is to compare the visual acuity outcomes attained by junior surgeons versus senior surgeons in the afore-mentioned individuals.

1.2 Literature review

The WHO estimates that 39% of the cause of blindness internationally can be attributed to cataracts.[2] The WHO has thus initiated the VISION 20/20 Global Initiative for the elimination of avoidable blindness (with cataract being the most common cause) by the year 2020.

A strong genetic link has been attributed to cataract formation.[10] Other known risk factors for cataract formation are: exposure to ultraviolet B (UVB) radiation, diabetes mellitus, corticosteroid use, excessive alcohol consumption, trauma, intraocular inflammation and nicotine usage.[10]

Several factors have resulted in an increase in the number of patients requiring cataract surgery:
a) A greater number of people are living to an advanced age
b) A global increase in the prevalence of chronic medical conditions such as diabetes mellitus causing cataracts at a younger age[11]
c) With significantly improved surgical and visual outcomes achieved, and a reduced threshold in performing cataract surgery, the number of eligible cataract surgery patients is predicted to increase.[12]

Cataract surgery is one of the most cost-effective of all health interventions and can be provided at high volume and good quality as cost-effectively as immunisations.[2] Cataract surgery aims to achieve optimal visual acuity and refraction (usually emmetropia) with no intra-operative or post-operative complications.[13]

Extracapsular cataract extraction (ECCE) with insertion of posterior chamber intraocular lens (IOL) is still the most frequently performed cataract surgery in developing countries.[5,6] ECCE is performed on advanced cataracts where the red reflex of the retina is not visible on slit-lamp examination. It involves extraction of the cataract in its entirety through a large surgical wound with insertion of a poly methyl

methacrylate (PMMA) hard lens. The surgical wound is sutured if it is placed at the corneal limbus, however, if a small incision cataract surgery (SICS/MSICS) technique was performed, the surgical wound may not need to be sutured.

Phacoemulsification with insertion of posterior chamber IOL is the most commonly performed cataract surgery in developed countries as evidenced by the number of studies originating from these countries.[1,7,14] This disparity between developing and developed countries is due to many factors including significant cost of phacoemulsification (phacoemulsification machine, disposable surgical items and foldable IOLs) and lack of surgeons trained in phacoemulsification (and many other administrative hurdles).[10] Phacoemulsification is performed by the creation of a small wound (1.8-3.2 mm in width) placed at the corneal limbus. An ultrasonic probe attached to a phacoemulsification machine/system is inserted through the corneal incision which fragments and aspirates the cataract within the eye. A foldable lens of varying material (silicone/acrylic) is then injected into the capsular bag through the incision site. The surgical wound does not need suturing in uncomplicated surgeries.

The current trend of femtosecond laser cataract surgery is gaining popularity in developed countries and among patients in higher income groups in developing countries. A femtosecond laser is used to create the corneal incisions, the anterior capsulotomy and to divide the lens nucleus into many fragments. A phacoemulsification probe is then utilised to remove the cataract. The IOL is then injected through the wound and positioned in the posterior chamber (or capsular bag) as in standard phacoemulsification with IOL. Femtosecond laser cataract surgery is considered to be minimally invasive surgery but has substantially higher cost implications for the patient.[15]

The threshold for performing cataract surgery in many developed countries is a visual acuity of 6/9.5 or worse.[10] Some countries like the United Kingdom perform cataract surgery on patients with a visual acuity of 6/12 or worse.[1] The majority of cataract surgery performed in developing countries is on patients with a visual acuity of 6/38 (logMAR 0.8) or worse, with a large proportion of patients having a visual acuity between light perception and 6/120 (> logMAR 1.30).[5,6]

Regardless of whether a surgeon has a threshold for performing cataract surgery for a patient with a visual acuity of 6/38 (logMAR 0.8) or 6/9.5 (logMAR 0.2), the surgeon aims for a post operative uncorrected visual acuity of at least emmetropia or 6/6 (logMAR 0)[10]. However, some patients may not require emmetropia and would prefer to perform their daily activities involving near or intermediate distance vision such as reading, working on their computers and using cellular phones without spectacle correction.

The target for cataract surgery outcomes states that at least 85% of patients must achieve an uncorrected visual acuity of 6/18 (0.5 LogMAR) or better post operatively as recommended by the WHO and the International Agency for the Prevention of Blindness.[2] This target was based on the insertion of a monofocal IOL that enables a patient to reach emmetropia.[16] The monitoring of outcomes in cataract surgery has made surgeons more aware of quality control, which has been shown to lead to improved outcomes in the longer term.[13] Fong et al have demonstrated that in older patients with moderate to severe visual impairment, the restoration of vision has been shown to be associated with a lower mortality risk when compared to cataract surgery patients in whose visual impairment persisted post operatively due to other possible pathology such as glaucoma or age-related macular degeneration .[3]

In the Liwan eye study involving 62 eyes, Huang W, Zheng Y and Wang L et al. noted that 77.1% (n=48) of patients achieved >6/18 (≤ logMAR 0.5) visual acuity, 14.5% (n=9) achieved between 6/18-6/60 (logMAR 0.5-1), and 8.06% (n=5) achieved <6/60 (>logMAR 1) visual acuity 5 years post operatively.[8]

Results from a multicentre cohort trial performed by Hahn U, Krummenauer F, Kölbi B et al, involving a total population of 1553 patients, 87.3% of patients achieved a visual acuity of 6/12 (logMAR 0.3) or better three months postoperatively.[7]

The European registry of quality outcomes for cataract and refractive surgery (EUROQUO) is a co-funded project between the European society of cataract and refractive surgeons (ESCRS) and the European union (EU). It was formulated to monitor cataract and refractive surgery outcomes including complication rates. EUROQUO evaluated 60 day post phacoemulsification visual acuity outcomes for 241136 European union patients with uncomplicated phacoemulsification and found

that 97.2% of them achieved a corrected (vision corrected with spectacles, contact lenses or corneal refractive surgery) visual acuity of 6/12 (logMAR 0.3) or better.[14]

When recently evaluating the effect of advanced age on post-cataract surgery visual outcomes, researchers found that the probability of achieving ≥ logMAR 0.3 (6/12) vision is 4.6 times higher for patients in the 60-79 year age group than that for patients aged 80 and above. This finding was independent of intraoperative or postoperative complications, the experience of the surgeon and ocular co-morbidities.[12]

In a recent prospective observational case series, spectral domain optical coherence tomography (SD-OCT) was utilised to assess the retinal thickness of twenty nine healthy eyes with normal slit lamp examinations that had undergone uncomplicated phacoemulsification with insertion of an IOL. The results showed a statistically significant increase in choroidal thickness with no morphological change in the retina. The choroidal thickness observed on SD-OCT persisted beyond the six month follow-up assessment.[17] An increase in choroidal thickness can be associated with a poorer visual acuity.

Researchers at the Singapore National Eye Centre (a large tertiary ophthalmic institution) evaluated cataract surgery outcomes of 48 337 eyes which had undergone phacoemulsification. This number included 887 (1.83%) eyes that had developed intraoperative and postoperative complications. 37 832 (78.2%) of these surgeries were performed by senior surgical staff and the rest were performed by junior surgical staff. At 5 years, the corrected visual acuity for 98.5% of patients was found to be logMAR 0.3(6/12) or better. In this study, researchers found no statistically significant difference when comparing the visual acuity results of senior cataract surgeons to those of junior cataract surgeons.[18]

When evaluating surgical outcomes of cataract surgery and comparing junior cataract surgeons (registrars) to senior cataract surgeons, some studies have shown an increased rate of surgical complications by some senior surgeons as opposed to junior surgeons[19]. This result is believed to be due to the fact that senior surgeons attempt more challenging cases and use more advanced phacoemulsification techniques than juniors who usually perform uncomplicated surgeries. Tsinopoulos et

al advocate the allocation of difficult cataract surgeries to surgeons with advanced experience noting that this reduces the risk of intraoperative complications, thereby improving the outcomes of surgery. Reduction of complications has been shown to lead to a better visual acuity and subsequently a better quality of life.[20]

In this study the use of postoperative uncorrected visual acuity has been shown to be an invaluable tool in assessment of cataract surgery outcomes. Assessment of cataract surgery outcomes has been advocated by the WHO[2] and it allows informed improvements to be made if need be, with regard to the cataract surgery offered in any ophthalmic institution. Furthermore the comparison of cataract surgery outcomes between junior and senior surgeons aids in evaluating the phacoemulsification training programme of teaching institutions.

1.3 Research aim:

The aim of this research project was to evaluate uncorrected visual outcomes achieved in patients who had undergone phacoemulsification with insertion of an intraocular lens at St John Eye Hospital.

1.4 Research objectives:

a) To evaluate visual outcomes obtained at St John Eye Hospital for patients undergoing phacoemulsification with insertion of a posterior chamber IOL and to compare these visual acuity outcomes with the standards recommended by the World Health Organisation.
b) To assess visual acuity outcomes achieved by junior and senior cataract surgeons and to compare the visual acuity outcomes of the junior surgeons to the senior surgeons.

CHAPTER 2

2. METHODS AND MATERIALS

2.1 Study Design

A retrospective clinical audit of 100 random files of patients who had undergone phacoemulsification with insertion of an IOL at St John Eye Hospital between 1 February 2015 and 31 January 2016. The uncorrected postoperative visual acuities of these patients were collected and analysed.

2.2 Ethical considerations

2.2.1 Ethical clearances

The research protocol was submitted to the following departments and the necessary permissions and clearances were obtained prior to commencement of the study:

a) Clearance certificate number M160145 issued by the University of Witwatersrand Human Research Ethics Committee (Medical) (Appendix 1)
b) Permission from Head of Department of Ophthalmology at St John Eye Hospital (Prof GD McLaren) to conduct the study. (Appendix 2)
c) Permission from the Chris Hani Baragwanath Academic Hospital Medical Advisory committee. (Appendix 3).

2.2.2 Patient confidentiality

Each patient's name and file number was allocated a serial number. All data were analysed using this serial number. The patient's name or file number is not divulged in any aspect of the study. The principal researcher and supervisor were the only persons with access to this information. The tenets of The Declaration of Helsinki were adhered to.

2.3 Data collection

The investigator collected post operative cataract surgery data of one hundred patients presenting randomly at St John Eye Hospital with a history of phacoemulsification with insertion of an IOL being done in the period between 1 February 2015 and 31 January 2016. All data were entered onto an Excel (Microsoft Corp) spreadsheet at the time of collection. All visual acuities were recorded in logMAR notation. Visual acuities were categorised as: good, borderline or poor in accordance with the WHO standards for evaluation of post cataract surgery visual acuity[2]

Table 1: WHO standards for evaluation of post cataract surgery visual acuity[2] (adapted to include logMAR notation)

CATEGORY	SNELLEN NOTATION	logMAR NOTATION
GOOD	6/6 – 6/18	0-0.5
BORDERLINE	< 6/18 – 6/60	>0.5-1
POOR	< 6/60	> 1

2.3.1 Inclusion Criteria

a) Patients had a history of uncomplicated phacoemulsification with insertion of a posterior chamber IOL between 1 February 2015 and 31 January 2016.
b) Files of eligible patients must have had recorded uncorrected visual acuities done at 1 week and 1 month post operatively.

c) A total of 100 patients' records were included in the study.
d) Patients' files must have had the name of the surgeon in order to assess the surgeons' level of experience.

2.3.2 Exclusion criteria

Patients with a history of the following ocular co-morbidities recorded in their files:

a) Corneal pathology including corneal guttata, corneal scar or patients who had undergone corneal refractive surgery.
b) Patients diagnosed with glaucoma (and those who have undergone any form of glaucoma surgery).
c) Patients with a history of uveitis and subsequent ocular complications as a result of it (such as keratic precipitates, band keratopathy, posterior synechiae, glaucoma and vitreoretinal pathology).
d) Pseudo-exfoliation syndrome
e) Patients with non-proliferative diabetic retinopathy stages II, III and proliferative diabetic retinopathy
f) Patients with a history of ocular trauma
g) Age-related macular degeneration
h) Patients who had undergone vitreoretinal surgery.
i) Patients who had IOL implantion for visual goals other than emmetropic correction.
j) Patients who had the following complications during phacoemulsification:
    i. Corneal trauma
    ii. Iris trauma or dehiscence
    iii. Posterior capsular rupture with inability to insert a posterior chamber IOL.
    iv. Patients presenting with a post operative refractive surprise as a result of incorrect IOL or IOL placed anywhere other than in the posterior chamber.
    v. Patients who had an IOL exchange.

2.4 IOL calculation method

IOL power calculation (biometry) was done using the NIDEK AL-SCAN optical biometer (NIDEK co LTD, Aichi Japan). The SRK-T formula was used in all patients.

2.5 IOL type

The FREEDOMFOLD® hydrophillic acrylic foldable IOL (Freedom Ophthalmic Inc. Missiauga, Canada) was used in all patients. The optic diameter is 6.00mm, overall diameter is 12.50mm and it has an A-constant of 118.0.

2.6 Surgical technique

All patients were dilated preoperatively with Cyclomydril. A 5% solution of povidone iodine was instilled 5 minutes prior to surgery, it was subsequently irrigated prior to the corneal incision being performed. Surgery was performed through a 3.2mm incision and an additional 1 or 2 further paracentheses were made depending on surgeon preference. An anterior capsulorrhexis was performed, the nucleus was hydrodissected. Phacoemulsification was performed using the INFINITI ® Vision System (Alcon, Fort Worth, Texas, USA). The IOL of appropriate dioptre power was then injected into the capsular bag. Vigamox® (moxifloxacin) (0.1ml) was injected intracamerally at the end of the procedure.

2.7 Postoperative care

All patients received Spersadex Comp® (dexamethasone/chloramphenicol) 6 hourly for a total period of 1 month. Paracetamol 1g q 6 hourly was supplied for a period of 1 week.

CHAPTER 3

3. Results

3.1 Study number

A total of one hundred files of individuals with a history of cataract surgery were selected randomly. All individuals had uncomplicated phacoemulsification with insertion of a foldable IOL and a history of no co-morbidities preoperatively or post operatively as noted in their records.

3.2 Gender distribution

Out of 100 study participants, 42 individuals were male and 58 were females.

3.3 Age distribution

Figure1: Age distribution of all individuals according to age groups

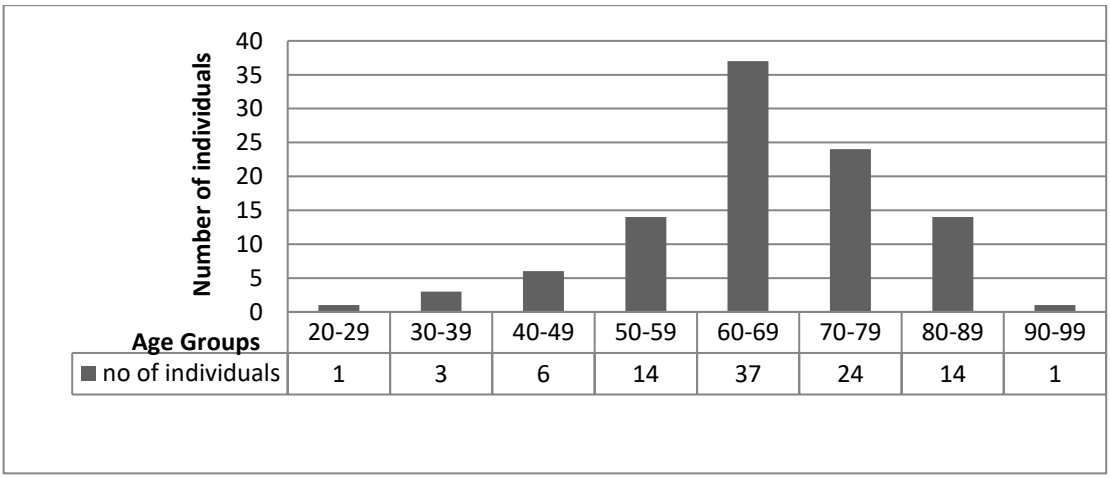


Table 2: Statistical evaluation of all patients' ages

Minimum age	21 years
Maximum age	90 years
Average age	66.7 years

The youngest patient was aged 21 while the oldest patient was aged 90. The average age for all patients included in the study was 66.7 years.

Figure2: Age distribution of females included in the study according to age groups

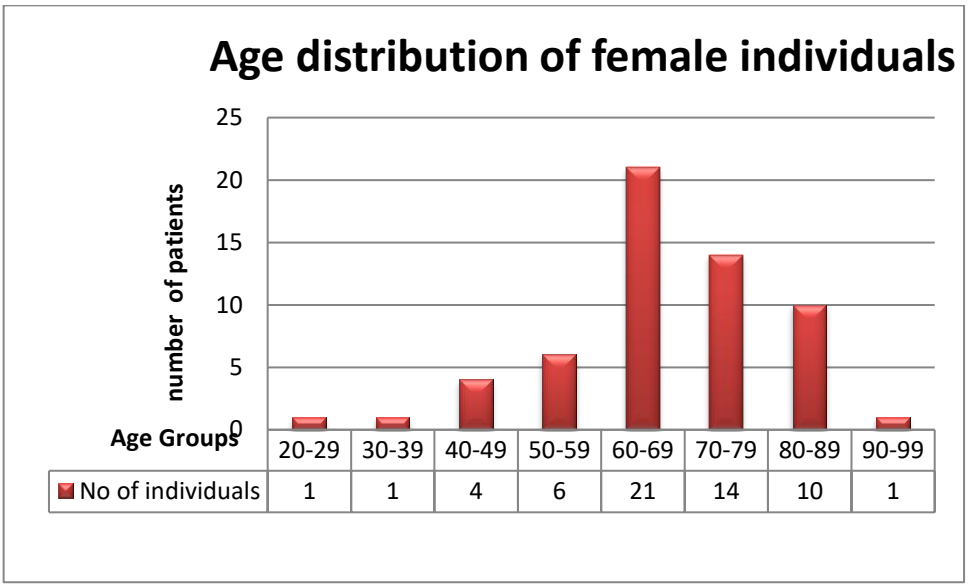


Table 3: Statistical evaluation of female patients' age

Minimum age	21 years
Maximum age	90 years
Average age	67.3 years

A total of 58 female individuals were included in this study. While the youngest female patient was 21 years of age, the oldest was 90 years of age. The greatest number of females included in this study fell into the 60-69 year age group (n=21) constituting 36% of female study participants. The smallest groups were the 20-29, 30-39 and 90-99 year age groups with 1 female individual each, constituting 2% of female study participants each. The average female age was found to be 67.3 years old.

Figure 3: Age distribution of male patients included in the study according to age groups

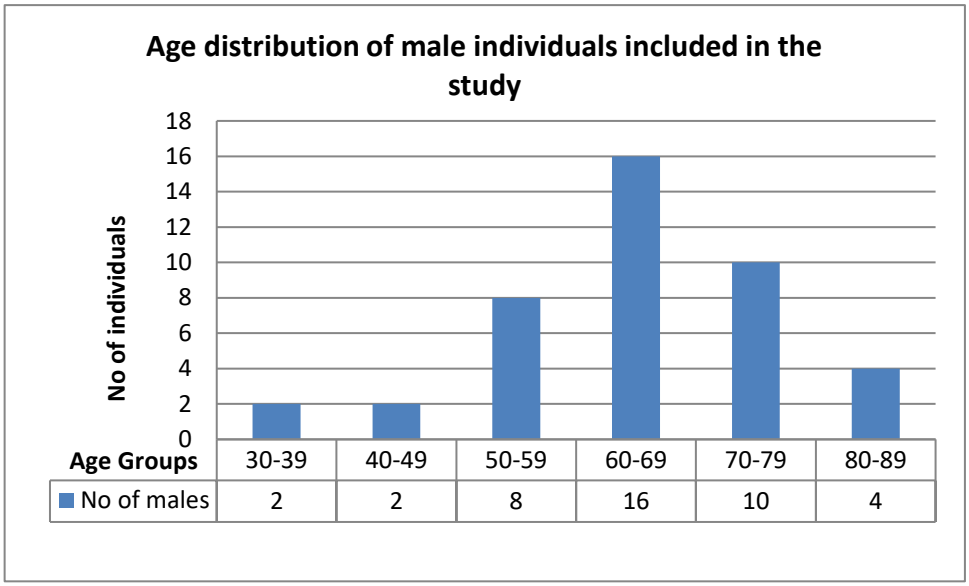


Table 4: Statistical analysis of age of males included in the study

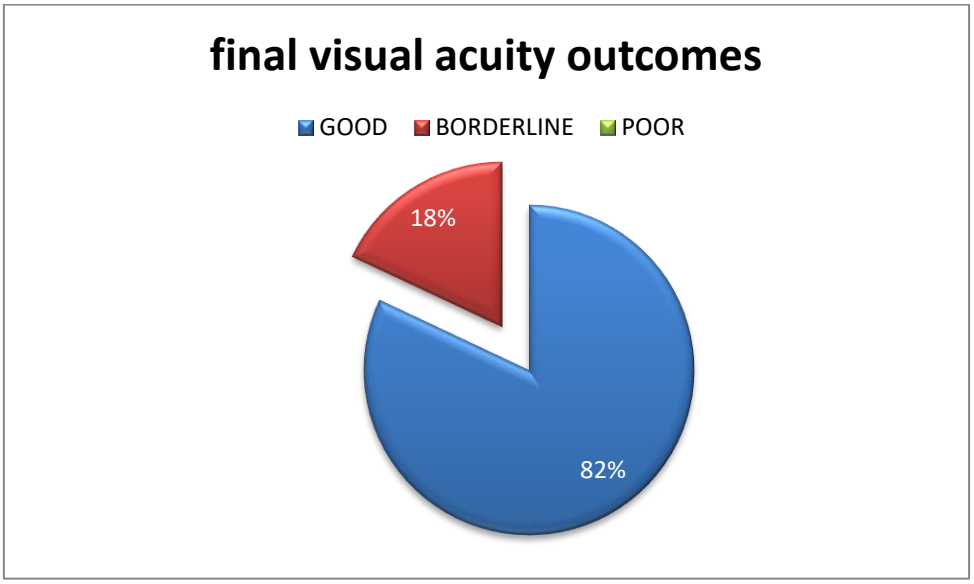
Minimum age	37 years
Maximum age	86 years
Average age	65.8 years

A total of 42 male individuals were included in this study. The youngest male patient was 37 years of age, with the oldest being 86 years of age. The greatest number of males included in this study fell into the 60-69 year age group (n=16) constituting 38% of male study participants. The smallest groups were the 30-39 and 40-49 year age groups with 2 male individuals each, constituting 4.8% of male study participants each. The average male age was found to be 65.8 years old.

3.4 Visual acuity outcomes

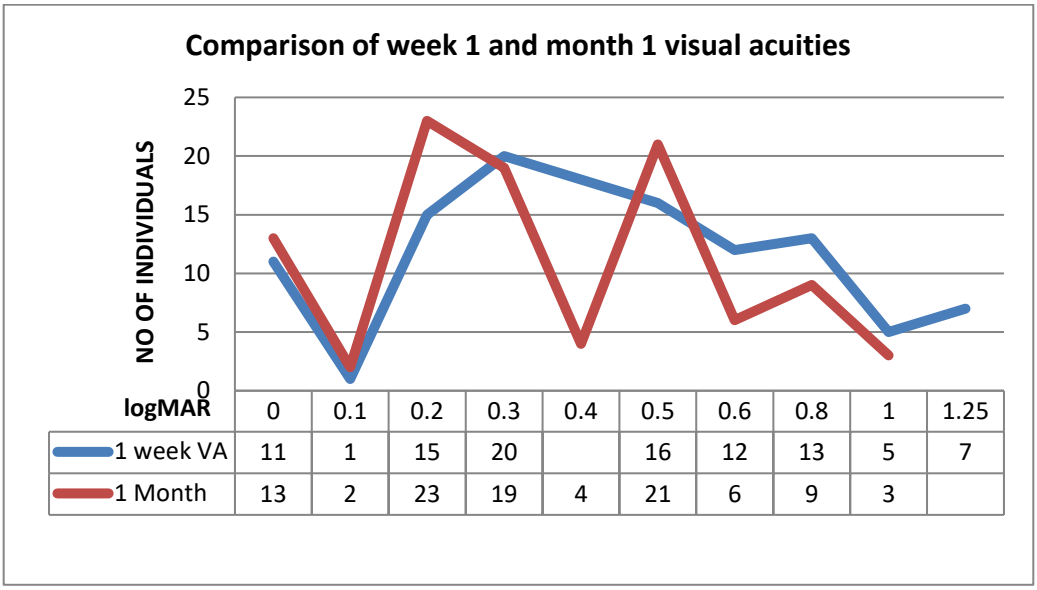
Visual outcomes were grouped into 3 categories as defined by the WHO[2]:
(see page 8)

Figure 4: Visual acuity achieved at 1 month follow-up visit (final VA)



At the 1 month follow-up visit, 82% of all individuals included in this study attained a good uncorrected visual acuity [logMAR 0 (6/6)-logMAR 0.5 (6/18)] while 18% of all individuals attained a borderline [between logMAR 0.5 (<6/18) and logMAR 1(6/60)] uncorrected visual acuity and no individuals achieved a poor (> logMAR 1 or < 6/60) uncorrected visual acuity. A primary objective of the study was to test whether at least 85% of individuals attained a good uncorrected visual acuity after the procedure. Although the observed proportion of 82% is less than 85%, a 95% confidence interval for underlying proportion is [74.4%, 89.5%]. Since this interval contains 85%, the observed proportion of 82%is not low enough for us to reject the hypothesis that at least 85% of individuals will obtain a good uncorrected visual acuity in general. We also have that 38% (n=38) achieved an uncorrected visual acuity of ≤ logMAR 0.2 (≥6/9.5).

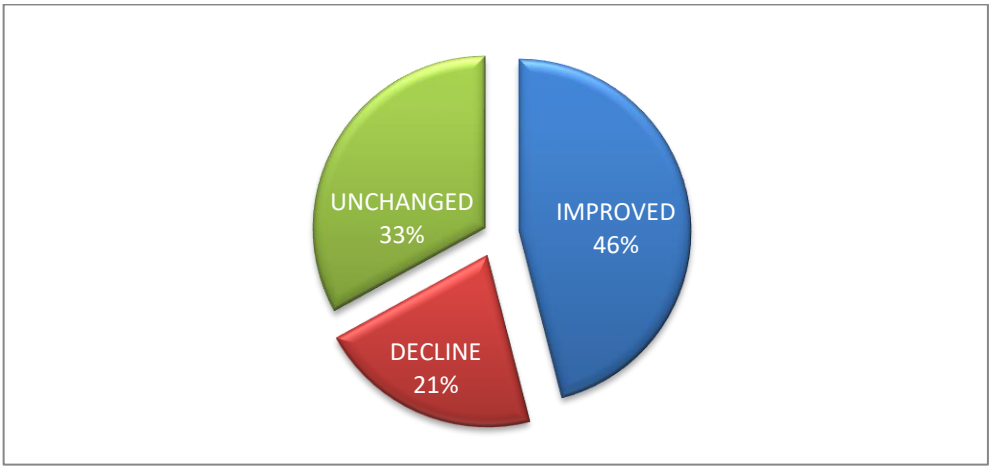
Figure 5: Comparison of average visual acuities achieved at 1 week and 1 month follow-up visits.



logMAR	0	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1	1.25
1 week VA	11	1	15	20		16	12	13	5	7
1 Month	13	2	23	19	4	21	6	9	3	

At the 1 week follow up, 63% (n=63) fell into the good visual outcome group, this number increased to 82% (n=82) at 1 month. The borderline visual acuity group comprised of 30% (n=30) of patients at 1 week, this number dropped to 18% (n=18) at the 1 month follow-up point. Seven percent (n=7) of patients fell into the poor visual outcome group at 1 week, there were no patients at the 1 month follow-up visit in the poor visual acuity group.

Figure 6: Distribution of individuals with improved, unchanged or decline in visual acuities between 1 week and 1 month post phacoemulsification.



Forty-six percent (n=46) of patients had an improvement in visual acuity between the 1 week and 1 month follow-up visits while the vision of 33% (n=33) of patients

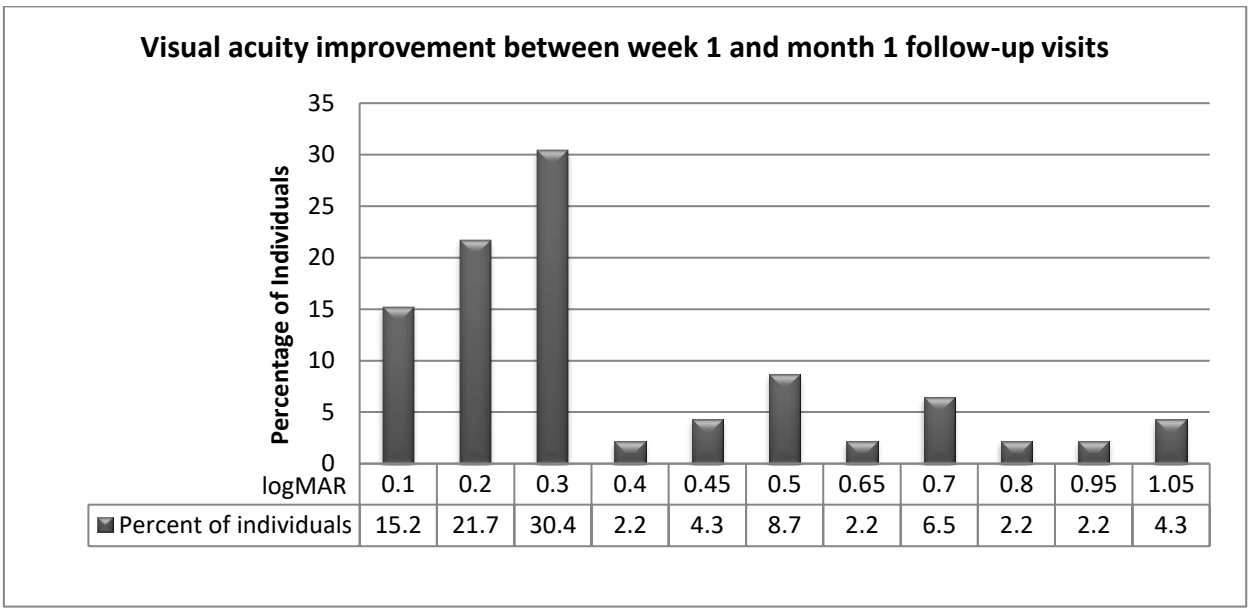
remained unchanged and 21% (n=21) of patients displayed a decline in vision. Patient records did not reflect other concurrent ocular pathology in order to isolate a cause for the decline in postoperative vision.

Table 5: Analysis of individuals in the group with improved visual acuities

Mean visual acuity at 1 week	LogMAR 0.49
Average VA improvement between 1 week and 1 month	LogMAR 0.12
Mean visual acuity at 1 month	LogMAR 0.36

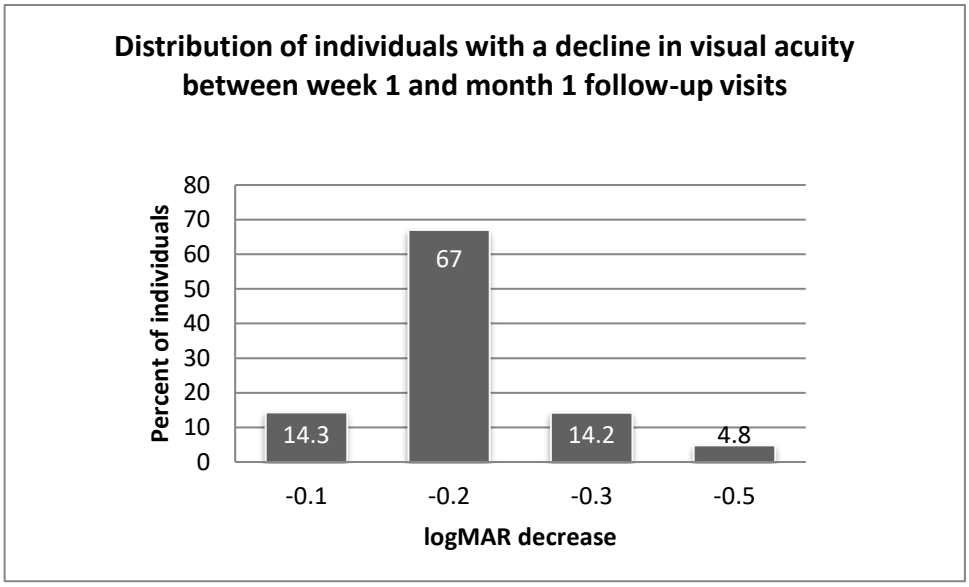
The mean visual acuity in this group of individuals was logMAR 0.49 (6/18). They showed an average improvement of logMAR 0.12 to reach a mean uncorrected visual acuity of logMAR 0.36 at the 1 month follow-up visit. The average 0.12 logMAR improvement in VA between the 1 week and 1 month follow-up visits is highly statistically significant with a p-value=0.0001 (p-value < 0.05 being statistically significant at 5%). It can thus be concluded that in a wider population, there will be an improvement in VA from 1 week to 1 month. Although the estimate of average VA improvement from 1 week to 1 month is 0.12 logMAR, it could be as high as 0.18 logMAR based on a two-sided 95% confidence interval.

Figure 7: Quantification of visual acuity improvement versus number of individuals with improvement in VA between the 1 week and 1 month follow-up visits



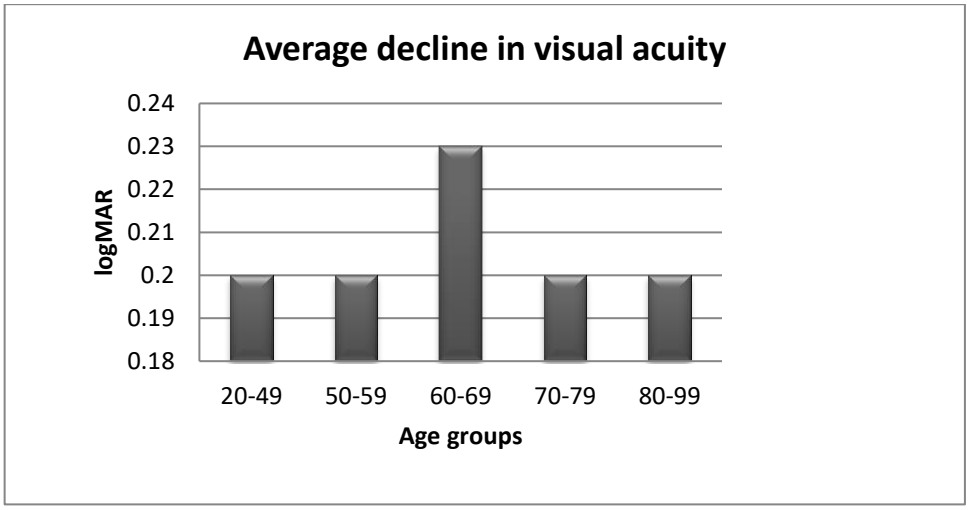
In this group, most of the individuals (30.4% (n=14)) had an improvement of only 0.3 logMAR, while 21.7% (n=10) had a 0.2 logMAR improvement and 15.2% (n=7) had an improvement of 0.1 logMAR. The remaining 32.7% (n=15) had an improvement that ranged between 0.5 and 1.05 logMAR.

Figure 8: Distribution of individuals with a decline in visual acuity between week 1 and month 1 follow-up visits



(a negative Log MAR value is used to denote the amount of decrease in VA)

Figure 9: Average decline in visual acuity of all patients according to age groups between the 1 week and 1 month visits

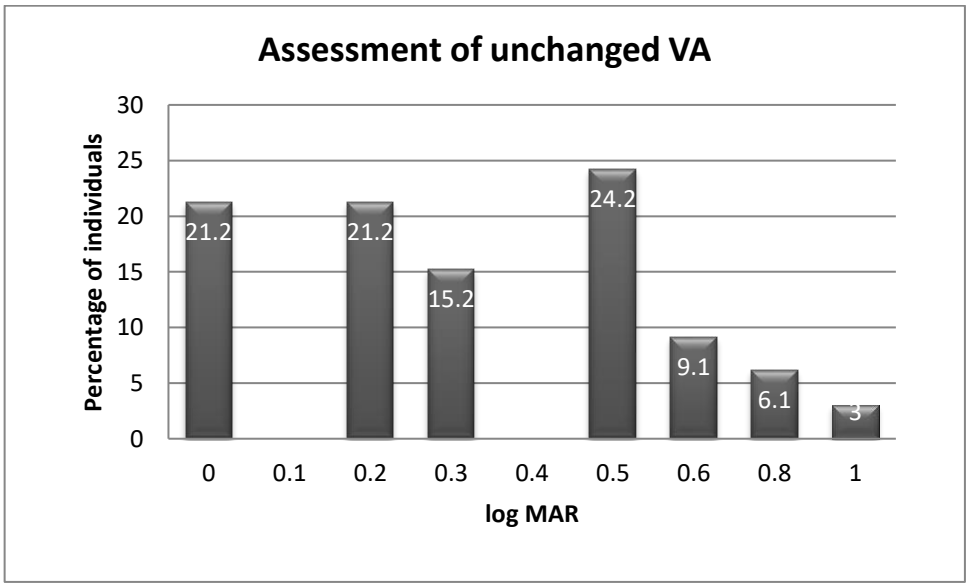


Within the group of individuals with a decrease in visual acuity (n=21), the majority of subjects (66.7% (n=14)) sustained a decrease of 0.2 logMAR. Three individuals (14.3%) had a decline of 0.1 logMAR and another 14.3% (n=3) sustained a 0.3 logMAR decline in visual acuity. One individual (4.8%) had a 0.5 logMAR decrease in visual acuity. Average decline in vision was 0.21 logMAR. The 60-69 year age group showed the greatest amount of average decline in VA. Causation for the decline in visual acuity could not be isolated in patient records as all patients included in the study displayed no records of other ocular pathology.

Table 6: Analysis of average visual acuities for patients with unchanged visual acuities between the 1 week and 1 month follow-up visits

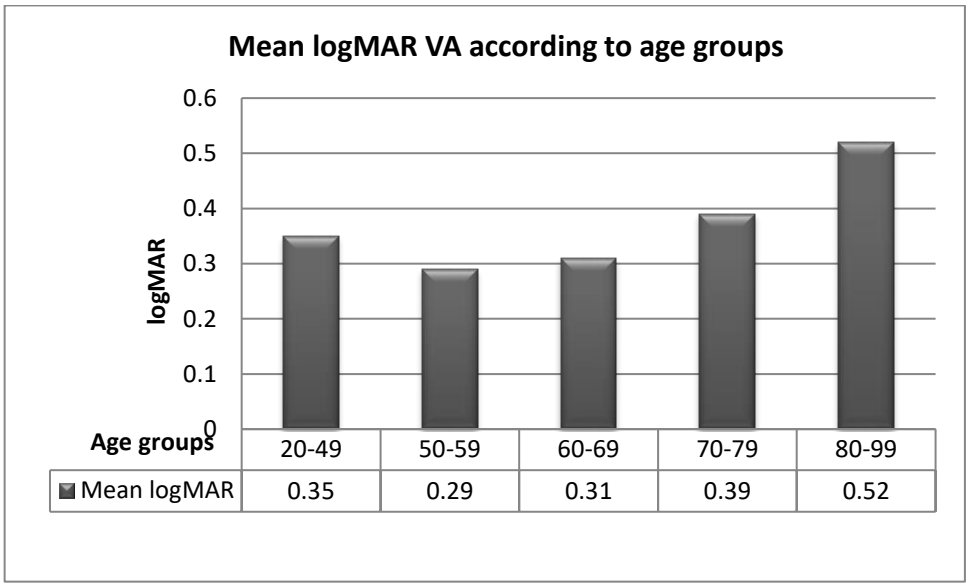
	LogMAR	Percentage of individuals
Average visual acuity	0.33	33
Average visual acuity for females	0.34	20
Average visual acuity for males	0.31	13

Figure10: LogMAR distribution of patients with unchanged visual acuities between the 1 week and 1 month follow up visits



Amongst individuals with no change in visual acuities between their 1 week and 1 month follow-up visits (33%; n=33), the mean VA was logMAR 0.33. Males had a slightly higher mean VA of logMAR 0.31 then females who had a mean VA of logMAR 0.34. Eight individuals (24.2%) maintained a VA of logMAR 0.5 (6/18), while 21.2% (n=7) of individuals maintained logMAR 0 (6/6) and a further 21.2% (n=7) maintained logMAR 0.2 (6/9). Twenty-seven individuals (81.8%) thus maintained a good visual outcome while 18.2% (n=6) maintained a borderline visual outcome.

Figure 11: Mean visual acuity outcomes according to age group.

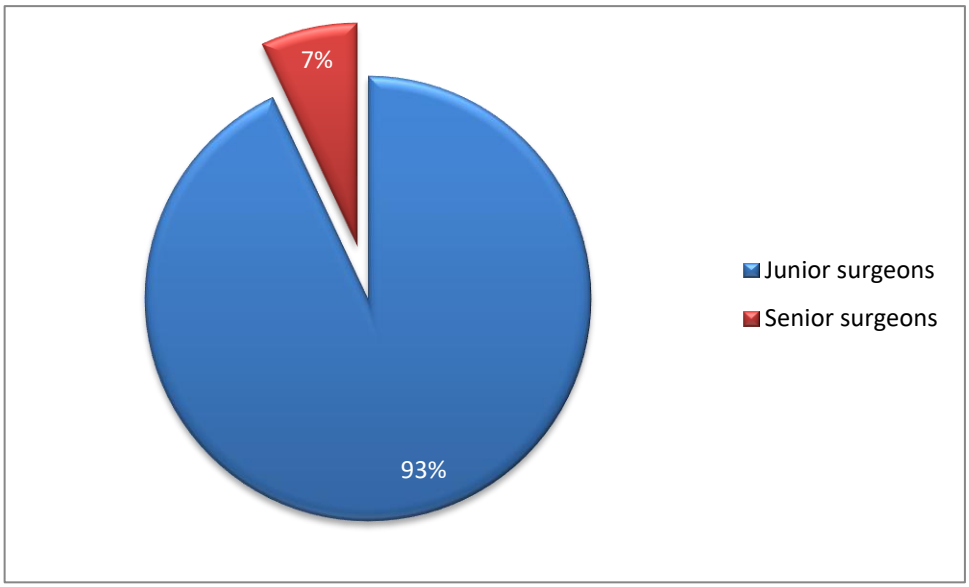


The range of mean visual acuity by age group was from 0.29 to 0.52 logMAR. It is noted that the oldest study participants (80-99 year age group) had the worst mean month 1 visual acuity (logMAR 0.52). The 50-59 year age group displayed the best mean visual acuity at the month 1 follow-up visit. It is noted that there is a 0.003 logMAR decrease in visual acuity for each year of advancing age.

When comparing different age groups' final visual acuity outcomes at 1 month, a p-value of 0.09 ($p<0.05$ is considered clinically significant) was derived. We can thus deduce that there is no statistically significant difference in the 1 month VA results between the different age groups.

3.5 Surgical skill analysis

Figure 12: Percentage of cataract surgeries performed by junior cataract surgeons compared to senior surgeons



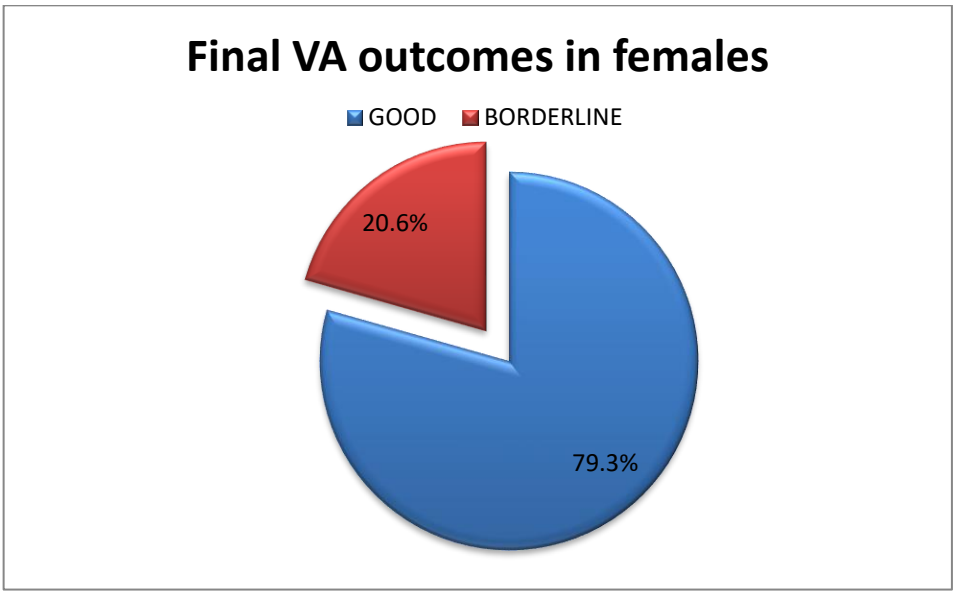
Ninety-three percent of cataract surgeries were performed by junior (registrars undergoing training with a variation of 0 to 3 years of experience in performing phacoemulsification) surgical staff and 7% were performed by senior (consultant surgeons with more than 3 years of experience in performing phacoemulsification) surgeons.

A statistical significance on visual acuity outcomes could not be assessed due to a low percentage of surgeries being performed by senior cataract surgeons.

3.6 Gender based analysis

3.6.1 Analysis of female individuals

Figure 13: Final visual acuity outcomes in female individuals



Fifty-eight female individuals were included in this study. Forty-six individuals (79.3%) attained a good visual acuity outcome (logMAR 0-logMAR 0.5), while 12 individuals (20.6%) achieved borderline (logMAR 0.6- logMAR 1.0) visual acuities.

Figure 14: Average 1 month visual acuity of female patients according to age group

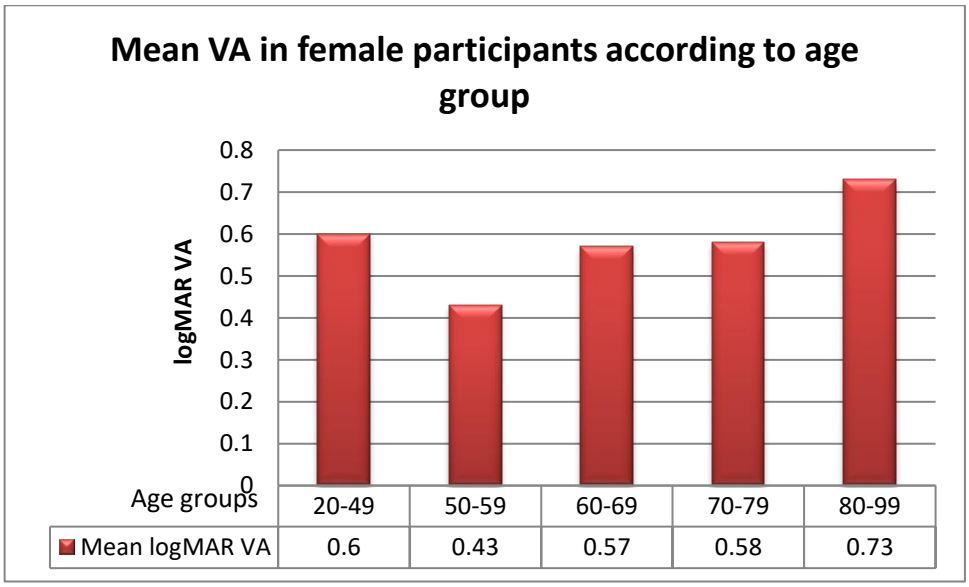
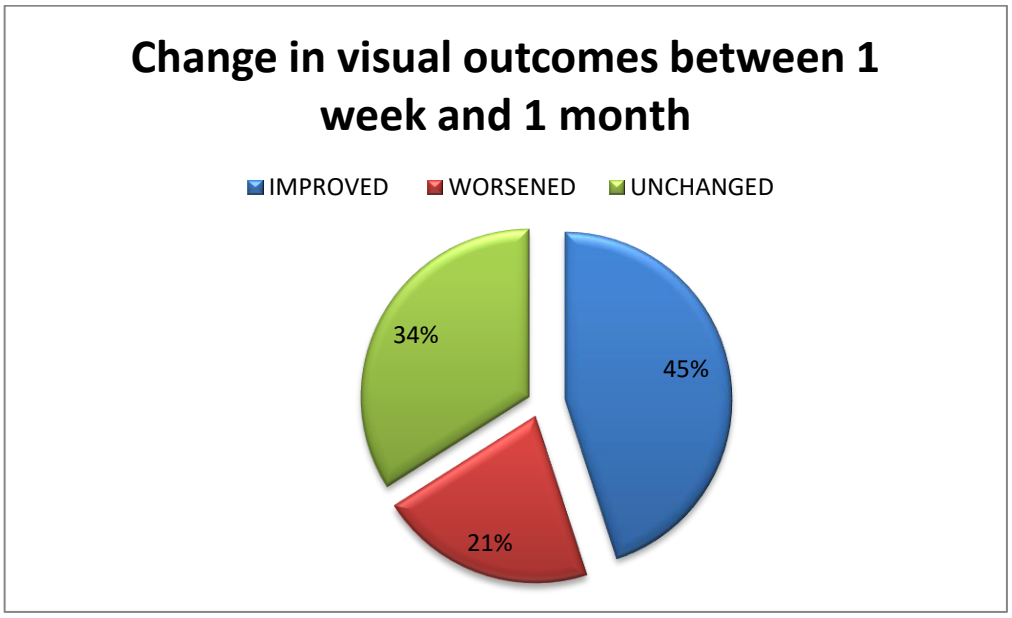


Figure 15: Change in visual outcomes between 1 week and 1 month in female patients



In 45% (n=26) of female individuals an improvement was noted in the logMAR VA between the 1 week and 1 month post phacoemulsification visits. The visual outcomes of 34% (n=20) of female individuals remained unchanged between their 1 week and 1 month follow-up visits while outcomes of the remaining 21% (n=12) decreased.

Figure 16:Line graph comparing average VAs at 1 week and 1 month visits according to age groups amongst females with an improvement in vision (n=26) highlighting the change in VA between these visits

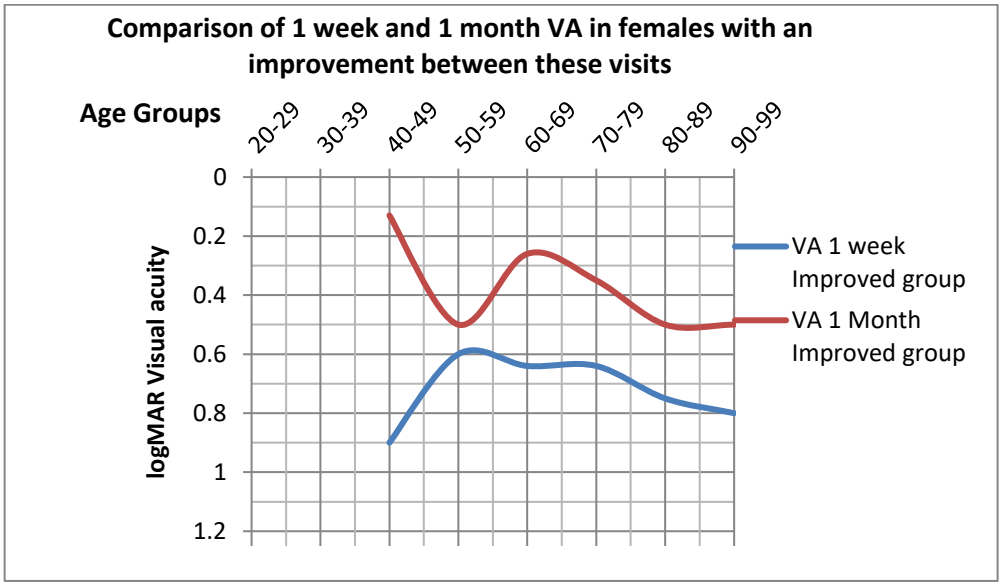
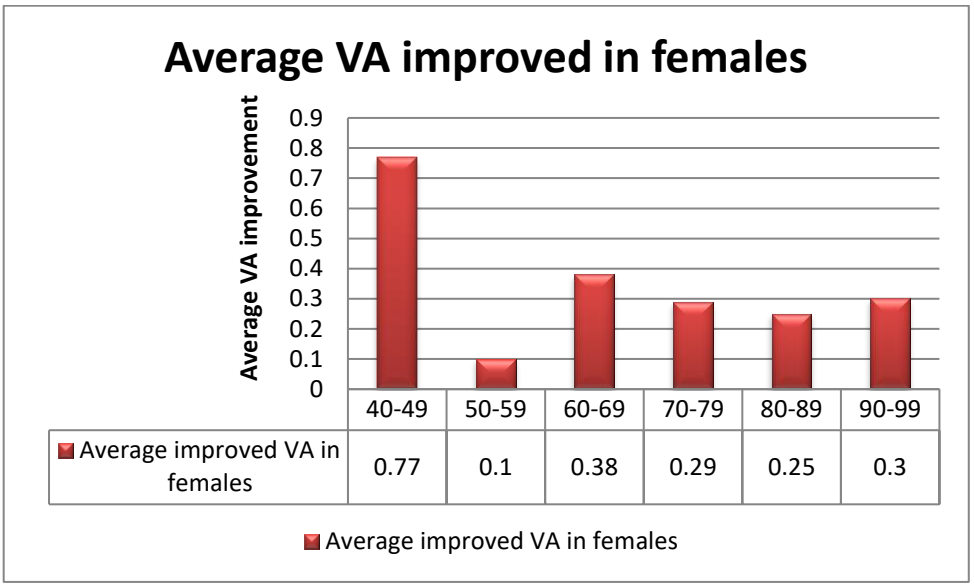


Figure17: Average improvement of visual acuity in females with an increase in vision between week 1 and month 1



In the above figures (Figure 16 and 17) it is noted that the greatest improvement between 1 week and 1 month in females was in the 40-49 year age group (average logMAR 0.77), with the least improvement occurring in the 50-59 year age group (average logMAR 0.1). Twenty-one percent (n=12) of females displayed a decrease in their vision between their week 1 and month 1 follow up visits. Females with an unchanged or decreased VA between 1 week and 1 month have been excluded in this graph. An average improvement of 0.45 logMAR was noted in this group, with a standard deviation of 0.31 logMAR.

Figure 18: Comparison of 1 week and 1 month VAs in female age groups with a decrease in visual outcomes. (n=12)

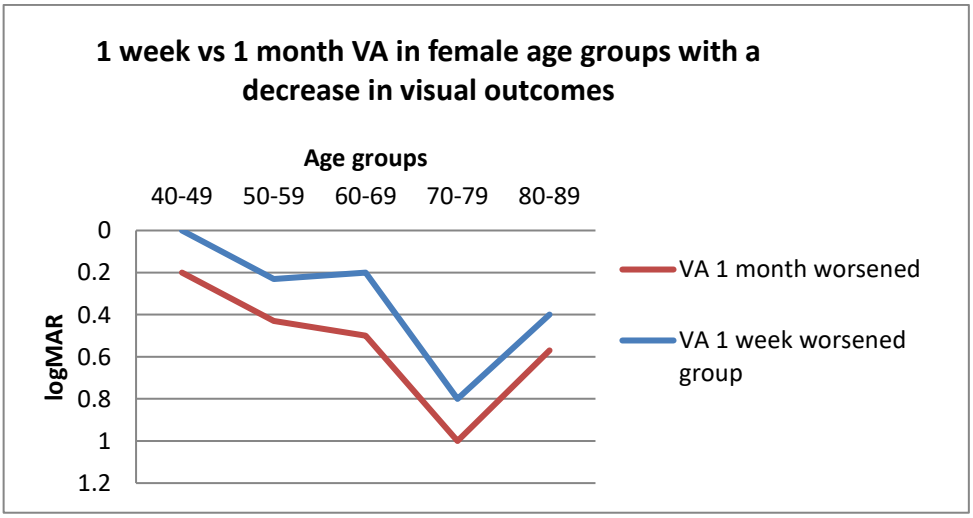
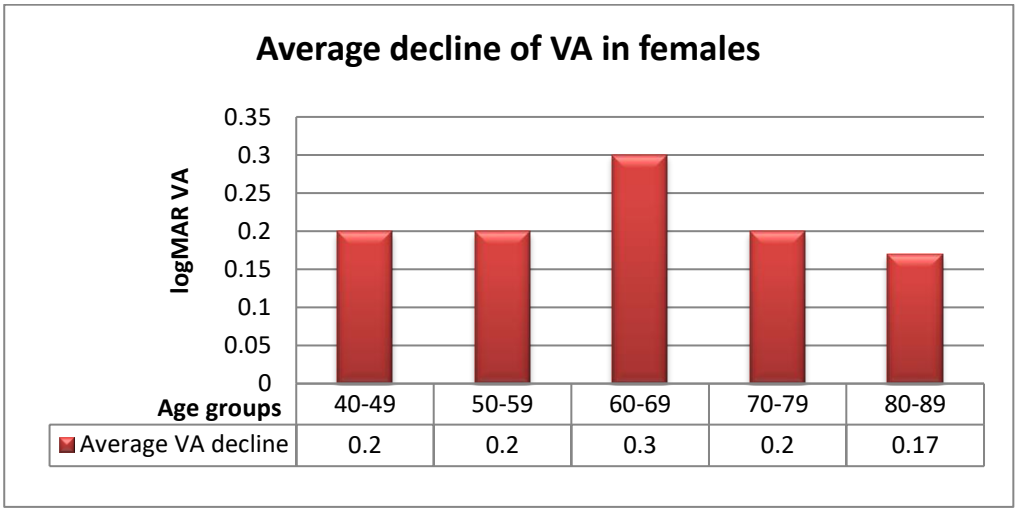


Figure 19: Average decline of visual acuity in females with a worsening of vision between week 1 and month 1 follow up visits



The most significant average decrease in VA of 0.3 logMAR was noted in the 60-69 year age group. Females in the 70-79 year age group had a mean decline of 0.21 logMAR displaying the poorest VA of logMAR 1 at the 1 month visit. Speculation of the reasons for this decline in vision can be found in the discussion.

Figure20: Mean visual acuity in females with unchanged vision between 1 week and 1 month follow-up visits.

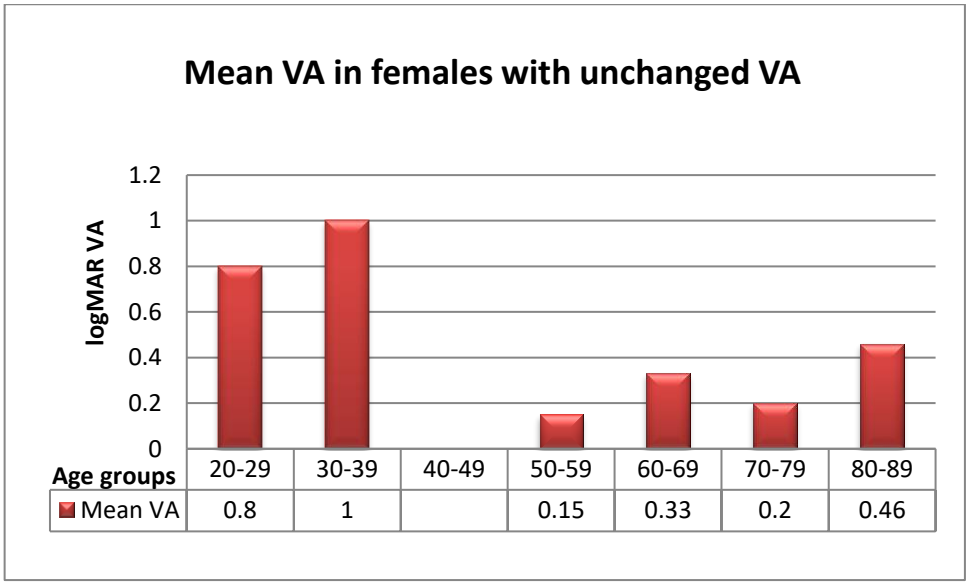
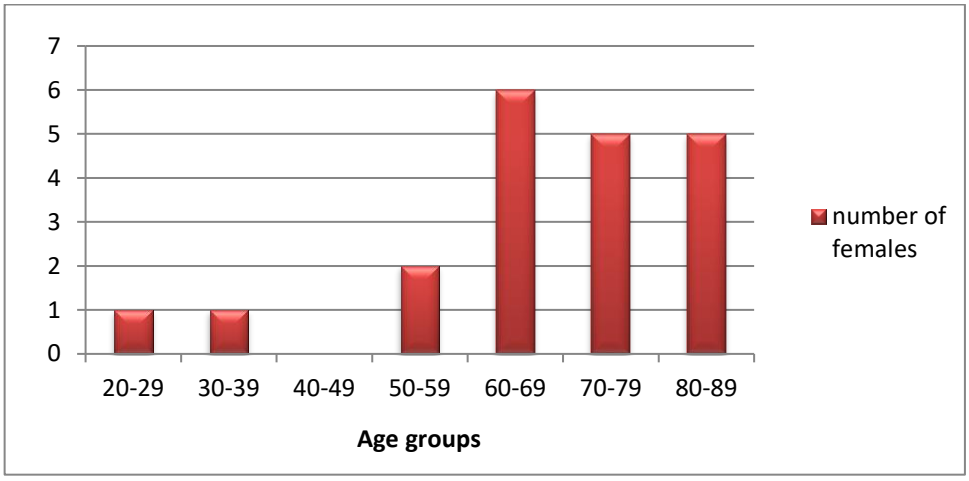


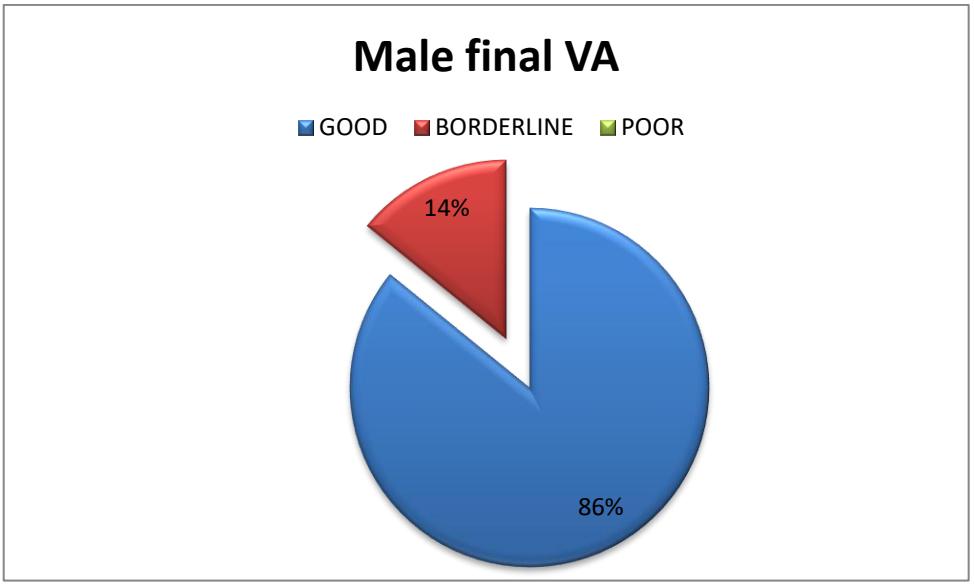
Figure 21: Number of females with unchanged logMAR VAs (n=20)



Thirty-four percent (n=20) of females had **no change** in logMAR VA between their 1 week and 1 month follow-up visits. The average for this group was logMAR 0.34. The poorest logMAR VAs were found in the younger females (20-29 (n=1) and 30-39 (n=1) year age groups). According to patient records, the female in the 20-29 year age group had type 1 diabetes mellitus but no active retinopathy was found at her post operative visits. The female in the 30-39 year age group had a normal ophthalmic examination post operatively with no other pathology noted in her records. The best logMAR VA was found in the 50-59 year age group.

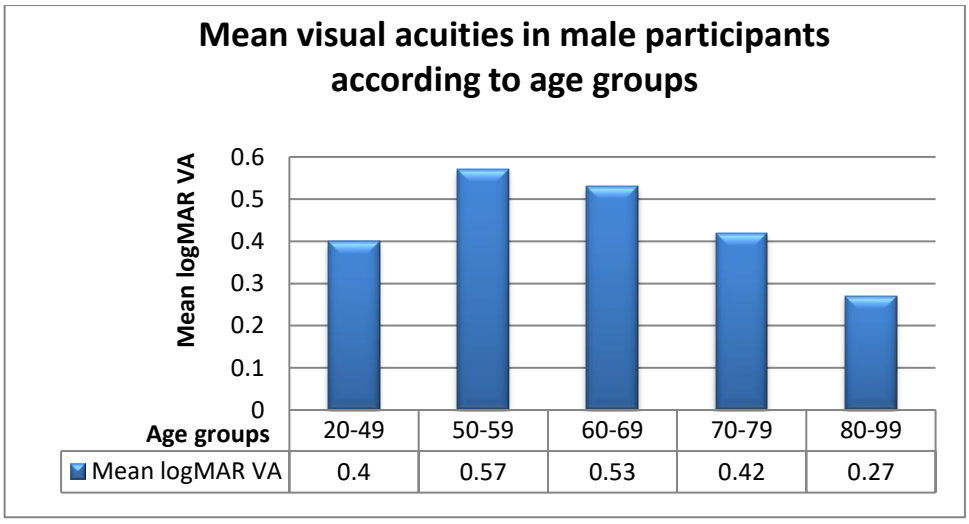
3.6.2 Analysis of male individuals

Figure 22: Final VA outcomes in male individuals



In male individuals 86% (n=36) achieved good visual outcomes (logMAR 0-0.5), while 14% (n=6) achieved a borderline visual outcome (0.6-1 logMAR) and no males achieved poor visual outcomes (> logMAR 1).

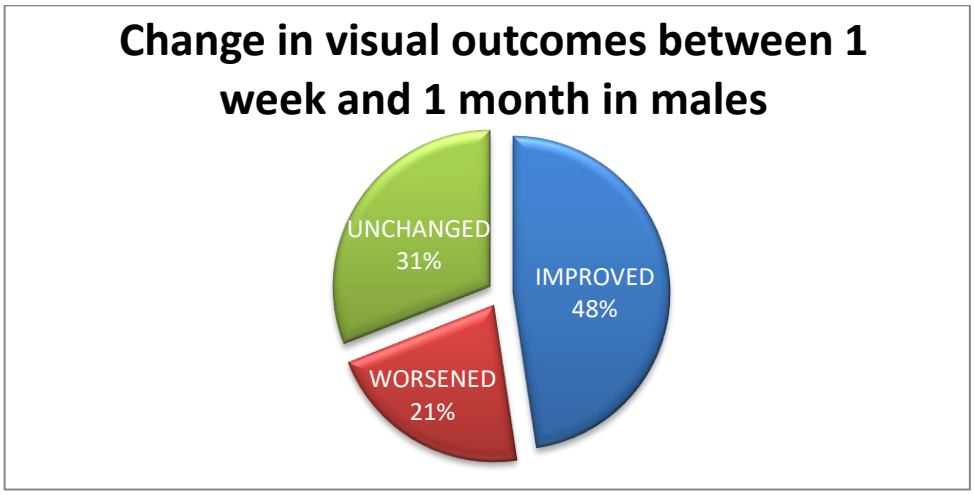
Figure 23: Mean visual acuities in male participants according to age groups. (n=42)



Males in the 80-99 year age group (n=4) achieved the best mean visual outcomes (logMAR 0.27) while those in the 50-59 year age group (n=8) had the poorest visual outcomes (logMAR 0.57). The older group of individuals (80-89 years) developed

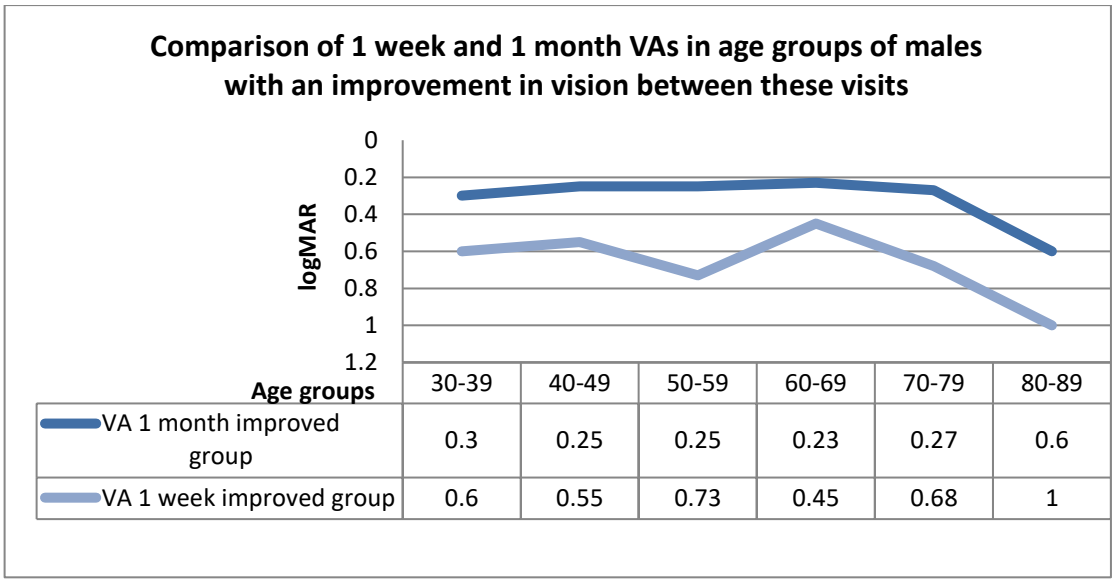
age related cataracts whereas the 50-59 year group developed cataracts as a result of other systemic co-morbidities such as diabetes mellitus and could therefore have had undetected ocular pathologies.

Figure24: Change in visual outcomes between 1 week and 1 month in males



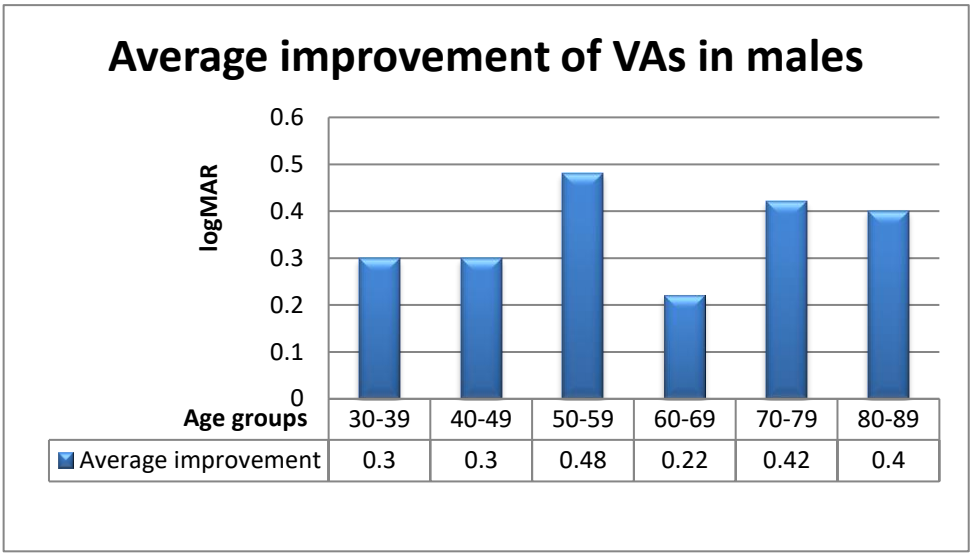
In 48% (n=20) of male participants, an improvement in logMAR VA was noted between the 1 week and 1 month follow up visits. Thirty-one percent (n=13) of males displayed no change in their visual outcomes, while 21% (n=9) of males had a worsening of their visual outcomes between their 1 week and 1 month follow up visits.

Figure25: Line graph comparing average VAs at 1 week and 1 month visits according to age groups amongst males with an improvement in vision between these visits. (n=20)



Age groups	30-39	40-49	50-59	60-69	70-79	80-89
VA 1 month improved group	0.3	0.25	0.25	0.23	0.27	0.6
VA 1 week improved group	0.6	0.55	0.73	0.45	0.68	1

Figure 26: Average visual acuity increase in males with an improvement in vision between their week 1 and month 1 follow-up visits (n=20)



In male participants the greatest improvement in visual outcomes was noted in 50-59 year age group (an improvement of 0.48 logMAR) while the least improvement occurred in the 60-69 year age group (0.22 logMAR improvement was noted). Amongst males with an improvement in visual outcomes, participants in the 80-89 year age group had the poorest average final visual outcomes (logMAR 0.6 or 6/24) and the 60-69 year age group had the best average final visual outcomes (logMAR 0.23 or approximately 6/9.5). Amongst male individuals with improved visual outcomes, there was a mean improvement of 0.48 logMAR.

Twenty-one percent (21%) (n=9) of males had a decrease in their visual acuities between their week 1 and month 1 follow-up visits. On examination of the records of these individuals, no other ocular pathology was noted as a possible cause for the decline in visual acuity.

Figure 27: Comparison of 1 week and 1 month VAs in male age groups with a decrease in visual outcomes. (n=9)

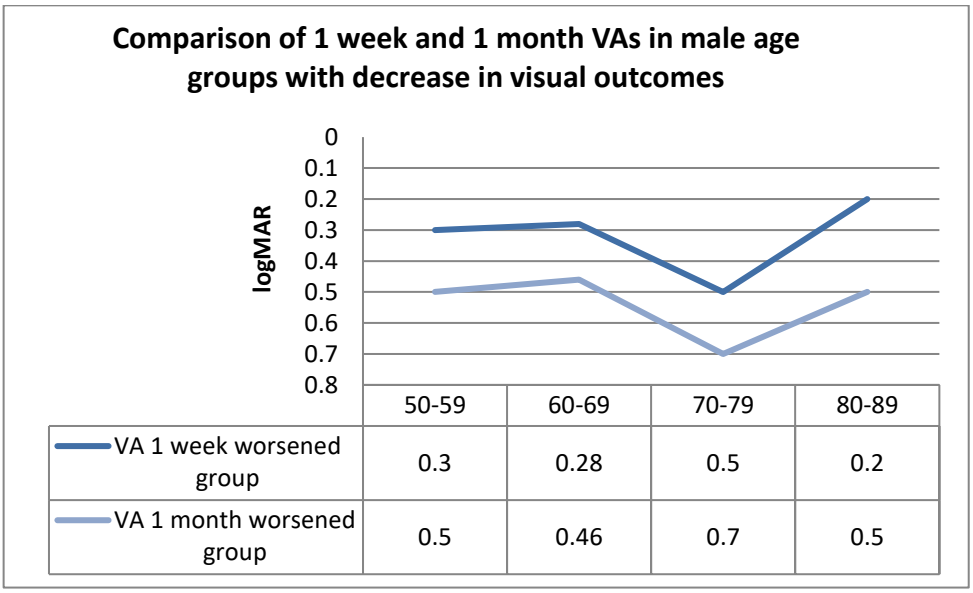
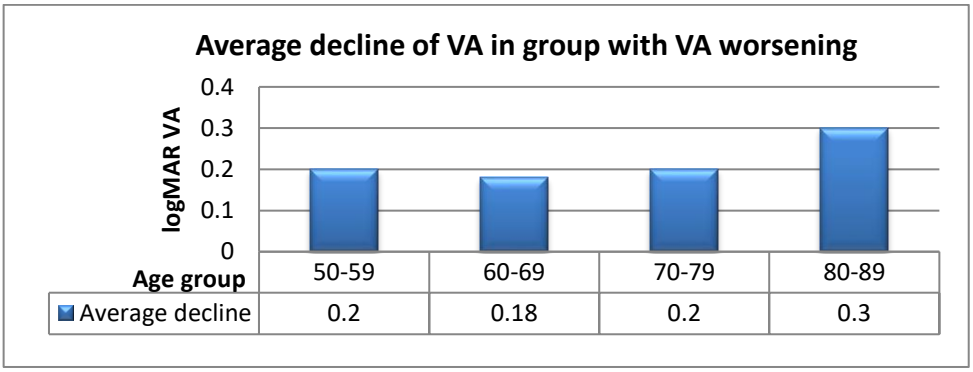
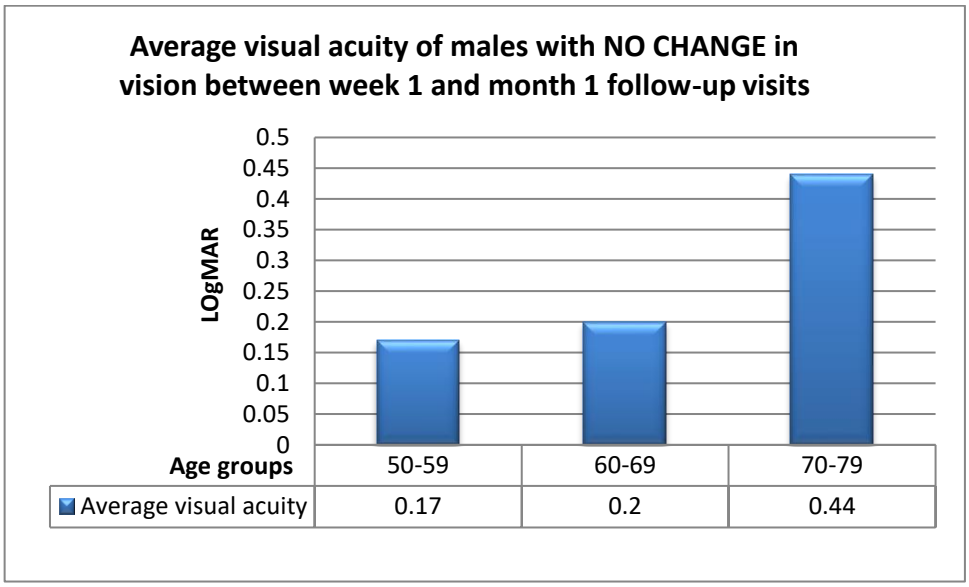


Figure 28: Average decline of visual acuity in males with a worsening of vision between week 1 and month 1 follow-up visits (n=9)



Males in the 70-79 year age group displayed the poorest initial and final average visual acuity (logMAR 0.5 and logMAR 0.7 respectively). Males in the 80-89 year age group had the best week 1 visual acuity (logMAR 0.2), yet displayed the greatest average decline (0.3 logMAR) to a month 1 visual acuity of logMAR 0.5. Male individuals in the 60-69 year age group displayed the best month 1 vision of logMAR 0.46. An average decrease of logMAR 0.21 was noted amongst males with a decline in vision between week 1 and month 1 visual acuities.

Figure 29: Average visual acuities in males with no change in vision between week 1 and month 1 follow-up visits



Thirty-one percent (n=13) of males had **no change** in their vision between week 1 and month 1 visual acuities. The average visual acuity for this group was 0.31 logMAR. The best average visual acuity amongst males showing no change in vision between week 1 and month 1 follow-up visits was noted in the 50-59 year age group (0.17 logMAR). The worst average visual acuity was found in the 70-79 year age group (0.44 logMAR).

When comparing male and female individuals' final visual acuity outcomes at 1 month, a p-value of 0.93 was derived, thus there was no statistical significance between these groups.

CHAPTER 4

4. Discussion

4.1 Visual acuity outcomes

Cataracts are regarded to be the leading cause of reversible blindness worldwide. Cataracts account for 39% of the causes of visual impairment globally.[7] The World Health Organisation's vision 20/20 report has resolved to make the reversal of blindness due to cataracts a health priority for all countries. This resolution further provides a target of visual acuity outcomes for individuals undergoing uncomplicated cataract surgery. The target states that countries should aim for 85% of cataract surgery patients to achieve good visual acuity defined as an uncorrected or presenting visual acuity of logMAR 0-0.5 (6/6-6/18).[2]

This study aimed to evaluate and compare the visual acuity outcomes of St John Eye Hospital with the above-mentioned target set out by the WHO. It further aimed to contribute partially towards much needed statistical data for the Vision 2020 project on visual acuity outcomes achieved post cataract surgery in South Africa. The final aim of this study was to compare visual acuity outcomes of experienced senior cataract surgeons to outcomes of their junior peers.

This study found that 82% (n=82) of individuals post phacoemulsification with insertion of an IOL included in this study attained a good month 1 uncorrected visual acuity (logMAR 0-0.5 or 6/6-6/18). This result falls within the target range as set out for cataract surgery target as recommended by the WHO and the International Agency for the Prevention of Blindness.[2] It also correlates well with similar studies evaluating post cataract surgery uncorrected visual acuity.[16]A total of 38% (n=38) of individuals achieved an uncorrected visual acuity in the range between logMAR 0 (6/6) to logMAR 0.2 (6/9).

This result is highly significant for a developing country such as South Africa, where a large percentage of the elderly population depends on government grants for their survival. It means that these individuals may be independent, contribute towards society and have an improved quality of life. Although many of these patients will

require correction of presbyopia, these spectacles are much more cost-effective than spectacles correcting myopia.

The average 0.12 logMAR improvement in VA between the 1 week and 1 month follow-up visits is highly statistically significant with a p-value of 0.0001. It can thus be concluded that in a wider population, there will be an improvement in VA from 1 week to 1 month. The average VA improvement could be as high as 0.18 logMAR based on a two-sided 95% confidence interval.

At 1 month post phacoemulsification, 18% (n=18) of individuals achieved a borderline uncorrected visual acuity [between 0.5 LogMAR (6/18) and 1 LogMAR (6/60)], while no individuals had a poor visual acuity outcome. A borderline visual acuity at 1 month in these individuals can be attributed to:

1. Human error or impatience in conducting visual acuity testing by nursing staff undergoing training.
2. Migrant patients originating from rural areas with a poor educational background with low rates of literacy.
3. Language barriers between staff conducting visual acuity testing and patients.
4. Hearing impairment, fatigue, hunger and epiphora in patients
5. Poor quality of the visual acuity charts (faded letters, unevenly lit charts).
6. Registrar notes (doctors undergoing training) lacking in thorough postoperative assessment or poor note taking, resulting in non–detection of ocular pathology such as post cataract surgery macula oedema.
7. A decrease in quality of vision attributed to higher order aberrations (such as glare, halos, streaks, starbursts, shadows and haze) caused by optical properties of the IOL, the anterior capsular rim and the edge of the IOL presenting as an inability to concentrate on reading visual acuity charts. [21]
8. A decline in post cataract surgery visual acuity may be attributed to retinal thickening present in healthy eyes post cataract surgery without morphological change detected on optical coherence topography.[17]
9. Patients unaware of or underreporting previous cerebro-vascular events[22], previous head, facial, or ocular trauma.

10. Changes in the refractive error caused by:
    a. Surgically induced corneal astigmatism attributed to large number, if iris hooks were utilised intraoperatively, width, length or incorrect location of corneal incisions, or corneal incisions being sutured too tightly if a suture is placed at the wound site.
    b. Lenticular mal-placement attributed to the IOL not being placed in the posterior chamber, IOL tilt (due to one haptic placed in the capsular bag and the other in the ciliary sulcus) or zonular dehiscence (due to previous trauma or pseudocapsular exfoliation).
11. Poor biometry technique can be as a result of:
    a. Inexperience in the performance of biometry by the physician or technician.
    b. Uncooperative/infirm patients unable to follow instructions[23].
    c. Type of biometry device unsuitable for specific density of the cataract[23].
12. Inability to isolate a cause of decrease in post cataract surgery visual acuity. In a study by Fong et al, no cause for the decrease in post cataract surgery visual acuity was isolated in 22.4% of their study participants[22].

An analysis of the week 1 data revealed that 63% (n=63) of individuals achieved a good visual outcome, whilst 25%(n=25) and 12% (n=12) achieved borderline and poor visual outcomes, respectively. A greater number of borderline and poor visual acuities at 1 week when compared to 1 month post cataract surgery (in addition to abovementioned reasons for borderline and poor visual acuity) can be explained by:

1. Post operative inflammation and corneal haze still present 1 week after surgery.
2. Patients still experiencing epiphora secondary to post operative ocular irritation.

4.2 Age based analysis

Individuals in the 50-59 year age group had the best average uncorrected visual acuity of logMAR 0.38 at 1 week and logMAR 0.27 at 1month postoperatively. The greatest improvement was noted in the 20-49 year age group with an average improvement of 0.3 logMAR between the 1 week and 1 month visits. Individuals in the 80-99 year age group had the smallest increase in visual acuity of 0.08 logMAR. This result correlates with the findings of a study by Westcott et al showing that in patients with no co-morbidities, the chances of achieving a visual acuity of greater than LogMAR 0.3 were 4.6 times higher in individuals 60-69 years of age than patients above the age of 80.[12]

4.3 Gender based analysis

The average visual outcomes for females was logMAR 0.38, while the male average was log MAR 0.35. This difference in visual acuity was found to be statistically insignificant with a p-value of 0.19. Seventy-nine percent (79%) (n=40) of all female individuals achieved a good (logMAR 0-0.5) month 1 post-phacoemulsification visual acuity in comparison to the males where 86% (n=36) achieved good visual acuity outcomes.

Females with a borderline [logMAR 0.5 -logMAR 1(6/18-6/60)] post phacoemulsification uncorrected visual acuity accounted for 21% (n=12), while 14% (n=1) of males were found to have a borderline visual outcome. As this study was a retrospective review of patient records and patients with ocular pathology were excluded from this study, no cause for borderline and poor visual acuity was isolated.

Forty-eight percent (48%) of male individuals (n=20) displayed an average improvement of 0.48 logMAR in their visual acuities between their week 1 and month1 follow-up visits in comparison to 45% (n=26) to females who displayed an average improvement of 0.45 logMAR.

Thirty four percent of the female group (n=20) and 31% of the male group (n=13) had unchanged visual acuities between the week 1 and month 1 follow-up visits. Females

in this group had an average vision of logMAR 0.34 while logMAR 0.31 was the male average.

Twenty-one percent (21%) of the patients (n=12 females; n=9 males) displayed an average decline in vision of 0.21 logMAR each in the study period.

4.4 Surgical skill analysis

Ninety-three percent (93%) of cataract surgeries included in this study were performed by junior cataract surgeons (registrars) while only 7% of surgeries were performed by senior cataract surgeons (consultants). The significantly high number of junior surgeons is due to the fact that individuals with ocular pathology other than cataracts were excluded from his study. At St John Eye Hospital, senior surgeons perform phacoemulsification on patients with ocular pathology in addition to cataracts so as to afford these patients the greatest opportunity to have uncomplicated surgery and achieve a better final visual acuity. Due to the significantly higher junior surgical rate in this study, no statistically significant data could be generated comparing junior to senior cataract surgeons.

The mere fact that up to 82% of all patients included in this study achieved good uncorrected visual acuities suggests that the visual outcome of junior surgeons at St John Eye Hospital is acceptable. One must be mindful that all complicated phacoemulsification procedures were excluded from this study, the surgical outcomes of junior surgeons may worsen if complicated surgeries were included.

4.5 Limitations of this Study

a) Eyes with ocular pathology other than cataracts and complicated phacoemulsification procedures were excluded from this study.
b) Only phacoemulsification surgeries were included, thus other forms of cataract surgeries such as extracapsular cataract extraction and manual small incision cataract surgeries were excluded.
c) All data were extracted from patient records, which were recorded by nursing staff performing visual acuities including nurses undergoing training. Thus, a percentage of the data may not accurately reflect a patient's true visual acuity.
d) The best corrected or pinhole visual acuities of patients were not included in this study as had been used in many other studies, perhaps a follow-up study may seek to address this issue.

CHAPTER 5

5. Conclusion

Cataracts can be very debilitating to patients, their families and society in general. They limit an individual's independence, ability to care for themselves, generate an income and enjoy pleasurable activities.

With an improving global and South African life expectancy, and an increase in visual demand for many forms of employment and pleasure, many elderly individuals affected by cataracts expect to regain their quality of life through cataract surgery. Phacoemulsification with insertion of an intraocular lens has repeatedly been shown to meet the demands of a majority of these individuals.

This study has shown that the provision of uncomplicated phacoemulsification with insertion of an intraocular lens performed mainly by junior cataract surgeons at St John Eye Hospital yields acceptable visual acuity to patients, while meeting targets for post cataract surgery visual outcomes as set out by the World Health Organisation and the International Agency for the Prevention of Blindness.

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APPENDIX

LogMAR notation to Snellen notation conversion chart

LogMAR	Snellen
-0.30	6/3
-0.20	6/4
-0.10	6/5
0.00	6/6
0.10	6/7.5
0.20	6/9.5
0.30	6/12
0.40	6/15
0.50	6/18
0.60	6/24
0.70	6/30
0.80	6/38
0.90	6/48
1.00	6/60
1.30	6/120
1.60	6/240
2.00	6/600

R14/49 Dr Raakesh Dayaram

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160145

NAME: (Principal Investigator)	Dr Raakesh Dayaram
DEPARTMENT:	Neurosciences Saint John Eye Hospital Chris Hani Baragwanath Academic Hospital
PROJECT TITLE:	Visual Outcomes Achieved Post Cataract Surgery at Saint John Eye Hospital
DATE CONSIDERED:	29/01/2016
DECISION:	Approved unconditionally
CONDITIONS:	Title change (25/05/2016)
SUPERVISOR:	Prof GD Mclaren
APPROVED BY:	Professor P. Cleaton-Jones,Chairperson, HREC (Medical)
DATE OF APPROVAL:	25/05/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004,10th floor, Senate House/2nd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/We fully understand the the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated,from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. in this case, the study was initially review in January and will therefore be due in the month of January each year.

Principal Investigator Signature Date 30/05/2016

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES