HOME-BASED NEURO OPTOMETRIC EXERCISES ON VISION RELATED QUALITY OF LIFE IN PATIENTS WITH VISUAL FIELD DEFICITS IN POST-CHIASMATIC LESIONS

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BY

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CERTIFICATE

This is to certify that the dissertation work entitled "**HOME-BASED NEURO OPTOMETRIC EXERCISES ON VISION RELATED QUALITY OF LIFE IN PATIENTS WITH VISUAL FIELD DEFICITS IN POST-CHIASMATIC LESIONS**" was carried out by **KOMAL BHANOT, Registration No.11111711**, Department of Physiotherapy, Lovely Professional University, towards partial fulfillment of the requirements of Master of Physiotherapy (Neurology) degree program.

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This is to certify that **KOMAL BHANOT, Registration No.11111711** has completed MPT Dissertation titled "**HOME-BASED NEURO OPTOMETRIC EXERCISES ON VISION RELATED QUALITY OF LIFE IN PATIENTS WITH VISUAL FIELD DEFICITS IN POST-CHIASMATIC LESIONS"** under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. The dissertation is fit for the submission and the partial fulfillment of the conditions for the award of MPT (Neurology).

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DECLARATION

I hereby declare that dissertation titled "**HOME-BASED NEURO OPTOMETRIC EXERCISES ON VISION RELATED QUALITY OF LIFE IN PATIENTS WITH VISUAL FIELD DEFICITS IN POST-CHIASMATIC LESIONS"** submitted for the MPT degree is entirely my original work and all the ideas and references have been duly acknowledged. I also declare that I have stick to the principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea, data, fact, source in my submission. I understand that any violation of the above will be cause for disciplinary action by the school and can also evoke penal action from the sources which have thus not been properly cited or from proper permission has not been taken when needed. It does not contain any work for the award of any other degree or diploma.

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Dedicated To My Parents

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"We are not a team because we work together.

We are team because we respect, trust and care for each other"

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"The best way to find yourself is to lose yourself in the service of others."

Abstract

HOME-BASED NEURO OPTOMETRIC EXERCISES ON VISION RELATED QUALITY OF LIFE IN PATIENTS WITH VISUAL FIELD DEFICITS IN POST-CHIASMATIC LESIONS

Bhanot Komal, Jeya Singh Raj Immanuel

Background: 20% to 60% of stroke population reported to have visual field deficits. Quality of life is adversely affected in terms of patient's participations and restrictions. Neuro-optometric regimen includes vision therapy to restore visual field. Aim of the study is to determine the effect of home based neuro-optometric exercises on quality of life in patients with post-chiasmatic lesions.

Methods: Quasi-experimental study was carried out in home based setting. Sample size of 10 patients from Punjab is taken to carry out the intervention study. Baseline assessments are measured through NEI VFQ-25, reading. Independent Mobility questionnaire and basic scanning test. Four intervention techniques are used i.e. top down strategy, bottom-up strategy, border field training and blind field training. Intervention dosage given for each technique constitutes 3 sets for 10 repetitions with 2 minutes rest after completion for 7 days a week for 30 days. Physiotherapist supervised after every 3 days at patient's home.

Results: Results interpreted showed overall significant improvement. In NEI VFQ-25, vision specific components showed most significant improvement. Number of mistakes significantly reduced post-training ($p=0.0001$) among reading parameters. Independent Mobility score showed non-significant improvement ($p=<0.47$). Reaction time showed more significant improvement ($p=0.0007$) among basic scanning parameters.

Conclusions: Neuro-optometric exercises proved to be effective for improving the quality of life in patients with cisual field deficits after post chiasmatic lesions. Outcome depends on the mechanism of neural plasticity after the restitution function training and increase in scanning strategy after compensatory training. Supervised home based intervention make it more reliable and applicable.

Key words

Visual field deficits, post- chiasmatic lesions, neuro-optometric exercises, quality of life.

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CHAPTER 1

INTRODUCTION

INTRODUCTION

Considering western society development and declined in mortality rates in stroke, there is an increase in number of patients with visual field deficits[1]. Vision loss in a part of the vision field which may occur peripherally or centrally is termed as visual field deficits[2]. Visual field deficits vary from isolated small blind spots or scotoma to vision loss in quadrant field or hemi field to entire eye[3]. Post-chiasmatic lesion demonstrates injury to visual pathway behind the chiasma including optic tract, optic radiation and visual cortex causing complete or partial loss of field[4]. In a study examined between 1974 to 1986, predominance of cerebral-vascular accident (79%) had been accounted over traumatic brain injury[5]. 40% suffers visual field deficits due to occipital lobe lesions, 30% due to parietal lobe and 25% due to temporal lobe lesions[2]. According to recent finding in India, the incidence rate of stroke is 119-145/100,000 [6]. The other study reported of having permanent or transient visual field deficits in 20% to 60% of stroke population[7].

The World Health Organization (2004) stated 3 principal types of visual deficiency: Deficit, disability or limitation of activities and handicap or restricted participation[8]. Visual field deficits usually cause disability (reading disorders and orientation deficits) and handicap (inability to drive, severe reduction in quality of life)[8]. According to International Classification of functioning, disability and health (ICF), emotional functions (b152) are 94% in body functions followed by light sensitivity (b21020, 87%) and orientation (b114, 65%). In activities and participation moving around obstacles (d4503), driving motorized transportation (d4702) and reading (d1666) are affected 98%, 91% and 80% respectively[9].

Subjective perceptions of an individual of how they are affected by their health state can be measured through the assessment of quality of life[10]. According to the World Health Organization (WHO), quality of life is defined as "the individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals." (WHOQOL Group,1995). Amongst main handicaps, hemianopic patients have reading impairment called hemianoptic alexia that affects the quality of life[8]. Visual field deficits always impact on patient's participation in rehabilitation and increases risk of falling[2]. Loss of independence with increased chances of traffic accidents have been seen[2,11]. Balance, movement or spatial perception problems might get triggered with visual processing and functional vision

problems[12]. Combination of limitations has potential to effect on individual's motivation and mood[10].

As rarely considered in rehabilitation program, no visual training is usually proposed to patients with cortical visual impairements[13]. Spontaneous recovery is seen in 3 months of after event[8]. After 1 month chances of recovery is 50% to 69%. From last couple of decades, the concept of plasticity in visual system has emerged[14]. The spontaneous recovery clearly indicates that the visual cortex holds a capacity of plasticity[15.]. Neural plasticity in visual system has been induced in patients with visual field deficits by activation of surviving neurons repetitively in partially intact brain regions[16]. Studies have shown that major predictor of treatment outcome is area of residual vision[15].

Neuro-optometric rehabilitation includes optometric vision therapy is defined as an individualized treatment regimen for patients with visual deficits as a direct result of physical disabilities or acquired brain injury[17]. Compensation strategy primarily targets the recruitment of alternative unaffected visual regions in the brain[4]. It deals in training of exploring visual stimuli the field of view (top down strategy). Better response has been seen in the combination of auditory and visual stimuli (bottom up strategy). Restorative strategy primarily targets the stimulation of partial affected regions that induces plasticity[4]. Border-field training represents the stimulation in the area of transition zone between intact and blind damaged fields[8]. Blind sight training represents the partially preserved areas in blind hemi field area[8]. Previous studies support that border training tends to improve detection of visual stimuli and processing is improved in blind sight training[8].

It has been seen in many previous studies that majority of training set-up is either in clinic or home with therapist full supervision. Limitations have been reported for patients on cost – increment and time associated for travelling to rehabilitation centers. Labor intensive and requirement of special facilities i.e. training boards and perimeters are also limiting its availibility[18]. Lina Aimola et al carried a study on unsupervised home-based compensatory approach which include reading and computer training exploration on 70 individuals out of which 18 individual failed training and rest showed significant improvements[18]. In an experimental study, once a week supervised home based exercises by the physiotherapist proved to be as effective as outpatient therapy[19].

In an experimental study, compensatory scanning training showed self-reported improvement in detection and avoiding obstacles but no improvement was reported on other visual skills[20]. Bergsma et al in a study proven improvement in color and shape perception after restorative functional training[21]. Clinical observational study by Iris Mueller et al, stated that visual restorative training improved visual confidence in terms of reading, collisions and carrying out hobbies[16]. Visual restorative training is usually performed at patient's house for30-60 minutes per day for a period of 6 months[4]. Gera A. de haan proved that horizontal compensatory scanning practice persists with higher potential to improve mobility than other visual search practice[20]. Thus, present study runs on an idea of combination of both restorative and compensatory training approach in patients with visual field deficits on specific post-chiasmatic population particularly in stroke.

High resolution perimeter, Humphrey field analyzer, Goldman perimeter are some of the instruments used to evaluate visual field defecits[22,8.] Lower values in Humphrey automated perimeter also shows lower values of NEI VFQ scores in patients with visual field defecits[1]. Thus it is proven that visual field deficits is related to deterioration of vision related quality of life. The national eye institute visual function questionnaire (NEI VFQ-25), SF-36, visual disability scale and impact of vision impairment have been used to access the vision related quality of life in patient with visual field defecits[23]. Almost two thirds of patients had visual field assessment by confrontation methods in a study. Confrontation test has been found a reliable test on admission but less reliable for follow up where there is some recovery[11]

National Eye Institute- Visual Functioning Questionnaire- 25 (NEI VFQ-25) has emerged as standard valid and reliable instrument to measure vision related quality of life in patients with visual field deficits[24,1]. It is originally developed by RAND and funded by NEI[25]. It targets 11 vision target subscales that access general vision, near vision activities, distance vision activities, social functioning, role limitations, dependency, mental health, driving difficulties, peripheral vision, color vision and ocular pain[25]. This outcome holds a good sensetivity[10].

Reading is taken as a outcome measure using 168 words passages[21]. Reading time and number of errors are taken into account. Reading time is measured in seconds. Appropriate reading speed in words per minute is calculated using formula[18] (words read- number of errors/time taken *60). Despite of visual impairment, the perceived ability for independent mobility is accessed by independent mobility questionnaire which rated on 5 point scales[9]. A basic scanning test is also

administered in this present study. 32 different dot patterns consisting few dots (6,7,8,9) and many dots (18,19,20,21) with 4 trials are counted by patients. Reaction time as well as accuracy scores are counted[20].

NEED OF THE STUDY

Post-chiasmatic lesions lead to visual impairments. One of the very common visual impairments is visual fields deficit which is rarely addressed. It end up in laws of vision in the visual fields and thus quality of life is compromised. Increase in activity limitations and participation restrictions, problems related to orientations, scanning, mobility and reading are some of well-known difficulties are reported in these patients. Studies done previously determined the assessment and rehabilitation on technology basis in chronic cases and under therapist guidance. The present study will increase the awareness in early as well as chronic cases that make therapist and patient aware of home based exercises which will be easily approachable in India. Thus, it will also contribute in early recovery and hence increasing the quality of life.

SIGNIFICANCE OF THE STUDY

Though many studies have been addressed on visual field deficits but its practicality in India in terms of assessment and rehabilitation is not handed well in early stages. This study will work on the concept of early facilitation of visual recovery and hence increases the quality of life in patients with visual field deficits. This experiment will be in reach of expense with limited supervision and is ergonomically advised. Thus, it will increase study practicality. It will play vital role in time management and will encourage the patient to perform oneself with help of attendants in early cases.

AIM OF THE STUDY

Effects of home based neuro-optometric exercises on quality of life in patients with visual field deficits after post-chiasmatic lesions.

OBJECTIVES OF THE STUDY

To determine the effect of home based neuro-optometric exercises on quality of life in patients with visual field deficits after post-chiasmatic lesions.

HYPOTHESIS

H_1 - There will be no significant effects of neuro-optometric exercises on quality of life in patients with visual field deficits after post-chiasmatic lesions.

H_2 - There will be significant effects of neuro-optometric exercises on quality of life in patient with visual field defects after post-chiasmatic lesions.

OPERATIONAL DEFINATIONS

Visual field deficits

Visual field deficit is a vision impairment that hinders in the perception of normal vision field. It is further divided into field area, border field area and blind field area. It is commonly found in patient with post-chiasmatic lesions. It may hinder in normal field view. Thus quality of life related to vision is affected.

Post-chiasmatic lesions

Any injury below the level of optic chiasma comes with the posterior chiasmatic lesion. It often ends with vision impairment like visual acuity and visual field deficits. Post chiasmatic lesions include cerebrovascular accident, tumors and traumatic brain injury.

Neuro optometric exercises

Neuro optometric exercises deals with the rehabilitation of visual impairment. It constitutes 3 approaches- substitution therapy, compensatory training and restorative training.

CHAPTER 3

REVIEW OF LITERATURE

Lauren R. Hepworth et al (2016)-The purpose of this systemic review was to determine the effect of visual impairments on quality of life using subjective questonaires. It included RCTs, cohort studies, observational and controlled studies. 2 authors have given STROBE assessment to 11 articles. Generic health related instruments included are European quality of life score, assessment of life habits and short form -36 which showed reduced scores in self-care, perceptual difficulties and visual field deficits respectively. Vision specific instruments included NEI VFQ-25, the veterans low vision visual function questionnaire which accessed visual ability , visual motor and mobility difficulties and self-reported assessment of functional visual performance (SRAFVP). It is concluded that NEI VFQ has helped to address the specific impact of vision[10].

Tadishi Nackeno et al (2016)- -This study used VFQ-J11 and VFQ-25 to access the vision related quality of life with visual impairment. Euro QOL Index was also used to access health related QOL. Study was carried out in 6 ophthalmology departments in Japan for 232 visual impaired Japanese patients. High scores of 3 questionnaires were significantly associated with visual acuity in better eye. VFQ-25 and VFQ-J11 low scores significantly co-related with visual acuity in worse eye. Composite scores of VFQ-25 and VFQ-J11 were significantly associated with each other. It was concluded that both scales were found to be valid but due to small amount of time taken for VFQ-J11, it is more valid then VFQ25[24].

Carolin Gall et al (2015)- In this study mental health status were accessed on 122 participants with visual field deficits through German Brief symptom Inventory in the patient's home after asking for participation over phone. 25.4% of participants were found with mental distress. From the subsample of patients with multisensory deficits found with increased amount and intensity of mental distress then only with visual impairment study focused on proper assessment of mental health status and also on psychological supportive therapies specially targeting subjects with cerebral visual injury and involvement of multisensory system[43].

De Haan et al (2015)- The main objective of this study was to link content of 3 questionnaires i.e. NEI VFQ, Independent mobility questionnaire and cerebral visual disorders questionnaire to the International Classification of Functioning, Disability and Health. This research also analyzed vision related difficulties reported by patients. 54 patients were analyzed on the basis of lesion of more than 5 months. Spontaneously reported difficulties like

orientation, reading problem, was seen. Difficulty with re-creational and leisure activities were seen. Light sensitivity was affected most following with negative feelings. Problems with color vision, perception of depth and independence were also encountered. Problems are then linked to ICF through ICF methods[9].

Gera A. de Haan et al (2015)-This study aimed to examine the effects of horizontal compensatory scanning training in participation and mobility related activities. Training group (N=30) and control group (N=24) were accessed with 2 different reading tests, dot counting tests, visual search test, hazard perception test, tracking task, obstacles, NEI VFQ-25, IMQ and CVD. Training protocol included 15 sessions of 60 to 90 minutes each for 10 weeks where emphasis was made on neck and head movements followed by eye movements. Patients were also given homework assignments where they scanned the given situations. Significant improvement was seen in mobility measures. Self-reported improvement was also observed. There was no improvement seen in visual search task[20].

Douwe Bergsma et al (2014)-This study was done to determine improvement of subjective vision using Goal Attainment scale after restorative functional training. It also determined the relation between GAS and VFE. 12 patients with HVFDs were accessed through dynamic Goldman perimeter and control magnification factor. GAS scores and aims were set with the help of occupational therapist. Training was done through custom made RFT at home to detect stimulus for 1 hour a day, 5 days a week for period of 13 weeks. t-test revealed that 12 patients showed visual field enlargement. GAS score was improved in 9 out of 12 patients. It was concluded that not only visual field enlargement was seen but also improvement in subjective vision was seen[4].

Lina Aimola et al (2014)- This study was done to determine the efficiency of un-supervised home based compensatory training in patient with HVFDs. In Durham University, 70 patients are randomly assigned into intervention and control group. Assessment was made with perimetery, visual search task, reading, task stimulating activities of daily living, attention task and subjective questionnaires through NEI VFQ-25 and visual impairment questionnaire before and after treatment. Treatment includes visual exploration (find a target) and reading task (detect non-word). 14 blocks per day that contained 120 trials. Each patient completed 294 exploration and 196 reading blocks. 18 participants dropped out. Visual search, reading and visuomotor

search improved significantly. Questionnaires showed significant improvement. It is concluded that home based compensatory training is an inexpensive rehabilitation option[18].

D.P. Bergsma et al (2012)- This study was done to determine whether improvement in color and shape perception and reading speed were caused by peripheral training. It also related to view better relation of VFE with average border shift and estimated amount of cortical surface gain. 12 patients of chronic stroke with supratentorial stroke with VFD are taken for this study. Patients were accessed through DGP, visual field enlargement through cortical magnification factor, color and shape perception through Microsoft power point and reading with 2 standardized tests. Patients went through white stimulus detection through goldmann monocularly. 40 sessions of 1 hour over 10 weeks were implemented. T- test was used for analysis. 9 patients showed VFE. 3 out of 7 patients significantly improved in color and shape perception. 7 patients significantly improved reading speed. It was concluded that white stimulus training induced field enlargement lead the efficiency of perception and increased reading speed [21].

Carolin Gall et al (2009)-This study was carried to investigate vision related QOL in visual field deficits. It also accessed the influence of visual field deficits and diminished visual acuity on vision related QOL. 2 groups were formed: 312 patients with post chiasmatic lesion and 360 healthy patients. Survey was done with NEI VFQ-25 and SF-36 for both groups and then later compared with multiple analysis of co-variance and multiple linear regressions. A coordinated influence of VFD is seen on vision related QOL after estimating lower NEI VFQ-25 scores with VFD. VFD did not co relate significantly with health related QOL[1].

Roberta McKean- Cowden et al (2008)- This study determined the association of VFL and vision related QOL in patients with glaucoma. It also determined the ADLs that were affected. Through population based prevalence 213 patients with open-angle glaucoma are included. Assessment was carried out visual field testing using Humphrey field analyzer, visual acuity, SF-12 and NEI VFQ-25. A monotonic trend was observed between subscales scores of NEI VFQ-25 and VFL. Glaucomatous VFL patients have significantly lower mean scores of SF-36. Larger effects were seen for NEI VFQ-25 composite score. Vision related role functions, driving difficulties, vision related dependency and peripheral vision were mainly affected. It was concluded that vision related quality of life was affected in patients with glaucoma[28].

Carolin Gall et al (2008)-This study examined whether visual field enlargements in cerebrally damaged patients have any effect on vision and health related QOL. 85 patients were divided into 2 groups i.e. the one who got VRT training for first time (N-69) and who got VRT training before and not included in first sample(N-16). Visual field loss is accessed through campimetry. Patients are given to self-administer NEI VFQ and SF-36 before and after VRT training which includes stimulation along border with static lights or kinetic. First group carried training for 6 months/150 hours and second group carried training for 3 months/75 hours. Both groups revealed significant pre-posttest improvements. It is concluded that NEI VFQ was a valuable measure and improvements was seen when co-related with visual field enlargements[44].

Iris Mueller et al (2007)-This study was done to examine the efficiency of VRT in 300 patients through clinical observational analysis in Europe. It also set aim to examine whether subjective vision had improved standardized post training through semi-structured interviews. 302 patients with pre-chiamatic lesions and presence of residual vision have taken participation in the study. Stimulus detection through HRP, fixation ability and subjective vision has been accessed. VRT training for 1 hour daily for 6 days a week for 6 months are given to the patients. Results showed improvement in hits, reaction time, false hits correlation between HRP and conventional perimeter were significant. Horizontal eye movements toward both sides increased significantly. Visual confidence followed by reading improved in majority patients. It was concluded that VRT has improved visual functions in patients with visual field deficits[16].

Dorothe A. Poggel et al (2004)-This study was done to see whether the efficiency of treatment can enhanced with attentional cueing with light stimulation. 19 patients were divided into experimental group (9) and controlled group (10). Computer based campimetric test was used as outcome measures. Training included stimuli detection which appeared on computer screen. Experimental group was provided by attentional cue which was large dim grey cue frame. 500 training stimuli were given for 30 to 35 minutes for 1month each in 6 training units. Results declared that upper visual field gain is more in experimental group. In HRP, more pronounced shift of visual field border to field area. It was concluded that attentional cueing promote long term neuronal plasticity[15].

Bernhard A. Sabel et al (2004)-This study determines to evaluate the efficiency of VRT in subjective visual improvement in post-chiasmatic brain damage. 16 patients are taken in Tuebingen Eye clinic. 9 patients of complete hemianopia and 7 patients of incomplete hemianopia were taken. Patients were evaluated through HRP, TAP, SLO, standardized vision questionnaire and patient's testimonials before and after VRT. VRT is provided on personal computer which is carried out in home based environment focusing on the area of residual vision. It is carried out twice daily for half an hour each during 6 months period. Analysis was made through t-tests and ANOVA. Results proved significant improvement in detection performance, false positive reactions, fixation performance and reaction time. Better reading, improved mobility and orientation also increased subjectively. It is concluded that visual field enlargement is co related with some subjective improvement[14].

CHAPTER-3

METHODS AND METHODOLOGY

Study Design

One group pre-test post-test design- Quasi experimental design

Study setting

Home based

Population and Sampling

In previous studies, population of stroke is estimated to be 119-143/100,000. 20% to 57% of stroke survivors are estimated to have visual field deficits. So as per sample size calculations, the sample constitutes of 8 patients. In this study, 10 subjects were included from the population of post-chiasmatic lesions from Ludhiana and Jalandhar. Convenience sampling method is used.

Proportion - Infinite N

N (Population size)	Infinite
p (expected proportion e.g., .50)	0.005
d (precision e.g., +/- 0.05)	0.05
z alpha/2 (95% CI)	1.96
n - num	0.0191
n - den	0.0025
Sample size, n	7.64

Criteria for sample selection

Inclusion criteria

1 Ischemic and hemorrhagic stroke.

2 Presence of residual vision.

3 Sufficient fixation ability.

4 50-70 years.

5 Both male and female.

6 No previous vision rehabilitation.

7 Confrontation test should be positive.

8 Duration of lesion should be more than 3 months.

9 VMC Grading of either hand should be 6.

10 Able to follow simple commands

Exclusion Criteria

1 Photosensitivity

2 Uncontrolled epilepsy

3 Total Blindness

4 Unilateral Neglect

5 Aphasia

6 Cognitive impairment interfering with training

7 Medical instability

Parameters

1 National Eye Institute Vision Function Questionnaire -25 (NEI VFQ-25)

2 Reading

-Number of mistakes

- Time taken

- Reading Speed

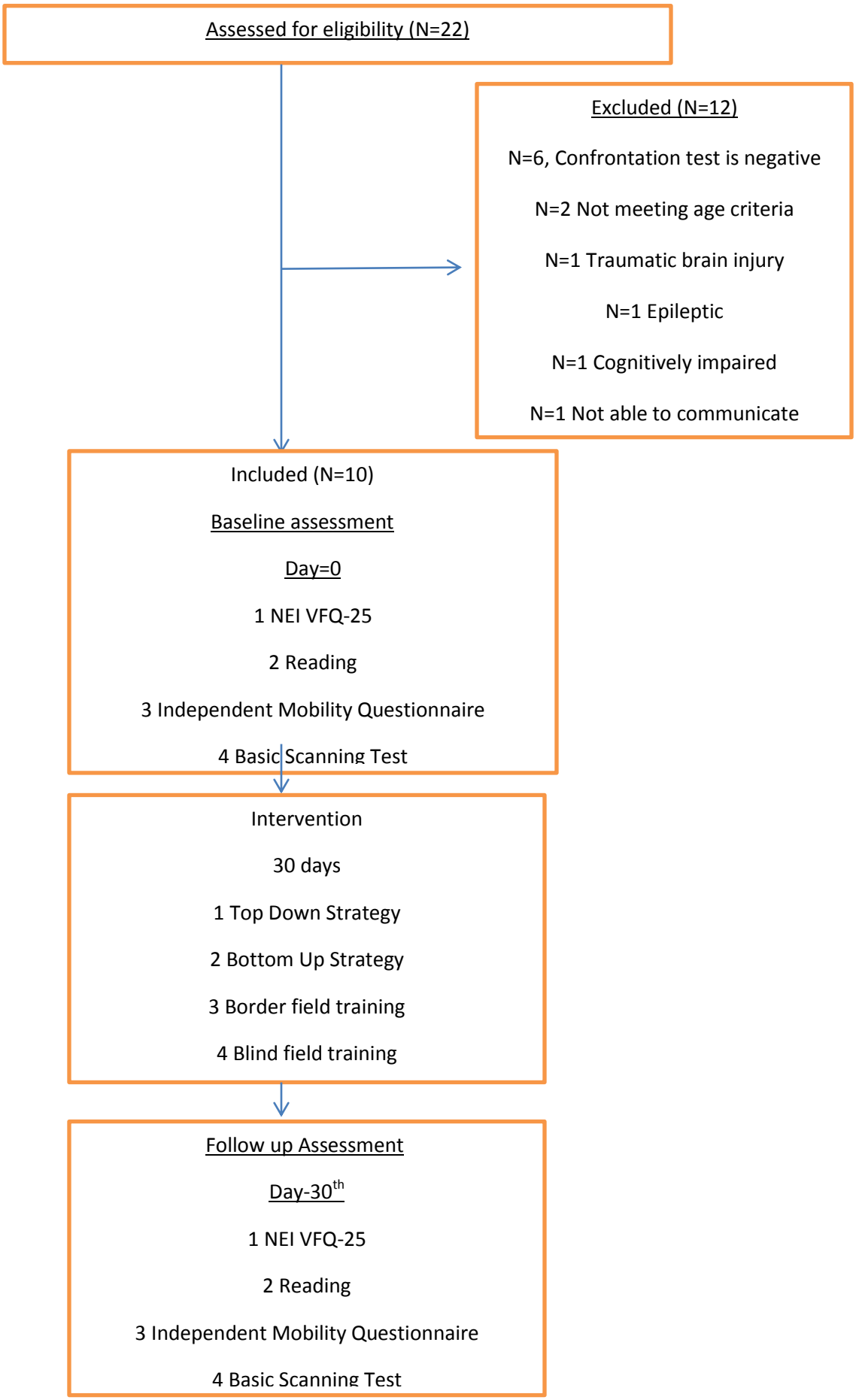
3 Independent Mobility Questionnaire

4 Basic Scanning Test

- Reaction time

- Accuracy

FIGURE 4.1 – ASSESSMENT OF BASIC SCANNING TEST


Assessed for eligibility (N=22)
Excluded (N=12)
N=6, Confrontation test is negative
N=2 Not meeting age criteria
N=1 Traumatic brain injury
N=1 Epileptic
N=1 Cognitively impaired
N=1 Not able to communicate
Included (N=10)
Baseline assessment
Day=0
1 NEI VFQ-25
2 Reading
3 Independent Mobility Questionnaire
4 Basic Scanning Test
Intervention
30 days
1 Top Down Strategy
2 Bottom Up Strategy
3 Border field training
4 Blind field training
Follow up Assessment
Day-30th
1 NEI VFQ-25
2 Reading
3 Independent Mobility Questionnaire
4 Basic Scanning Test

Variables

Independent Variables

Neuro-optometric exercises

Dependent Variables

Vision related quality of life

Instruments and Tools

1 Lasers

2 Whistles

3 Reading Material

Procedure

Baseline assessment is done on 0^{th} day. Physiotherapist will teach attendants the intervention procedure on the 0^{th} day. Physiotherapist will supervise patients in their home after every 3 days. Post assessment will be taken on after 30 days of intervention. Intervention given for each technique constitutes 3 sets of 10 repetitions with 2 minutes rest after completion for 7 days a week for 30 days.

1 Top Down strategy

Patients are asked to keep their head still and hold the laser light in the non-affected hand. Attendant will emit the laser light on the front wall. Patients will detect the targeted light by moving their eyes without moving their head and will emit the light from his laser on the targeted light on the respective wall.

2 Bottom Up strategy

Patients are asked to keep their head still and hold the laser light in the non-affected hand. Attendant will emit the laser light on the front wall and blow whistle simultaneously. Patients will detect the targeted light by moving their eyes without moving their head and will emit light from his laser on the targeted light on the respective wall.

3 Border Field Training

Patients are asked to fix their gaze at the center of the front wall. Patients are made to hold the laser light in the non-affected hand. Attendant will emit the laser light on the wall in the between the zones of their field area and blind area i.e. border field. Patients will detect the targeted light by neither moving their eyes nor moving their head and will emit light from his laser on the targeted light on the respective wall.

4 Blind Field Training

Patients are asked to fix their gaze at the center of the front wall. Patients are made to hold the laser light in the non-affected hand. Attendant will emit the laser light on the blind field adjacent to border field. Patients will detect the targeted light by neither moving their eyes nor moving their head and will emit light from his laser on the targeted light on the respective wall.

FIGURE 2 PATIENT PRACTICING INTERVENTION AT HOME WITH HELP OF ATTENDANTS

Stastical Analysis

t-test

Analysis was done by using paired t-test to know the significance within the groups.

Using arithmetical formula for the mean, for a given number of subjects, mean was calculated:

$X=\sum X/N$

Where,

X= arithmetic mean

$\sum X$= Sum of all the variables

N= number of observations

Standard Deviation was given by

$SD=\sqrt{\sum X^2/N}$

N= number of scores

Paired t-test

This is considered an appropriate test for determining the significance of mean of the group when population variance is not known.

Formula

$T=(x_D-\mu_o)/S_D/\sqrt{N}$

X_D= average

SD= standard deviation

CHAPTER 4

RESULTS

Baseline Assessment

Assessment reveals the intake of 3 females and 7 males in present study. Age varies from 50-68 years (Mean=58.90 SD=5.174). Study includes 20% of hemorrhagic and 80% of ischemic incidences with different types of visual field deficits. Lesion time varies from 4 months to 2.5 years. Time taken in in reading and basic scanning test is in seconds.

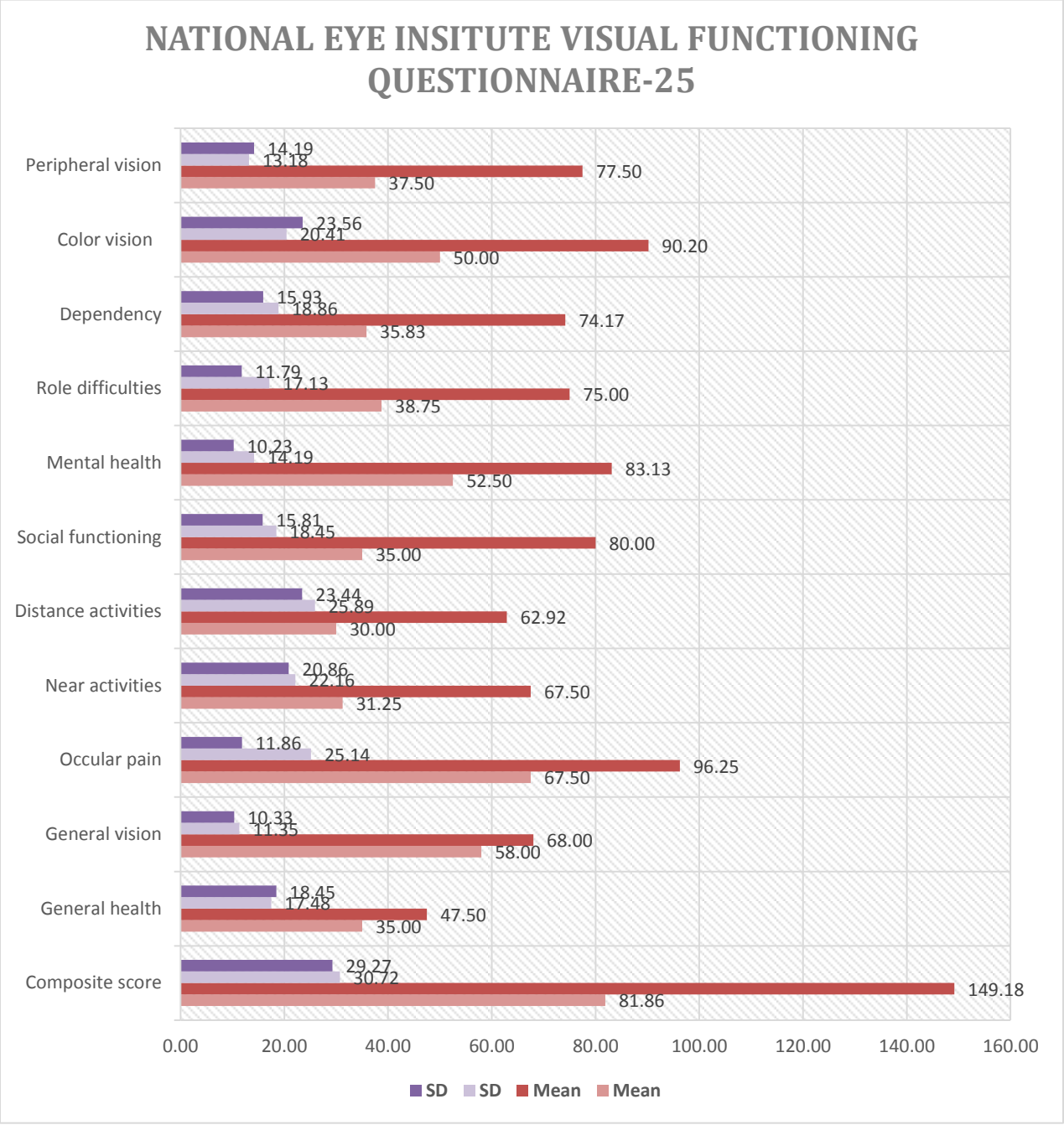
TABLE 1- PROFILE OF SUBJECTS

Code	Age	Gender	Stroke Type	Visual Field defects	Post Onset Time
PVFD1	57	Male	Ischemic	Incomplete Right Homonymous Hemianopia	17
PVFD2	60	Male	Ischemic	Quadrantanopia_to right upper quadrant	24
PVFD3	54	Male	Ischemic	Quadrantanopia to left upper quadrant	5
PVFD4	53	Male	Hemorrhagic	Quadrantanopia to left upper quadrant	24
PVFD5	65	Male	Ischemic	Incomplete left Homonymous Hemianopia	13
PVFD6	68	Female	Ischemic	Incomplete right Homonymous Hemianopia	5
PVFD7	63	Female	Ischemic	Quadrantanopia to right upper quadrant	4
PVFD8	54	Male	Ischemic	Quadrantanopia_to right lower quadrant	4
PVFD9	60	Female	Ischemic	Incomplete right Homonymous Hemianopia	5
PVFD10	55	Male	Hemorrhagic	Incomplete left Homonymous Hemianopia	12

TABLE 2- Details for paired t-test for mean difference with standard deviation and significant values(p) for patients

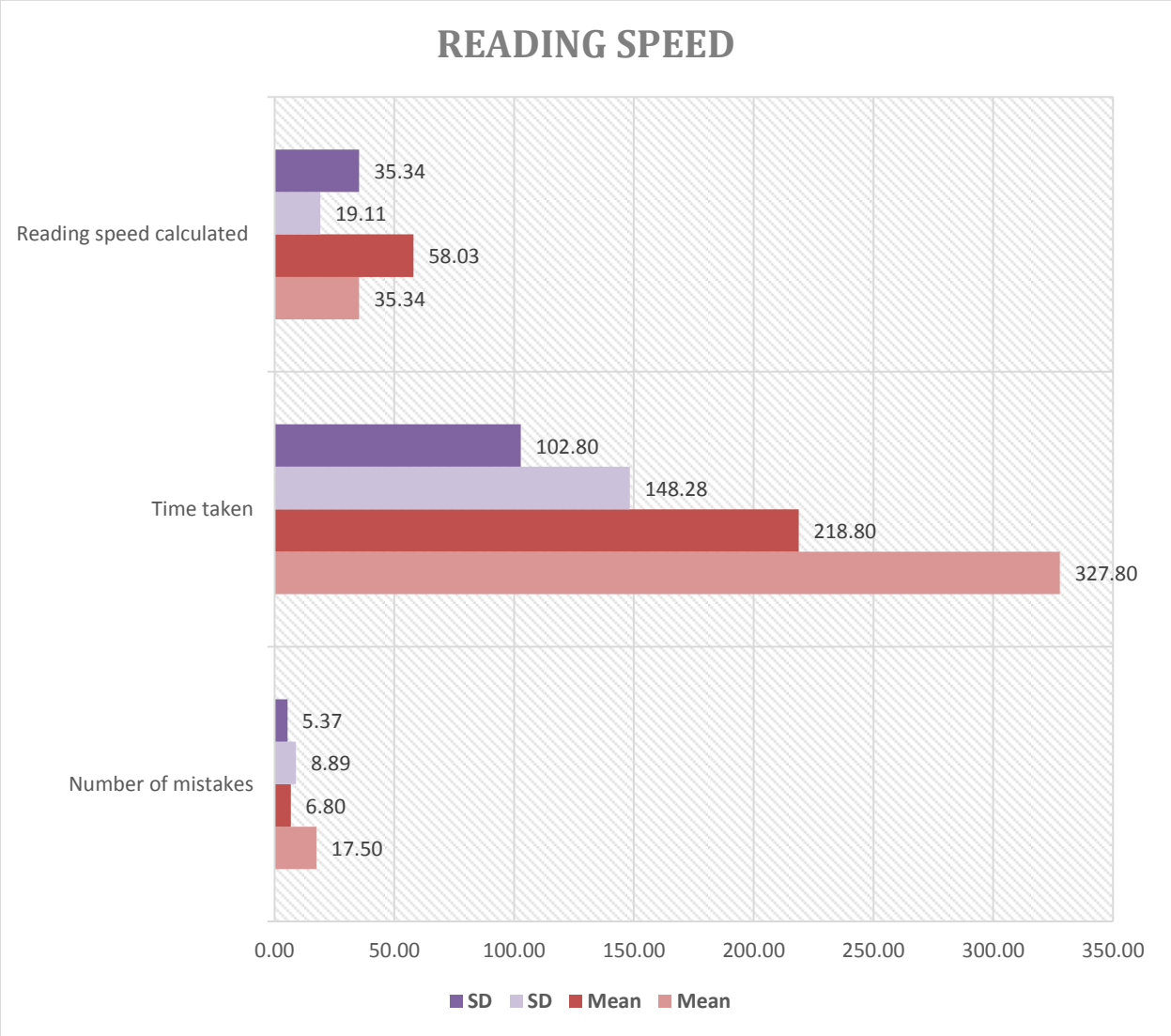
	Pre	Post	p - Value	Results
NEI VFQ -25				
Composite score	81.86±30.72	149.18±29.27	<o.oo1	Significant
General health	35.00±17.48	47.50±18.45	0.015	Significant
General vision	58.00±11.35	68.00±10.33	0.015	Significant
Ocular pain	67.50±25.14	96.25±11.86	0.0032	Significant
Near activities	31.25±22.16	67.50±20.86	0.0001	Significant
Distance activities	30.00±25.89	62.92±23.44	0.0001	Significant
Social functioning	35.00±18.45	80.00±15.81	<o.oo1	Significant
Mental health	52.50±14.19	83.13±10.23	<o.oo1	Significant
Role difficulties	38.75±17.13	75.00±11.79	<o.oo1	Significant
Dependency	35.83±18.86	74.17±15.93	<o.oo1	Significant
Driving	*	*	*	*
Color vision	50.00±20.41	90.20±23.56	0.0002	Significant
Peripheral vision	37.50±13.18	77.50±14.19	<o.oo1	Significant
READING SPEED				
Number of mistakes	17.50±8.89	6.80±5.37	0.001	Significant
Time taken	327.80±148.28	218.80±102.80	0.0065	Significant
Reading speed calculated	35.34±19.11	58.03±35.34	0.0231	Significant
INDEPENDENT MOBILITY QUESTIONAIRE	123.40±17.93	115.60±29.09	<o.o47	Non-Significant
BASIC SCANNING TEST				
Reaction Time	661.00±232.55	451.30±176.45	0.0007	Significant
Accuracy	0.68±0.11	0.90±0.06	<o.oo1	Significant

NEI VFQ-25 Significant improvement is observed in composite score (p=<0.0001). Each sub component of NEI VFQ-25 showed significant improvement. A sub component of NEI VFQ-25 i.e. driving is not measured along for any participants because either patients don't drive or has quit due to involvement of motor impairments. General health and general vision component showed least significant improvement in (p=0.015) each. Vision specific components showed most significant improvement.



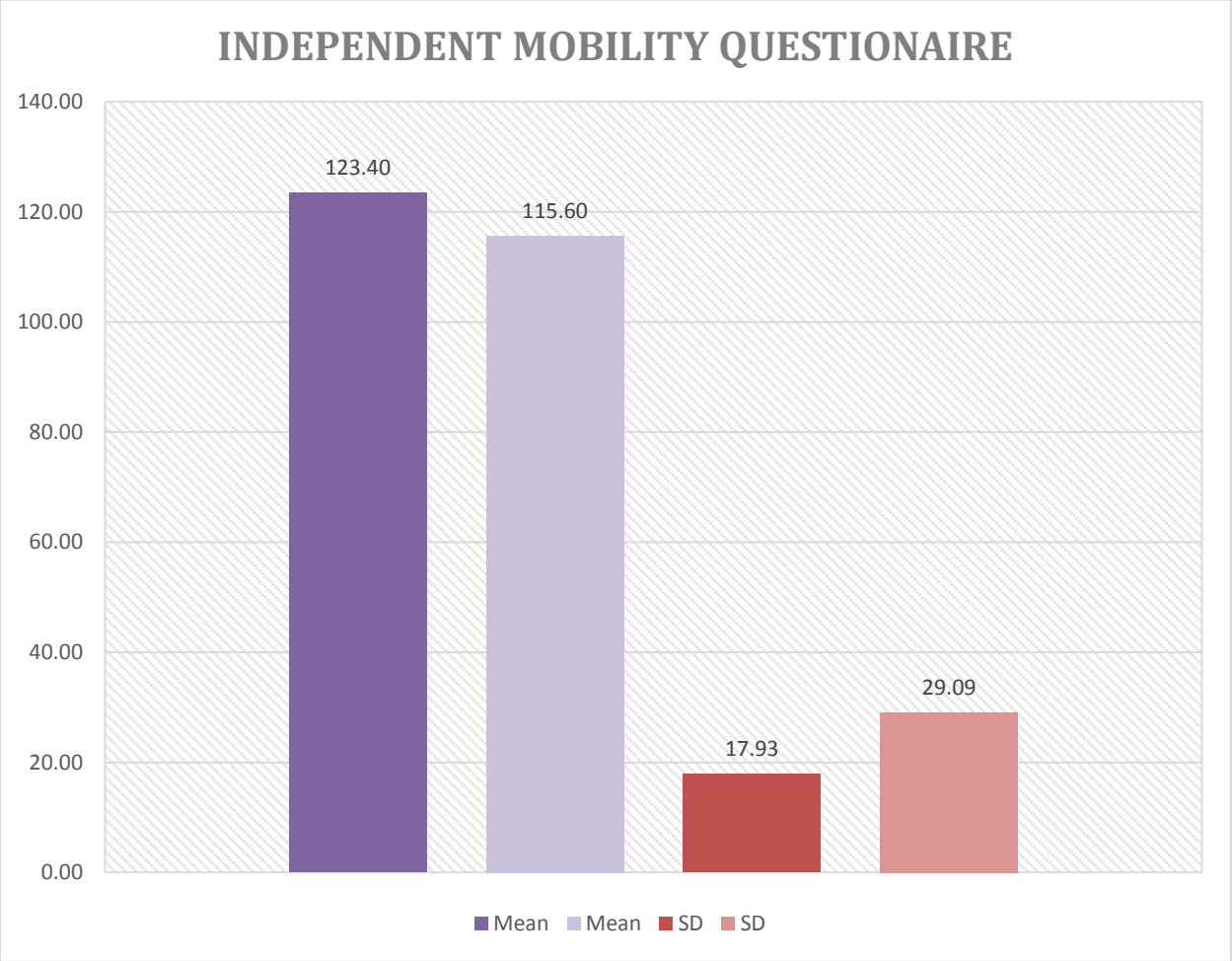
Reading

Number of mistakes showed most significant improvement (p=0.001) followed by time taken parameter (p=0.0065). Reading speed calculated showed lesser significant improvement (p=0.0231).



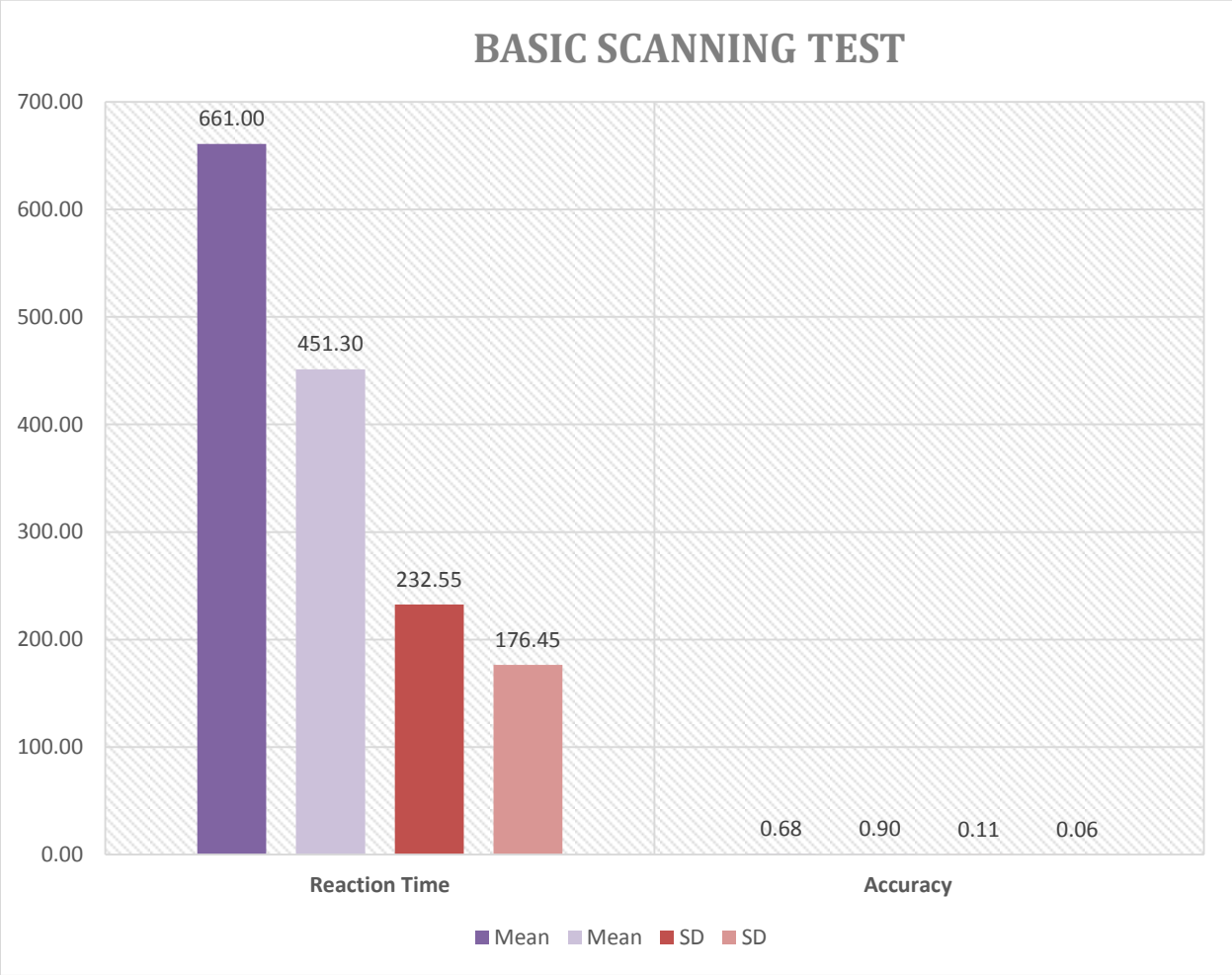
Independent Mobility Questionnaire

Results emerges as non-significant improvement in score of independent mobility questionnaire (p=<0.47).



Basic Scanning Test

Reaction time is time taken to respond to scanning task. Accuracy is defined as proportions of correct responses. Reaction time showed more significant improvement (p=0.0007) compared to accuracy (p=<0.0001)



CHAPTER 5

DISCUSSION

Discussion

Overall significant improvement outcome stands up with the results of the present of large area of residual vision at baseline which proved to be effective to restore visual functions[16]. This study constitutes the patients with incomplete hemianopia. Retrospective analysis provided reliable evidence that VRT efficacy is not influenced by age, gender and etiology[16]. A significant improvement in the composite score and sub components is seen in the present study. Dual effects of compensation and restoration strategies stand in favor of aim of the present study i.e. Effects of home based neuro-optometric rehabilitation on quality of life in patients with visual field deficits after post-chiasmatic lesions.

Compensatory strategy involves training practice in the blind and receptive hemi fields which proved improvement in performance over approximately 20 hours of training[29]. Restitution approach claims hypothetical mechanism of training which states 1 Training stimulates spared neurons in first visual cortical area. 2 Induces plasticity in spared perilesional area. 3 Reactivate the damaged primary visual cortex 4 Strengthen external striatal pathways. 5 Recruits and inhibits visual areas in intact hemisphere[21]. Visual field enlargement has been reported in many studies after vision restitution therapy using VRT[27]. Past researches compared the NEI VFQ-25 score of stroke patients with visual field deficits to healthy population and reported reduced quality of life in patients with visual field deficits[7]. A study stated that subjective improvements are noted in patients with small visual field enlargement after VRT but also then no improvement in ADLs is seen with more subjective improvement because of other factors like expectations, awareness of cognitive and sensory deficits and topography of visual field deficits[16]. This finding gave the reasons of interpretation of general vision least significant score.

Among the three components of reading (number of mistakes, time taken and reading speed) most significant improvement is seen in number of mistakes and time taken. The results are explained in a study which stated that stimulation in defected area lead to increased sensitivity of inactive neurons so less energy needed for detection and decrease in detection thresholds[21]. Least significant improvement in reading speed in this study is linked to hypothesis that states of reduced visual acuity in the receptive field enlargement area activated into blind field[21]. A study supports the results of present study for reading speed by explaining the role of small and precise saccades in reading while the compensatory training involved large saccades movement[20].

The independent mobility questionnaire score showed non-significant improvement in this study. For support, in a study which assessed the efficacy of VRT, no correlation was found between visual field enlargement and 'visual confidence/mobility' and 'ability to avoid collisions' after VRT[14]. Another study also interpret the non-significant co-relation between subjective improvement and visual field enlargement in high resolution perimeter for categories 'collisions and mobility' after vision restoration therapy[16]. An intervention study on focusing on compensatory training on 28 samples exclaimed the similar non-significant improvements in obstacle avoidance, visuomotor search and hazard perception[18]. Contrary to present result, a study reported significant improvements after compensatory training participants performed more mobility-related tasks with less difficulty[20]. Furthermore, it is observed that certain training characteristics are missing in IMQ assessment i.e. top down scanning strategy, periphery targeting training exercises, feedback and inclusion of exercises to enhance mobility[20].

Accuracy showed lesser significant improvement compared to reaction time. This finding corresponds to a previous RCT which stated that searching in predefined target is complex task as it requires serial search, every feature has to be watched separately[20]. Training decreased reaction time as indicated by significant improvement. It has been suggested that after training, patient's visual attention spread to more evenly to the right and left side, while still paying attention in front[20].

Limitations

Scientific impact of this study would have gained if randomization and blinded design had been used. As we did not have enough patients to create control group, so practicality is not possible.

Previous studies run on the custom made software for restoration functional training on computer but the practicality in India is not possible as the age group we have taken in this study are not frequent with laptop or computer use.

Former studies included perimeter tests as outcome measures. But the costs for such tests are high and non-affordable due to lack of funds.

Issues were faced for ensuring patients to keep them to the treatment schedule.

For the patients included in this study post onset time ranges from 4 months to 24 months.

Future Scope

Greater potential can be imagined if efficacy of unsupervised home based neuro-optometric can be assessed. Telephonic encouragement and supervision can also be provided. More reliable outcome measures can be used. More of post chiasmatic population like traumatic brain injury and carcinoma can be assessed and given the benefit of neuro-optometric exercises.

CHAPTER 6

CONCLUSIONS

It is possible to actually improve the quality of life in patients with visual field deficits after post-chiasmatic lesions. The combination of compensatory and restitution strategies has brought significant improvement in activities of daily living related to vision. The central finding states that supervised home based training significantly improves primary outcome NEI VFQ-25. However, non-significant is seen in one of the secondary outcome measures i.e. independent mobility score. Furthermore, training is happily encouraged among patients as it is home-based, therapist has to invest 35% of total time to make it more reliable treatment. Less investment of time corresponds to cost effective plan and thus increase in accessibility is accounted

CHAPTER 7

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CHAPTER 8

APPENDICES

Annexure 1:

INFORMED CONSENT

PERSONAL DETAILS:

Name:

Address:

Phone No:

Email Address:

Date of Birth:

Occupation:

Please carefully read and sign this form.

1. I understand that it is important that I give the most accurate health history and information to my physiotherapist so that any planned treatments and therapies are in by best interest.
2. I understand that my physiotherapist will discuss any assessment and treatment plans with me before they are administered.
3. I understand that information given by me will be kept confidential and private during the study.
4. I understand the importance and method of assessment and treatment used in the study as discussed with my physiotherapist.
5. I understand the risk of physiotherapy treatment can include but it is not limited to an exacerbation of symptoms, strains, sprains allergic reactions, electrical shocks and burns.
6. I understand the consequences of not receiving treatment can include but is not limited to a continued exacerbation of symptoms or no improvement of symptoms.
7. I understand that I can discuss my interest or disinterest in the treatments with my physiotherapist.
8. I have read and understand the contents of this form. I hear by grant permission to my physiotherapist to perform the assessment and treatments that may that may be necessary to treat my condition or injury.
9. I understand that my physiotherapist will also provide further details regarding the benefits, risks, consequences, and availability of alternative and adjunctive therapies specific to my symptoms during the course of the assessment and treatment.

10. I also understand that I can withdraw consent to any component of the assessment or treatment at any time.

DATE: _____ PATIENT SIGNATURE:

Annexure 2

PB/SA

National Eye Institute Visual Functioning Questionnaire - 25 (VFQ-25)

version 2000

(SELF-ADMINISTERED FORMAT)

January 2000

The following is a survey with statements about problems which involve your vision or feelings that you have about your vision condition. After each question please choose the response that best describes your situation.

Please answer all the questions as if you were wearing your glasses or contact lenses (if any).

Please take as much time as you need to answer each question. All your answers are confidential. In order for this survey to improve our knowledge about vision problems and how they affect your quality of life, your answers must be as accurate as possible. Remember, if you wear glasses or contact lenses, please answer all of the following questions as though you were wearing them.

INSTRUCTIONS:

11. In general we would like to have people try to complete these forms on their own. If you find that you need assistance, please feel free to ask the project staff and they will assist you.

12. Please answer every question (unless you are asked to skip questions because they don't apply to you).

13. Answer the questions by circling the appropriate number.

14. If you are unsure of how to answer a question, please give the best answer you can and make a comment in the left margin.

15. Please complete the questionnaire before leaving the center and give it to a member of the project staff. Do not take it home.

16. If you have any questions, please feel free to ask a member of the project staff, and they will be glad to help you.

STATEMENT OF CONFIDENTIALITY:

All information that would permit identification of any person who completed this questionnaire will be regarded as strictly confidential. Such information will be used only for the purposes of this study and will not be disclosed or released for any other purposes without prior consent, except as required by law.

Visual Functioning Questionnaire - 25

PART 1 - GENERAL HEALTH AND VISION

1. In general, would you say your overall health is:
(Circle One)

Excellent **1**
Very Good **2**
Good **3**
Fair **4**
Poor **5**

2. At the present time, would you say your eyesight using both eyes (with glasses or contact lenses, if you wear them) is excellent, good, fair, poor, or very poor or are you completely blind?
(Circle One)

Excellent **1**
Good **2**
Fair **3**
Poor **4**
Very Poor **5**
Completely Blind **6**

3. How much of the time do you worry about your eyesight?

(Circle One)

None of the time **1**
A little of the time **2**
Some of the time **3**
Most of the time **4**
All of the time? **5**

4. How much pain or discomfort have you had in and around your eyes (for example, burning, itching, or aching)? Would you say it is:

(Circle One)

None **1**
Mild **2**
Moderate **3**
Severe, or **4**
Very severe? **5**

PART 2 - DIFFICULTY WITH ACTIVITIES

The next questions are about how much difficulty, if any, you have doing certain activities wearing your glasses or contact lenses if you use them for that activity.

5. How much difficulty do you have reading ordinary print in newspapers? Would you say you have:

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

6. How much difficulty do you have doing work or hobbies that require you to <u>see well up close</u>, such as cooking, sewing, fixing things around the house, or using hand tools? Would you say:

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

7. Because of your eyesight, how much difficulty do you have <u>finding</u> <u>something on a crowded shelf</u>?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

8. How much difficulty do you have <u>reading street signs or the names of stores</u>?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

9. Because of your eyesight, how much difficulty do you have going down steps, stairs, or curbs in dim light or at night?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

10. Because of your eyesight, how much difficulty do you have noticing objects off to the side while you are walking along?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

11. Because of your eyesight, how much difficulty do you have seeing how people react to things you say?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

12. Because of your eyesight, how much difficulty do you have <u>picking out and matching your own clothes</u>?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

13. Because of your eyesight, how much difficulty do you have <u>visiting</u> <u>with people in their homes, at parties, or in restaurants</u> ?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

14. Because of your eyesight, how much difficulty do you have <u>going out</u> <u>to see movies, plays, or sports events</u>?

(Circle One)

No difficulty at all **1**
A little difficulty **2**
Moderate difficulty **3**
Extreme difficulty **4**
Stopped doing this because of your eyesight **5**
Stopped doing this for other reasons or not interested in doing this **6**

15. Are you <u>currently driving</u>, at least once in a while?

(Circle One)

Yes ..... 1*Skip To Q 15c*

No 2

15a. IF NO: Have you <u>never</u> driven a car or have you <u>given up driving</u>?

(Circle One)

Never drove ..... 1*Skip To Part 3, Q 17*

Gave up..... 2

15b. IF YOU GAVE UP DRIVING: Was that <u>mainly because of your eyesight</u>, <u>mainly for some other reason</u>, or because of <u>both your</u> <u>eyesight and other reasons</u>?

(Circle One)

Mainly eyesight ..... 1*Skip To Part 3, Q 17*

Mainly other reasons ..... 2*Skip To Part 3, Q 17*

Both eyesight and other reasons ... 3*Skip To Part 3, Q 17*

15c. IF CURRENTLY DRIVING: How much difficulty do you have <u>driving during the daytime in familiar places</u>? Would you say you have:

(Circle One)

No difficulty at all **1**

A little difficulty **2**

Moderate difficulty **3**

Extreme difficulty **4**

16. How much difficulty do you have <u>driving at night</u>? Would you say you have:

(Circle One)

No difficulty at all **1**

A little difficulty **2**

Moderate difficulty **3**

Extreme difficulty **4**

Have you stopped doing this because of your eyesight **5**

Have you stopped doing this for other reasons or are you not interested in doing this **6**

16A. How much difficulty do you have <u>driving in difficult conditions, such</u> <u>as in bad weather, during rush hour, on the freeway, or in city traffic</u>? Would you say you have:

(Circle One)

No difficulty at all **1**

A little difficulty **2**

Moderate difficulty **3**

Extreme difficulty **4**

Have you stopped doing this because of your eyesight **5**

Have you stopped doing this for other reasons or are you not interested in doing this **6**

PART 3: RESPONSES TO VISION PROBLEMS

The next questions are about how things you do may be affected by your vision. For each one, please circle the number to indicate whether for you the statement is true for you all, most, some, a little, or none of the time.

	(Circle One On Each Line)				
READ CATEGORIES:	**All of the time**	**Most of the time**	**Some of the time**	**A little of the time**	**None of the time**
17. Do you accomplish less than you would like because of your vision?	**1**	**2**	**3**	**4**	**5**
18. Are you limited in how long you can work or do other activities because of your vision?	**1**	**2**	**3**	**4**	**5**
19. How much does pain or discomfort in or around your eyes, for example, burning, itching, or aching, keep you from doing what you'd like to be doing? Would you say:	**1**	**2**	**3**	**4**	**5**

For each of the following statements, please circle the number to indicate whether for you the statement is definitely true, mostly true, mostly false, or definitely false for you or you are not sure.

(Circle One On Each Line)

	Definitely True		Mostly True	Not Sure	Mostly False	Definitely False
20.	I stay home most of the time because of my eyesight.....	1	2	3	4	5
21.	I feel frustrated a lot of the time because of my eyesight.....	1	2	3	4	5
22.	I have much less control over what I do, because of my eyesight.	1	2	3	4	5
23.	Because of my eyesight, I have to rely too much on what other people tell me. .	1	2	3	4	5
24.	I need a lot of help from others because of my eyesight.....	1	2	3	4	5
25.	I worry about doing things that will embarrass myself or others, because of my eyesight.....	1	2	3	4	5

Annexure 3 READING MATERIAL

This is not a book. That is a pencil. Milk is good for you to drink. One is strong. The other is weak. It is really wonderful. I am busy just now. I am glad you like it. I am ready for breakfast. The car is near the tree. Your hat looks very nice. My sister has a cup. I have a lot of thing to eat. We have a car waiting outside. There is not any book on the table. There are two pencils in my box. There are seven days in a week. I opened the door. I have bought the car. It is getting dark. You are getting fat. He said he always carried a gun. I take a slower. I brush my teeth. I comb my hair. I go back to bedroom. I begin to dress. I tie my tie. I close the window. I turn off the light. I want to eat. I want you to tell me this. I will be fine.

Annexure 4

INDEPENDENT MOBILITY SCALE

Range rankings from ***1*** *no difficulty* to ***5*** *extreme difficulty*.

1 Walking in familiar areas ***1 2 3 4 5***

2 Walking in unfamiliar areas ***1 2 3 4 5***

3 Moving about at home ***1 2 3 4 5***

4 Moving about at work ***1 2 3 4 5***

5 Moving about in the classroom ***1 2 3 4 5***

6 Moving about in stores ***1 2 3 4 5***

7 Moving about outdoors ***1 2 3 4 5***

8 Moving about in crowded situations ***1 2 3 4 5***

9 Walking at night ***1 2 3 4 5***

10 Using public transportation ***1 2 3 4 5***

11 Detecting ascending stairwells ***1 2 3 4 5***

12 Detecting descending stairwells ***1 2 3 4 5***

13 Walking up steps ***1 2 3 4 5***

14 Walking down steps ***1 2 3 4 5***

15 Stepping onto curbs ***1 2 3 4 5***

16 Stepping off curbs ***1 2 3 4 5***

17 Walking through doorways ***1 2 3 4 5***

18 Walking in high-glare areas ***1 2 3 4 5***

19 Adjusting to lighting changes during the day: indoor to outdoor ***1 2 3 4 5***

20 Adjusting to lighting changes during the day: outdoor to indoor ***1 2 3 4 5***

21 Adjusting to lighting changes at night: indoor to streetlights ***1 2 3 4 5***

22 Adjusting to lighting changes at night: streetlights to indoor ***1 2 3 4 5***

23 Walking in dimly lit indoor areas ***1 2 3 4 5***

24 Being aware of another person's presence ***1 2 3 4 5***

25 Avoiding bumping into people ***1 2 3 4 5***

26 Avoiding bumping into walls ***1 2 3 4 5***

27 Avoiding bumping into head-height objects ***1 2 3 4 5***

28 Avoiding bumping into shoulder-height objects ***1 2 3 4 5***

29 Avoiding bumping into waist-height objects ***1 2 3 4 5***

30 Avoiding bumping into knee-height objects ***1 2 3 4 5***

31 Avoiding bumping into low-lying objects ***1 2 3 4 5***

32 Avoiding tripping over uneven travel surfaces ***1 2 3 4 5***

33 Moving around in social gatherings ***1 2 3 4 5***

34 Finding restrooms/washrooms in public places ***1 2 3 4 5***

35 Seeing cars at intersections ***1 2 3 4 5***

Annexure 5 McMASTER CHART

Code	Name	Age	Gender	***NATIONAL EYE INSITUTE VISUAL FUNCTIONING QUESTIONNAIRE-25***			
				Composite score		**General health**	
				pre	post	pre	post
PVFD1	Manas Kumar Chakravorty	57	Male	78.18	161.81	50	75
PVFD2	Pramod Kumar Saini	54	Male	55.45	155	50	75
PVFD3	Rajinder Kumar	53	Male	150.9	192.27	50	50
PVFD4	Amarjit Singh	65	Male	66.81	121.36	25	50
PVFD5	Shakuntala Devi	68	Female	89.54	143.63	50	50
PVFD6	Savinder Kaur	63	Female	62.7	146.36	25	50
PVFD7	Davinder Kumar	54	Male	110	185	50	50
PVFD8	Narinder Kaur	60	Female	44.54	89.54	0	25

General vision		occular pain		near activities		distance activities		social functioning	
Pre	post	pre	post	pre	post	pre	post	pre	post
60	80	37.5	100	41.66	75	41.66	83.33	50	87.5
60	80	50	100	8.33	75	25	75	12.5	87.5
60	60	50	100	75	100	91.66	91.66	75	100
60	60	50	100	50	62.5	25	50	25	75
60	80	100	100	25	66.66	16.66	50	37.5	75
40	60	75	100	12.5	62.5	8.33	50	25	87.5
60	60	87.5	100	41.66	91.66	41.66	91.66	50	100
40	60	37.5	62.5	0	25	0	25	25	50

mental health		role difficulties		dependency		driving		color vision	
Pre	post	pre	post	pre	post	pre	post	pre	4th
37.5	75	25	75	16.66	75	*	*	75	100
37.5	81.25	25	75	25	75	*	*	50	100
81.25	100	75	100	83.33	100	*	*	75	100
56.25	81.25	37.5	75	33.33	66.66	*	*	50	100
62.5	81.25	50	75	33.33	50	*	*	50	100
50	81.25	25	75	33.33	83.33	*	*	25	100
62.5	100	50	75	50	91.66	*	*	75	100
43.78	68.75	25	50	25	50	*	*	25	27

READING SPEED

peripheral vision		number of mistakes		time taken		reading speed calculated	
Pre	post	pre	post	pre	post	pre	post
50	75	40	12	607	325	12.66	28.83
25	75	15	2	210	75	43.71	132.8
50	100	7	0	208	156	46.53	64.61
25	50	12	4	162	103	57.77	95.9
25	75	14	5	324	308	28.51	31.77
25	75	21	12	452	364	19.52	25.74
50	100	12	4	166	125	72.22	78.84
25	75	17	15	346	300	26.21	30.6

INDEPENDENT MOBILITY QUESTIONAIRE		***BASIC SCANNING TEST***			
		Reaction time		**accuracy**	
Pre	post	pre	post	pre	post
122	110	950	545	0.46	0.87
121	105	540	250	0.62	0.93
93	90	264	205	0.78	1
148	136	475	372	0.68	0.87
116	112	896	643	0.65	0.93
137	100	807	701	0.56	0.78
122	105	492	382	0.78	0.96
149	124	554	472	0.71	0.87