

**A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER
VISION SYNDROME AMONG REGULAR COMPUTER USERS
AND EFFECT OF YOGIC EXERCISES IN THEM**

Dissertation submitted to



**THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY,
CHENNAI-600032**

In partial fulfillment of the requirement for the award of the degree of

Doctor of Medicine in Physiology (Branch V)

M.D.(PHYSIOLOGY)

APRIL 2016

**DEPARTMENT OF PHYSIOLOGY
TIRUNELVELI MEDICAL COLLEGE
TIRUNELVELI-11**

CERTIFICATE

This dissertation entitled “**A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER VISION SYNDROME AMONG REGULAR COMPUTER USERS AND EFFECT OF YOGIC EXERCISES IN THEM**” is submitted to the **Tamil Nadu Dr.M.G.R.Medical university**, Chennai, in partial fulfillment of regulations for the award of **M.D.Degree in Physiology** in the Examinations to be held during April 2016.

This dissertation is a record of fresh work done by the candidate **DR.S.SUBHALAKSHMI**, during the course of the study (2013-2016).

This work was carried out by the candidate herself under my supervision.

Dr.K.SithyAthiyaMunavarah.M.D **Dr.R.Thenmozhi.M.D.DCP.**

Dean,
Tirunelveli medical college,
Tirunelveli-627011.

Associate professor and Head,
Department of Physiology,
Tirunelveli medical college,
Tirunelveli – 627011.



ENDORSEMENT BY THE GUIDE

This is to certify that the dissertation entitled “entitled “**A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER VISION SYNDROME AMONG REGULAR COMPUTER USERS AND EFFECT OF YOGIC EXERCISES IN THEM**” is a bonafide research work carried out by **Dr.S.SUBHALAKSHMI** in the department of Physiology, Tirunelveli Medical College, Tirunelveli under my direct guidance and supervision in partial fulfillment of the requirement for the award of the degree of MD in PHYSIOLOGY (BRANCH – V) in April 2016.

GUIDE :

Dr. B. SUJATHA, M.D.D.A.

Associate professor,

Department of Physiology,

Tirunelveli Medical College,

Tirunelveli- 627011.

DECLARATION

I solemnly declare that the dissertation titled “**A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER VISION SYNDROME AMONG REGULAR COMPUTER USERS AND EFFECT OF YOGIC EXERCISES IN THEM**” is done by me at Monet computer centre, Tirunelveli.

The dissertation is submitted to The TamilnaduDr,M.G.R.Medical university towards the partial fulfilment of requirements for the award of M.D.Degree (Branch V) in Physiology.

Place: Tirunelveli.

Date:

Dr.S.SUBHALAKSHMI,

Postgraduate student,

M.D.Physiology,

Department of Physiology,

Tirunelveli Medical College,

Tirunelveli – 627011.

ACKNOWLEDGEMENT

I express my sincere thanks to **Dr.K.SithyAthiyaMunavarah,M.D.,** Dean,Tirunelveli Medical College, Tirunelveli, for granting me permission to do this dissertation.

I am extremely thankful to **Dr.S.M.Kannan MS.M.ch,** Vice Principal, Tirunelveli Medical College, Tirunelveli,for his encouragement during this study.

I am deeply indebted to **Dr.R.Thenmozhi M.D.DCP,** Associate Professor and Head, Department of Physiology, Tirunelveli Medical college, Tirunelveli, for her support and encouragement during this study.

I am deeply indebted to **Dr. B.Sujatha, M.D.D.A.,** Associate Professor, Department of Physiology, Tirunelveli Medical college, Tirunelveli, for the able guidance, inspiration, support and encouragement she rendered at every stage of this study.

I express my heartfelt gratitude for all Assistant Professors, and all the staff members of Department of Physiology, Tirunelveli Medical College, Tirunelveli, for their valuable guidance in doing this study.

I express my profound thanks to **Mr.S.Ganesh**, Managing Director of Monet Computer Center, Tirunelveli, and all the staffs for their kind cooperation to do this study.

I express my profound thanks to my Post Graduate Colleagues, of Department of Physiology, Tirunelveli Medical College, Tirunelveli, for their kind cooperation in doing this study.

I gratefully acknowledge the subjects who cooperated to submit themselves for the study.

Last but not the least I am indebted to my husband **DR.T.Amirthamani Ganesh** and my daughter **A.Kavin Bharathi** not only for their moral support but also for tolerating my dereliction of duty during the period of my study.



Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author: 201315304.physiology SUBHALAKS..
Assignment title: TNMGRMU EXAMINATIONS
Submission title: A STUDY OF CARPAL TUNNEL SY...
File name: STUDY.docx
File size: 604.56K
Page count: 88
Word count: 12,916
Character count: 70,823
Submission date: 03-Sep-2015 12:49PM
Submission ID: 565416345

A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER
VISION SYNDROME AMONG REGULAR COMPUTER USERS
AND EFFECT OF YOGIC EXERCISES IN THEM

Dissertation submitted to



THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY,
CHENNAI-600032

In partial fulfillment of the requirement for the award of the degree of

Doctor of Medicine in Physiology (Branch V)

M.D.(PHYSIOLOGY)

APRIL 2016

**DEPARTMENT OF PHYSIOLOGY
TIRUNELVELI MEDICAL COLLEGE
TIRUNELVELI-11**

Originality

GradeMark

PeerMark



16% SIMILAR

-- OUT OF 0

VISION SYNDROME AMONG REGULAR COMPUTER USERS AND EFFECT OF YOGIC EXERCISES IN THEM

20 Dissertation submitted to



Match Overview

- 1 www.himalayaninstitut... Internet source 2%
- 2 www.yogamag.net Internet source 2%
- 3 myopiament.org Internet source 2%
- 4 Submitted to Higher Ed... Student name 1%



**A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER
VISION SYNDROME AMONG REGULAR COMPUTER USERS
AND EFFECT OF YOGIC EXERCISES IN THEM**



CONTENTS

S.No	TITLES	Page No
1	Introduction	1
2	Aims and Objectives	5
3	Review of Literature	6
4	Materials and Methods	52
5	Result Analysis	63
6	Discussion	82
7	Summary and Conclusion	86
8	Bibliography	88
9	Annexures	

ABBREVIATIONS USED IN THIS STUDY

- CTS - Carpal Tunnel Syndrome
- CVS - Computer Vision Syndrome
- BMI - Body Mass Index
- WRMSD - Work Related Musculo Skeletal Disorders
- VDT - Video Display Terminals
- VDU - Video Display Users
- CPU - Central Processing Unit
- TBUT - Tear Film Break Up Time
- OSHA - Occupational Safety and Health Administration
- OOS - Occupation Overuse Syndrome
- FSS - Functional Status Score
- NCS - Nerve Conduction Study
- EMG - Electromyography
- BCTQ - Boston Carpal Tunnel Questionnaire
- MNCV - Median Motor Nerve Conduction Velocity

**A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER VISION
SYNDROME AMONG REGULAR COMPUTER USERS AND EFFECT OF
YOGIC EXERCISES IN THEM**

ABSTRACT

INTRODUCTION: Computer use is increasingly common among working populations. Currently it is estimated that, about 75% of working activities of all jobs involve computer use. On one hand these computers have made lives so much easy but on the other hand have created many human health related problems. This negative risks associated with the usage of these computers are increasing with their growing demand day by day. Several studies suggested that long term computer users are at increased risk for carpal tunnel syndrome(CTS) and other work related musculoskeletal disorders of the upper extremities. Carpal Tunnel Syndrome (CTS) is the syndrome which occurs due to compression of median nerve within the carpal tunnel. Hence, it is very important to diagnose this condition at an early stage and we can treat as early as possible and also restore the normal use of hands and wrist. In the beginning, studies were mainly focused on radiation hazards but gradually ophthalmic complaints due to video display terminals(VDT) exposure became the main focus and the term computer vision syndrome(CVS) was born. Prolonged computer usage without taking a break leads to eyestrain. Traditionally these computer related health disorders have been treated with wrist splint, application of anti-inflammatory agents, steroid injection therapy, application of artificial tears, avoidance of occupational duties and surgery. Yoga and relaxation

technique have been used to reduce the musculoskeletal disorders (MSD) and computer related ophthalmic symptoms.

AIMS AND OBJECTIVES: To find out the prevalence of carpal tunnel syndrome and computer vision syndrome among regular computer users and to study the effectiveness of yogic exercises and relaxation techniques in the improvement of carpal tunnel syndrome and computer vision syndrome among regular computer users.

MATERIALS AND METHODS: It is a cross-sectional study followed by an interventional study. After getting ethical committee clearance, this study was conducted in Monet Computer Centre, Tirunelveli. The study period extended from February 2015 to July 2015. A total of 100 regular computer users working in the computer centre, both males and females in the age group between 20 to 40 years were selected.

INCLUSION CRITERIA: Regular computer users (10 to 15 hours/week) who have been in the same occupation for the last twelve months.

EXCLUSION CRITERIA: Any physical deformity of the upper limbs and neck which prevents the performance of the tasks, Diabetes mellitus, thyroid disease, known visual problems etc.

Proforma – To get the detailed history of the subjects with carpal tunnel syndrome and computer vision syndrome and for recording the biochemical and clinical findings of the subjects.

Slit lamp – for measuring tear film breakup time, Schirmer's strip – To record wetting of filter paper, Computerized RMS EMG EP MARK II equipment – To record the median motor nerve conduction velocity were used for this study.

STATISTICAL ANALYSIS: To compare quantitative variable of group before and after the intervention “paired t test” was used, difference between groups were considered statistical significant at $p < 0.05$. In this study prevalence of carpal tunnel syndrome among the regular

computer users was 38% and prevalence of computer vision syndrome was 62%. Median motor nerve conduction velocity after yogic exercises was increased and it was statistically significant. The study showed 62 persons having computer vision syndrome and the frequency of symptoms reduced after intervention. **DISCUSSION AND CONCLUSION:** Extensive and prolonged computer use has given rise to computer related health disorders. Carpal tunnel syndrome and computer vision syndrome are the common problems among them. Yogic exercises help to reduce these problems. The improvement in CTS and CVS was statistically significant. This indicates poor work station design, improper posture, working in a computer for a longer duration without taking break accelerates the symptoms and these can be corrected or reduced by regular yogic exercises and special attention should be given to these regular computer users. To conclude, regular computer users with CTS and CVS can be advised yogic exercises for improvement of computer related health problems.

KEY WORDS: Carpal Tunnel Syndrome, Computer vision syndrome, Computer users, Yogic exercises.

A STUDY OF CARPAL TUNNEL SYNDROME AND COMPUTER VISION SYNDROME AMONG REGULAR COMPUTER USERS AND EFFECT OF YOGIC EXERCISES IN THEM

INTRODUCTION

Computer use is increasingly common among working populations. Currently It is estimated that, about 75% of working activities of all jobs involve computer use¹. Computers are the main tools in offices, businesses and educational systems. On one hand these computers have made lives so much easy but on other hand have created many human health related problems. This negative risks associated with the usage of these computers are increasing with their growing demand day by day².

Several studies suggested that long term computer users are at increased risk for carpal tunnel syndrome(CTS)³ and other work related musculoskeletal disorders of the upper extremities.Increased computer work coincided with a higher prevalence of work related musculoskeletal disorders of the upper extremities(WRMSDs)⁴.These are defined as disorders or injuries of the muscles,tendons,joints,cartilage,nerves and spinal discs associated with risk factors exposure in the working place⁵. Carpal Tunnel Syndrome (CTS) is the syndrome which occurs due to compression of median nerve within the carpal tunnel. It is a clinical condition consists of tingling, numbness, burning sensation and nocturnal pain exacerbation located mainly along the median nerve

distribution. Any delay in diagnosing this condition results in permanent nerve damage and persistent symptoms⁶. Hence, it is very important to diagnose this condition at an early stage and we can treat as early as possible and also restore the normal use of hands and wrist.

In the beginning, studies were mainly focused on radiation hazards but gradually ophthalmic complaints due to video display terminals(VDT) exposure became the main focus and the term computer vision syndrome(CVS) was born. Prolonged and repeated computer use leads to a more health related problems and the eyes are the most affected target organ. Prolonged computer usage without taking a break leads to eyestrain. Contributing factors are include; decrease in the blinking rate continuous staring at the screen, a reduced humidity in the working place and the chances of undiscovered refractory errors, which may increase the eye related problems.

Computer Vision Syndrome (CVS) is defined as a complex of eye and vision related problems that occur during and related to prolonged computer use. CVS may occur temporarily or permanently depends upon the duration of computer use. Computer vision syndrome (CVS) is a group of eye and vision-related problems⁷ due to prolonged computer use. The features of CVS are: diffuse pain in eye, double or blurred vision, photophobia, headache, irritated and dry eyes, watering of eyes, ocular itching, burning, dark spots in front of eyes, pain

after movement of eyeball, reduced speed of reading, worsening of far-vision, near-vision and astigmatism, neck ache, shoulder pain and also back pain⁸.

Among complaints reported by video display users (VDUs) red eye, blurred vision, diplopia, burning sensation and eye weakness or fatigue is more common⁹. Headache, shoulder pain, neck or back pain are the main non-ocular symptoms. CVS is being recognized as a growing public health problem worldwide¹⁰. Prolonged visual display terminal exposure reduces blink rate¹¹, blink amplitude and blink quality which leads to tear film instability¹². Therefore, dryness of eyes is common due to prolonged computer use¹³.

Traditionally these computer related health disorders have been treated with wrist splint, application of anti-inflammatory agents, steroid injection therapy, application of artificial tears, avoidance of occupational duties and surgery. However, these options have provided less satisfactory symptoms relief¹⁴. The best approach is to be aware of own working habits, symptoms of overuse and ways to adjust the work area¹⁵. Hence, to some extent the risk of carpal tunnel syndrome and computer vision syndrome can be reduced by proper adjustment of work station, good work practices like proper light adjustment, taking regular breaks between work, adjusting the chair height, proper hand position on the key board and mouse to avoid awkward wrist positions that can lead to CTS and CVS.

The complementary and alternative medicine reflects changing needs in modern society in general¹⁶. Yoga and relaxation technique have been used to

reduce the musculoskeletal disorders (MSD) and computer related ophthalmic symptoms.

Yogic exercise has been shown to be useful in reducing mental stress, computer related musculoskeletal symptoms, improvement of nerve function due to reduction of compressive stresses in median nerve and brachial plexus and also due to enhancement of micro circulation. They are used to improve physical fitness and health. During the practice of Hatha Yoga, both the pathological and physiological improvement takes place as a result of regular practice. The eye muscles also react to stress like other muscles and chronically over-contracted, causes eyestrain and it produces many eye related problems. Yogic eye exercises help to reduce eye related symptoms and also increases the stamina of eye muscles¹⁷.

All the above said non pharmacological strategies if applied to regular computer users provide a positive impact on their muscle strength and dry vision. The studies have shown significant improvement in range of motion in muscle strength and in computer dry eye by supervised programme of yoga and relaxation. Hence the present study helps to evaluate whether a programme of specially designed yoga and relaxation technique will provide an effective treatment for symptomatic participants among regular computer users.

AIMS
&
OBJECTIVES

AIMS AND OBJECTIVES

- 1.To find out the prevalence of carpal tunnel syndrome among regular computer users.
- 2.To find out the prevalence of computer vision syndrome among regular computer users.
- 3.To assess the carpal tunnel syndrome by measurement of median motor nerve conduction velocity.
- 4.To assess the extent of dry eye by performing Tear film Break Up Time (TBUT) and schirmer's test.
- 5.To determine the correlation of age, sex , body mass index, years of employment, average number of working hours per week with the carpal tunnel syndrome and computer vision syndrome.
- 6.To study the effectiveness of yogic exercises and relaxation techniques in the improvement of carpal tunnel syndrome and computer vision syndrome among regular computer users.

**REVIEW
OF
LITERATURE**

REVIEW OF LITERATURE

Computer use is increasingly common among working populations. Computer related injuries like musculo skeletal disorders and computer vision syndrome began to be reported in India five years ago are now developing into an epidemic among regular computer users¹⁸. Work related musculoskeletal disorders (WMSD) are common among regular computer users¹⁹. WMSD consists of a group of disorders which are characterized by numbness, tingling, pain in muscles, joints and tendons²⁰.

CARPAL TUNNEL SYNDROME

Definition

The word carpus is derived from Greek language, “karpos” means “wrist”. Carpal tunnel is a closed space present in the wrist region. It is a space between the fibrous band which functions as support for the wrist joint and the wrist bone. Median nerve which provides sensations to thumb, index finger, middle finger and radial half of ring finger passes through this tunnel and any compression of the nerve within the tunnel results in carpal tunnel syndrome(CTS)²¹.

CTS is the most common entrapment neuropathy caused by median nerve compression when it passes through the tunnel beneath the flexor retinaculum²². It frequently causes pain, numbness and tingling sensation in the upper extremities. CTS is a recognized cause of work disability²³.

CTS is the common peripheral mononeuropathy²⁴, and it is the one among the Work-Related Musculoskeletal Disorders (WMSDs)²⁵. According to US Department of Labour Occupational Safety and Health Administration (OSHA), CTS results in more number of days away from work, i.e. median of 25 days²⁶.

Alternative names

CTS is also called as median entrapment neuropathy or median nerve dysfunction²⁷.

ICD-9 Classification

According to ICD-9 classification, CTS code is 354.0.

Work Related Musculoskeletal Disorders (WMSDs)

These are commonly known as Repetitive strain Injury (RSI), Occupational Overuse Syndrome (OOS), Work Related Upper Limb Disorder (WRULD) or Cumulative Trauma Disorder (CTD). WMSDs are classified into 3 groups²⁸ as follows;

Local inflammation	Compression syndromes	Pain syndromes
Trigger finger	Carpal tunnel syndrome	Chronic pain syndrome
De Quervains	Thoracic outlet syndrome	Myofascial syndromes
Tenosynovitis	Radial nerve compression	Fibromyalgia
Rotator cuff syndrome	Ulnar nerve compression	Complex regional
Bursitis		Pain syndromes (reflex sympathetic dystrophy)
Epicondylitis		
Cervicothoracic dysfunction		
Muscle strain		
Postural syndromes		

HISTORICAL PERSPECTIVES

CTS has increased attention in the recent 10 to 20 years and it is mainly due to earlier diagnosis and better public awareness. Occupational hand /wrist disorders (like writer's cramp, tailor's cramp, telegraphist's cramp etc.) have already described in early 1900's and these signs and symptoms are now being

included in CTS²⁹. Paget (1854) was the first person to describe the clinical presentations in a patient with fracture of distal radius. Marie and Foix (1913) described the pathological changes noted in the long term compression of median nerve in an 80 year old patient with atrophy of thenar muscles. First surgical decompression was performed by Learmonth (1933). **The term “carpal tunnel syndrome” was coined by Moersch (1938).** Through a continuous publications Dr. George Phalen (1950s) ,a famous hand surgeon receives most of the credit for popularizing this condition and bringing it to the attention of the medical community³⁰.

Long periods of uninterrupted and continuous computer work would appear to be one of the important risk factors in MSD³¹. The main causes are high level of strain, poor posture and pressure over the nerves³².

A strong association between workplace factors and CTS was established by Osorio and co-workers (1994). Since then, various studies which have been related with work related musculo skeletal disorders have been done on different occupational groups (fish and pork processing workers, grocery store workers, electricians, etc)²⁹.

ANATOMY OF THE CARPAL TUNNEL

Carpal tunnel is a fibro-osseous tunnel. It is the passageway present on the palmar aspect of the wrist which connects the forearm to the middle compartment of the deep plane of the palm. It has roof and floor.

Roof: Roof is formed by flexor retinaculum. It is a transverse carpal ligament which is attached medially to the pisiform and hook of hamate and laterally to scaphoid tuberosity and part of trapezium

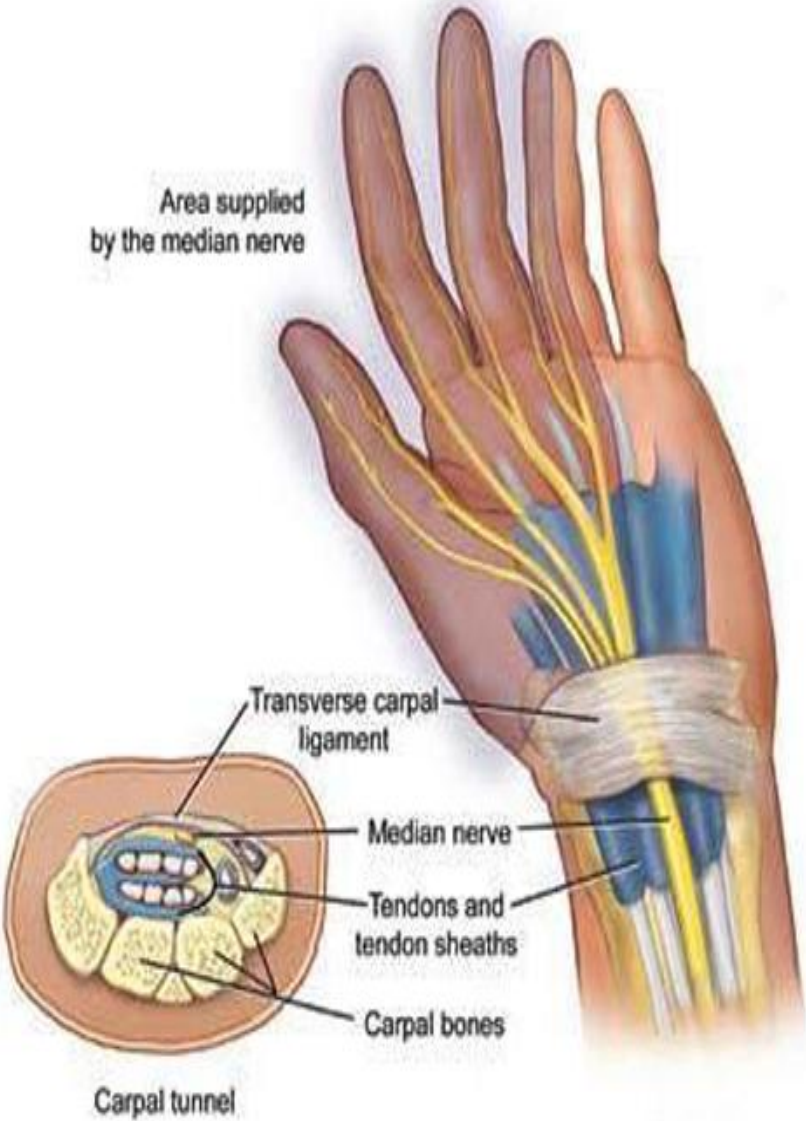
Floor: Floor is formed by palmar radiocarpal ligament and palmar ligament complex.

Contents:

1. **Median Nerve** - most superficial present just under the retinaculum.
2. **Nine flexor tendons** – consists of four flexor digitorum superficialis tendons and four flexor digitorum profundus tendons which are present within common synovial sheath and one flexor pollicis longus tendon which is present in a separate sheath.

The canal is narrow, and when any of flexor tendons passing through it swell or degenerate which leads to narrowing of canal and it results in compression of median nerve resulting in a medical condition called carpal tunnel syndrome.

CARPAL TUNNEL ANATOMY



Effect of wrist movements

Shape and width of the carpal tunnel is affected by movements in the wrist. During the normal range of movement in the wrist the width of the canal decreases considerably and flexing the wrist produces the flexor retinaculum to move closer to the radius and it considerably decreases the cross section of the proximal opening of the tunnel. Also, the distal end of the capitate bone presses into the opening. In extreme extension, the lunate bone constricts the passage as it is pressed toward the interior of the tunnel. Chronic compression of median nerve within the carpal tunnel at the wrist leads to pain, numbness and tingling sensation in the upper extremities.

MEDIAN NERVE

Median nerve is also called as “Labourer’s Nerve” and it controls coarse movements of the hand. It is a mixed nerve, it has both sensory and motor functions and it also has autonomic fibers to the whole hand³⁷.

Origin

Root value of median nerve is C_{5,6,7,8}T₁. It originates from the brachial plexus in the axilla.

Course

In the arm, it crosses from lateral to medial side and it enters the cubital fossa and it lies medial to brachial artery and biceps tendon.

In the forearm, it crosses from medial to lateral side and it descends vertically in the midline.

Then in the hand it enters the carpal tunnel and lies deep to the flexor retinaculum. In the tunnel it divides into medial and lateral branches.

Distribution

In the arm, it gives branches to pronator teres and few vascular branches to branches to brachial artery³⁷.

Medial root of median nerve provides motor fibers to distal median muscles of the forearm and hand. It also gives sensory fibers to the lateral half of the ring finger. Lateral root provides motor fibers to proximal median forearm muscles and gives sensory fibers to thenar eminence, thumb, index and middle fingers. In the hand, first and second lumbricals supplied by motor branch and it gives sensory fibers to palmar aspect of lateral three and half fingers. Opponenspollicis, abductor pollicisbrevis and flexor pollicisbrevis are supplied by recurrent muscular branches.

PATHOPHYSIOLOGY

Previously CTS was thought to be due to brachial plexus compression by cervical rib other structures in the neck. But after the discovery of electrophysiological studies in 1940s, CTS is known to be caused by chronic compression of median nerve.

When the wrist is in the neutral position, in normal individuals intracarpal canal pressure is 2.5 mm Hg and in CTS patients it is 32 mm Hg. But when wrist is 90° flexed, in normal individuals this pressure increases to 31 mm Hg and in CTS patients it increases about 94 mm Hg and it increases about 110 mm Hg when the wrist is extended. Due to increase in pressure there is obstruction to venous flow, leads to oedema formation and ischemia in the nerve³⁸.

Both pressure and ischemia result in demyelination and occasionally axon injury due to which both small and large myelinated fibres are affected³⁹. Sensory fibers are affected first followed by motor. Autonomic fibers may also be affected.

RISK FACTORS

- 1. Age:** Older people are at higher risk with peak incidence between 50-59 years.
- 2. Sex:** Females are at higher risk than males with ratio of approximately 3:1²². This is due to small carpal bones and small carpal tunnel. Hormonal changes also play a role.

3. Family history: risk may be due to obesity associated with medical conditions.

4. Obesity: Increased body mass index (BMI) may lead to CTS. Increased BMI associated with conditions like thyroid disorders, diabetes mellitus, acromegaly, etc have increased risk of developing CTS.

5. Occupations: List of occupations at risk for developing CTS²⁹ are;

- Grocery store work
- Meat and fish packing
- Poultry workers
- Computer users
- Electricians
- Pork processing
- Welders and carpenters
- Machine operators
- Garment workers
- Cleaners and sweepers
- Dairy workers
- Musicians
- Rock drillers
- Musicians
- Hospital workers like laboratory technicians

CAUSES

CTS is mainly due to compression of median nerve. The main cause of nerve compression is thickening or swelling of the synovial sheaths of the tendons with in the tunnel. This will reduce the tunnel space results in median nerve compression³⁸.

1. Working conditions

More than half of the CTS patients are associated with occupational factors, also CTS is primarily associated with medical or physical conditions and such a person is exposed to occupational factors, then the risk for CTS become significant. so convergence of these factors lead to nerve damage.

CTS is higher in persons with occupations involving repetitive movements of the hands, hand/wrist vibrations and forceful work.

2. Idiopathic: common, where cause is not known.

3. Systemic Diseases

Diabetes mellitus (DM): This diabetes mellitus leads to development of peripheral neuropathy and median nerve during its passage in the tunnel is most vulnerable to change and thereby leads to CTS. Prevalence rate of CTS⁴⁰ in diabetes mellitus ranges from 0.9% to 26%. About 6% of patients with diabetes

mellitus develops CTS. Hyperglycemia mediated biochemical mechanism leads to vascular and neuronal cell dysfunction.

Endocrine disorders: In hypothyroidism, there is a peripheral tissue oedema result in CTS⁴⁰. In acromegaly, there is nerve compression due to abnormal growth of the bones around the wrist and hand which may leads to CTS.

Rheumatoid arthritis: Due to inflammatory process there will be increase in pressure within the carpal tunnel leading to CTS⁴⁰.

Amyloidosis: Infiltration of amyloid in the flexor retinaculum results in median nerve compression.

Multiple myeloma

Muscle and bone diseases: Gout, Paget's disease may lead to CTS.

Chronic renal failure/ haemodialysis: CTS occurs due to deposition of beta 2 microglobulin.

Other conditions: Systemic lupus erythematosus, Down's syndrome, etc also cause Carpal tunnel syndrome.

4.Traumatic conditions

Like Colles fracture, fracture of distal radius, fracture both bones forearm, fracture-dislocation of carpus. All these conditions narrow the tunnel and compression of median nerve³⁰.

5.Genetic factors

Certain genetic abnormalities in genes regulating myelin may produce carpal tunnel syndrome.

6.Hormonal changes

During pregnancy fluid retention and swelling of tenosynovium leads to carpal tunnel syndrome.

7.Anomalous anatomic structures

Aberrant muscles like palmaris longus and lumbricals.

8.Others

Tumors, tuberculosis, double crush syndrome, hepatitis C, pyridoxine deficiency, etc.

CLASSIFICATION OF CTS

1. Based on onset

Divided into two types -Acute CTS and chronic CTS.

Acute CTS: Rare, may be associated with crush injuries or colles fracture resulting in rapid development of symptoms.

Chronic CTS: common and gradual in onset. It consists of three stages;

Stage I (Early): In this stage there is no gross alteration of median nerve.

Sensory latencies are more prolonged than the motor.

Stage II (intermediate): In this stage there is a constant sensory deficit. Motor impairment may be seen.

Stage III(Advanced): There is severe loss of sensory and motor functions and atrophy of thenar muscle.

2. **Based on the severity of symptoms**

Divided into three types

Group I- Mildest form and there is intermittent numbness, pain and tingling sensation along the distribution of median nerve. There are no abnormal findings on examination.

Group II- There is persistent symptoms of reduced tactile sensation, loss of dexterity and clumsiness. On examination, there is skin changes, thenar atrophy and sensory loss.

Group III- Severe form, there is marked sensory loss and functional impairment. On examination, there is skin atrophy, marked thenar wasting and loss of dexterity²².

3. **Based on electrophysiological evaluation**

Divided into three types

Mild –There is sensory abnormalities.

Moderate – Both sensory and motor abnormalities.

Severe – In this, there is decreased motor or sensory responses distal to the tunnel³⁸.

SYMPTOMS

Primary symptoms are tingling, numbness and nocturnal exacerbations. Pain, clumsiness and weakness are the secondary symptoms³⁹. Dominant hand is affected severely than the other hand.

Patients may have tingling and numbness in the lateral three and a half fingers. Patients may complain of dropping of things from fingers without notice. In some cases there is paresthesias due to involvement of autonomic fibers.

Due to occurrence of venostasis and swelling during night, there is severe compression of nerve within the tunnel worsens the pain. Pain can be an aching sensation present over the anterior aspect of the wrist.

SIGNS

In early stages, sensory changes are usually negative, but in advanced stages there may be severe loss of sensation along the distribution of median nerve. Motor changes includes weakness and atrophy of the muscles supplied by the median nerve. In long standing or neglected cases, there is thenar atrophy⁴¹. The easiest muscle to test is Abductor pollicis brevis. Opponens pollicis and flexor pollicis brevis are tested for opposition and abduction.

Special provocative tests: These are the tests which are not to be used for CTS diagnosis as they cannot distinguish between the other causes of nocturnal hand complaints and CTS.

1. Phalen sign: This sign is elicited by keeping the both wrists with the hands in complete palmar flexion for one minute. If there is numbness or tingling in the distribution of median nerve, then the test is positive.
2. Hoffmann – tinel sign: This sign is elicited by percussing median nerve at the flexor retinaculum. If there is tingling in median nerve distribution the test is positive.
3. Flick sign: Flicking movements of wrist and fingers eliminate the symptoms in the hand
4. Wrist – extension test: This test is elicited by keeping the both wrists with the hands in complete dorsal extension for one minute. . If there is numbness or tingling in the distribution of median nerve, then the test is positive.
5. Tourniquet test: This test is elicited by tying blood pressure cuff above the elbow and inflating it above the systolic blood pressure. . If there is numbness or tingling in the distribution of median nerve, then the test is positive.
6. Carpal compression test: Applying pressure over the carpal tunnel upto 30 seconds to produce symptoms.
7. Luthy’s sign: If the skinfold between index finger and thumb does not close tightly around a cup due to paresis of thumb abduction, then the sign is positive.

8. Square- wrist sign: If the ratio of wrist thickness to its width is more than 0.7, then the square-wrist sign is positive.

INVESTIGATIONS

1.Electro physiologic Evaluation

Nerve conduction studies (NCS): These are objective studies and assess the large myelinated fibers³⁹. Various median nerve motor and sensory tests are there to show the presence of neuropathy.

Distal motor latency prolongation of median nerve is considered as the motor counterpart of delayed sensory conduction.

Historical aspects of nerve conduction:

Invention of cathode ray oscilloscope in the year 1897 by Braun was the breakthrough in the study of action potentials. String galvanometer was found out by Einthoven in 1903. Muscle action potential instead of muscle twitch was recorded by the measurement of conduction velocity in motor nerves by Piper in the year 1909 and Munnich in 1916. By stimulating the tibial nerve Hoffmann demonstrated the monosynaptic reflex in soleus and it was named as H reflex in 1918.

In 1920 Fobers and Thacker used electron tube to amplify the action potentials. At Cambridge, United Kingdom, Edger Douglas Adrian recorded

action potential in a single nerve fibre by amplifying the signal 5000 times. He also observed the similarity of sensory and motor impulses. He is famous for his contribution of all – or – none law. Routine use of acoustic properties of EMG signals was found out by Adrian and he also contributed in the development of Electroencephalography and he was honoured with nobel prize for his contribution on nerve transmission.

Joseph Erlanger and Herbert Spencer Gasser in 1922, found out the difference in conduction velocity of impulse in a nerve is directly proportional to diameter of the nerve fibres. Based on this they classified the nerve fibres into 3 groups. The large nerve fibres were grouped as type A nerve fibre with maximum velocity and smaller fibres grouped as type C with minimum velocity, for that they received nobel prize in the year 1944. John Eccles devised a micropipette and explained the existence of potential difference across cell membrane. Denny Brown demonstrated motor unit potential in the year 1929. The publication of action potential in medial and ulnar nerve by stimulation was made by Eicher in 1937. Harvey and Masland demonstrate the decremental response in myasthenia gravis by stimulating the motor nerves in 1941. Eaton and Lambert used the same procedure in various neuromuscular disorders in 1957. Larger MUP in neuropathy and smaller MUP in myopathies were the independent observations by Fritz Buchthal in the year 1941 and Kugelberg in 1945 respectively. Alan Lloyd Hodgekin and Andrew F.Huxley did study on Squid and cattle fish and measure

the resting membrane potential and action potential. They observe the sodium and potassium ion permeability during various phases of action potential. They were the pioneer in devising voltage clamp method. Huxley demonstrated the saltatory conduction in myelinated nerve fibres in 1949. Both Hodgkin and Huxley along with John Eccles were awarded nobel prize in 1963. Use of nerve conduction studies in the differentiation of axonal neuropathy and demyelinating disease and was adopted by Lambert and Kaeser.

Electromyography(EMG): These studies are less useful when compare to nerve conduction studies.

2.Imaging studies

They are not considered as routine in diagnosing CTS.

X-rays – It helps to find out bone fracture or arthritis,

Ultrasound- It is inexpensive, quick and comfortable. It shows movement of flexor tendon within the tunnel. But its use for diagnosing carpal tunnel syndrome is still unproven.

Computed tomography – It provides information about bony anatomy well³⁰.

Magnetic resonance imaging – This imaging test shows information about soft tissues and space occupying lesions³⁰. It also provides information about swelling

of median nerve, carpal tunnel narrowing and about the problems with the blood circulation through the tunnel.

3. Laboratory tests

Conditions like diabetes mellitus, rheumatoid arthritis, hypothyroidism, etc. is higher in patients with CTS, So screening of these conditions will permit early diagnosis and treatment to reduce the increased pressure within the carpal tunnel⁴⁰.

DIAGNOSIS

Combination of various symptoms, signs and electrophysiological abnormalities used to define the cases. Combination of symptoms and abnormal median nerve function has been considered as gold standard in epidemiological studies³⁹. According to some, Electro diagnostic studies (EDS) is the gold standard one, it is an objective test to demonstrate the median nerve function across the carpal tunnel and it is diagnosed by comparing the focal median nerve function across the wrist compared to the another section of nerve in the same limb.

If the EDS are not available, then the symptoms and signs can be diagnostic. A self-administered Boston Carpal Tunnel Questionnaire (BCTQ) used for diagnosing CTS. It is a patient oriented data collection, can be completed within ten minutes. It has symptom severity scale and functional status scale.

Symptom severity scale

Consists of eleven questions with five multiple choice answers. Scoring of each question ranges from one point(mildest) to five points(most severe). Overall score is calculated as mean of the scores of all eleven questions.

Functional status scale

Consists of eight activities which are usually affected by CTS. To assess different occupational groups, this scale can be modified. Scoring of each activities ranges from one point(no difficulty) to five points(cannot do at all). This scale can be modified for assessing the different occupational groups. Overall score is calculated by taking the mean scores of all eight activities.

Historical objective (Hi-Ob) scale also assesses the symptoms by pain. But it is evaluated by neurophysiologist⁹.

DIFFERENTIAL DIAGNOSIS

Helps to distinguish the true CTS from the conditions with similar symptoms and signs.

Thoracic outlet syndrome: It occurs due to compression of nerves and blood vessels running down from the neck to the arm and also due to compression at the first rib in front of shoulder. When the person rises his affected hand or turn his

head to the opposite side, there will be reduction in blood flow and this will cause pain.

Cervical radiculopathy: Sixth cervical root is commonly affected by chronic cervical spondylosis. This condition is characterized by neck pain and shoulder pain radiating into chest wall and posteriorly to medial border of scapula and there is worsening of pain during use of arm and hands. Patients have pain during daytime, but usually absent at night. But there are no abnormal findings on neurological examination.

De Quervain's tenosynovitis: In this condition there is pain on the side of the forearm and wrist just below the base of the thumb. This is commonly associated with CTS.

Digital flexor tenosynovitis: It is otherwise known as trigger or snapping finger. It occurs due to tendon thickening, so the thumb or fingers are in bent position and it causes pain and clicking sound. This condition mimic like rheumatoid arthritis, hypothyroidism and some connective tissue disorder.

Reynaud's phenomenon: This is a condition in which symptoms are not localized to particular finger. In this condition cold contact will produces vasoconstriction, pallor, rubor and cyanosis of the hands. But in case of CTS there is no relationship with cold.

Guyon's canal syndrome: It is otherwise known as ulnar tunnel syndrome. Symptoms are similar to CTS, here sensation is affected in little and ring finger and outer half of the palm.

Osteoarthritis of the first carpo-metacarpal joint: Sometimes it is confused with CTS.

Thenar atrophy due to other causes: Disuse neuropathies³⁰.

Lesions of the central nervous system: Transient ischemic attack or focal motor seizure can mimic CTS. In central nervous system lesions, there is absence of pain and the episodes last for several minutes to hours. Sometimes migraine affects sensory nerve distribution of hands, but it is associated with headache, dizziness and visual disturbances²².

Generalised peripheral neuropathies: Clinical conditions like chronic inflammatory polyradiculopathy, diabetic neuropathy and chronic lepromatous leprosy can mimic CTS.

TREATMENT

1. Conservative

Non operative management usually done for mild cases and in patients with intermittent symptoms which includes;

- Avoiding the activities which precipitates the CTS.

- Splint the wrist in a neutral position, during the initial part of treatment full time splint the wrist for 3-4 weeks followed by night splinting.
- Non-steroidal anti-inflammatory drugs (aspirin or ibuprofen) can be given orally or injected into the tunnel (20 mg of methyl prednisolone mixed with one to two ml of 1% xylocaine). To avoid tendon rupture and nerve injury it is advisable to give only three to four injections.
- Use of diuretics can reduce fluid retention.

2. Operative

It is indicated when there is failure of non-operative treatment or if there is any clinical evidence of atrophy of thenar muscle or persistent sensory loss. Treatment options are;

- **Open carpal tunnel release:** Most commonly done. This procedure is done by division of transverse carpal ligament.
- **Endoscopic carpal tunnel release:** It is a latest technique.
- **Percutaneous balloon carpal tunnel – plasty:** This procedure is done without cutting the ligament.

3.Others

- **Yoga and other relaxation techniques:** More effective in reducing the pain and improve motor and sensory conduction⁴².

- **Physical therapy:** Aerobic exercises and other modalities like phonophoresis, iontophoresis, etc. give some relief³⁸. By bombarding the wrist with sound waves ultrasound reduces the pain.
- **Occupational therapy**
- **Diet and vitamins**
- **Laser therapy**
- **Alternative therapies:** Acupuncture, heat, hydrotherapy, herbal oils like arnica oil, etc. are used in treatment of CTS.

PREVENTION Preventive measures are;

1.Reduce repetition: By reducing repetitive movements we can avoid the overexertion of wrist and fingers.

2.Take regular breaks i.e. every 15 to 20 minutes: Give a break and rest to hands and wrist by gently bending and stretching them. Taking frequent breaks is important for those who use computers.

3.Reduce force and relax grip.

4.Maintain neutral position of the wrist.

5.Avoid contact stress

6.Maintain proper position while operating computers.

7.Using fingerless gloves to keep the hands warm.

FACTORS AFFECTING MOTOR PERFORMANCE

- **Age:** As with advanced age, time required to perform a particular task increases. In elderly fatigue sets in early⁴³. Young adult can perform better than elderly and children. With advanced age due to decline in neuromuscular function, there is decreased muscular strength and speed of movement and also fatigue sets early in old age. Visual changes also occur like decreased acuity, defective accommodation and defective hand eye coordination. These conditions can affect the hand functions.
- **Sex:** Usually males have better motor performance than females.
- **Physical training:** With good physical practice and training, there will be a better motor performance.
- **Build:** Persons with sound physical build can perform motor function better than obese or very thin⁴³.
- **Mental status:** Motivation and encouragement stimulate the reward center in the brain and increases the motor performance.
- **Haemoglobin content of the blood:** In iron deficiency anaemia, there is reduction in oxygen transport which may lead to reduced motor performance.

Thus the motor performance of the hand mainly depends upon anatomic integrity, muscle strength, sensation and coordination. Motor performance also influenced by age, sex, mental status and diseases affecting not only the hands but also other areas.

COMPUTER VISION SYNDROME



Definition

Computer vision syndrome(CVS) refers to ocular and extra-ocular symptoms which results from prolonged computer usage.

Common symptoms associated with computer vision syndrome (CVS) are:

- Eye strain
- Dry eyes
- Burning sensation
- Headache
- Blurred vision
- Redness

- Neck and shoulder pain
- Lighting or glare effect

These symptoms may be caused by:

- Poor lighting
- Glare on a digital screen
- Poor seating posture
- Improper viewing distance
- A combination of these factors

Alternative names

CVS is also known as digital eye strain

Many studies states that correlation between eye problems and computer usage⁹and it was mainly produced by ionizing radiation given off by monitors. Cathode ray tubes which are used to display the information on the computer. They send off radiation.

SYMPTOMS OF COMPUTER VISION SYNDROME



Epidemiology of computer vision syndrome

Thomson (1998) describes the prevalence of eye related symptoms in computer users ranges from 25-93% .Torrey (2003) states that 70% of computer users in the united states are suffered from computer vision syndrome³⁴. Anshel (2006) states that 75-90% of persons with regular computer usage have the symptoms of computer vision syndrome³⁵. More than 80% of persons who were woring on a computer for more than two hours in a day have the problem of CVS and less than one in four regular computer users have the problem of carpal tunnel syndrome. Divjak&Bischof (2009) states that 70% of computer users worldwide report having vision problems³⁶.

Comorbidities

Sauter, Hales, Fine, Peterson, Putz-Anderson &Schleifer (1994) state that arround 22% of regular users of computer have muscular and skeletal problems, likeneck pain, shoulder pain, back pain and carpal tunnel syndrome. Idowu, Adedoyin, Adagunodo&Owoyomi (2005) state that neck pain and low back pain were the commonest pain complaints and their prevalent rates are 73% and 74% , among this 67% are complained of wrist ache. The foot and knee ache were the less reported complaints with 25% and 26% respectively. Izquierdo (2010) states that diseases that cause widening of interpalpebral fissures or causing lid retraction. Thyroid disorders may lead to more evaporation of tear, thereby worsens the eye problems.

Causes

CVS is caused by decreased blink rate with long working hours on the computer screens. About 16-18 times in a minute is the normal blink rate. Rathore et al 2010 states that rate of blinking decreases to as low as 6-8 times per minute (about 1/3rd of the normal) leading to dry eyes⁴⁴. Also the near focusing effort needed for long hours produces more strain over the ciliary muscle. This induces the features of asthenopia after long hours.

Human focusing system responds well to images with well defined edges and better contrast. On computer screen the tiny dots called pixels make the characters. They are due to electron beam hitting the phosphor-coated rear screen surface. They have blurred edges. Chakrabarti et al 2007 reported that blurred edges makes difficult for the human eye to maintain focus and leads to fatigue and eyestrain⁴⁵.

Environmental causes

Short viewing distance, large angle of gaze, excess room illumination and low humidity may exacerbate dry eye symptoms. While using computers, computer operators wide open their inter palpebral fissures while looking the screen. Therefore they have increased exposure to the environmental factors, that can cause more evaporation of tears. Izquierdo et al (2004) states that features associated with CVS are decreased while computer operators gaze downwards at an angle of 14 degrees or more⁴⁵. An exposure of more than 40% of the cornea during upward gaze causes drying

of the tear film. Regular computer use particularly stressful for contact lens wearers. Long non-blinking phases cause dryness of the surface of most lenses and cause discomfort and reduction in visual clarity.

The computer workstation factors

The core factors of computer workstation include a computer and its accompanying screen (monitor), peripheral attachments like keyboard and/or mouse, work or computer table, a chair, and footrest⁵⁰. All these factors put together and making the regular computer users at risk if not properly designed⁵¹.

Position of the computer screen is usually at a distance of 20 to 40 inches and the top of the monitor should slightly below the level of the eyes⁵². But Wall, Riel et al states that eye level should be at the middle of the monitor⁵³.

Personal causes

Uncorrected refractive errors also predisposed to CVS. Prolonged working hours at the computer screen is a risk factor that can also lead to dry eye related symptoms. Pre-existing dry eyes may also exacerbate these conditions⁴⁵.

Age and Gender

Maissa&Guillon 2010 states that female patients have reduced tear film's aqueous layer with increasing age⁴⁶ and they also states that the tear evaporation rate in older women was 34-80% higher than that of older men and 36-69% higher

than young females. Dry eye is more common in older patients and it is marked in females than males. The increase in dry eye with the age advanced is thought to be decrease in tear production which is enhanced by hormonal changes. During old age presbyopia, can all contribute to the development of computer vision syndrome when using a computer or digital screen device.

Clinical features

Symptoms

Normally our eyes are protected by tear film layer and it covers cornea and sclera. This normal tear film helps to supply enough nutrition and oxygen and also protects our eyes against infection. Up to 5 to 8 seconds this tear film remains intact and with eye blinking, it breaks itself and reforms. Tear film break up time, it is the time that is used to evaluate the time during which the tear film remains intact on the corneal surface. Prolonged tear film break up time provides better protection to the eyes. Even a mild increase in tear film break up time may bridge the gap between tear film break up time and blink time and protects the surface of the eye. Eyestrain, blurred vision, headaches, neck or shoulder pains are the most common symptoms reported in a national survey by optometrist⁴⁷. Rathore, Bagdi&Rathore (2011) reported that eyestrain, dry eyes, blurred vision, headaches, neck and shoulder pains are the symptoms of CVS. Izquierdo (2010)

states that redness, burning sensation, stinging sensation, tearing and photophobia are the symptoms of CVS.

Diagnosis of Computer Vision Syndrome

Computer vision syndrome can be assessed by a comprehensive examination. These include:

History

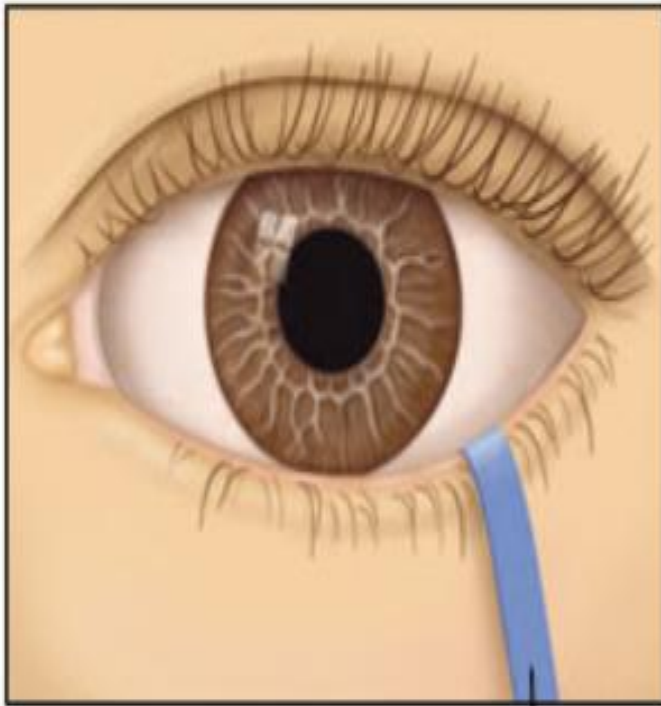
History of the patient including age, sex, presenting symptoms and onset of symptoms should be obtained. A questionnaire can be given to get the information about the work habits, ceiling and desk illumination, window proximity, type and position of their computer equipment³⁵.

Previous history of diseases of eye and treatment should be evaluated. Should ask about history of associated clinical conditions like thyroid disease, arthritis, xerostomia, Parkinson's disease and carpal tunnel syndrome and ask about drug intake which may exacerbate the symptoms of dry eye (examples are antihistamines, anticholinergics and diuretics)⁴⁸.

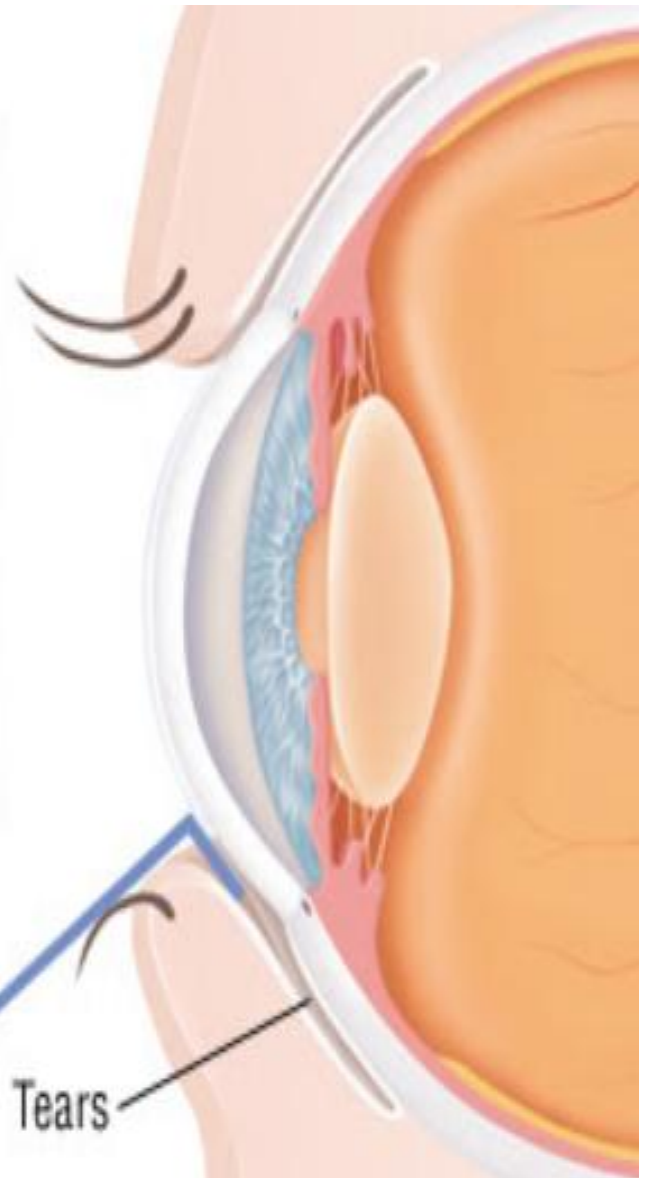
Physical examination

Patients with the symptoms of CVS should undergo following ophthalmic evaluation which includes;

Schirmer's test



Filter paper



Tears

- Best corrected visual acuity for distant and near vision
- A refraction to get the appropriate lens power. (near-vision, far-vision or astigmatism).
- A Schirmer test to evaluate dry eye.
- A slit lamp examination to evaluate tear meniscus

This test can be done without using any eye drops for evaluating how the eyes respond during normal conditions. In cases with some of the hidden eyes' focusing power, we can use eye drops. While testing they keep the eyes from changing focus temporarily.

The information obtained by these tests and with the results of other tests, we can determine the Digital Eye Strain.

Management / Treatment of CVS

Management of digital screen-related vision problems differs. They can be reduced by obtaining regular eye care and producing changes in viewing digital screen. These include;

- Obtaining regular professional eye care: In persons who do not require the use of spectacles for other normal daily activities may benefit from glasses prescribed particularly during computer use. Individuals previously on glasses may find their actual prescription does not produce the perfect vision for viewing the digital screen.

The Ideal Position



- Contact lenses or eyeglasses prescribed for daily activities may not be comfortable and adequate for operating the computers. Lenses given for the exclusive visual needs of computer viewing may be required. Special lens powers, lens tints or coatings, lens designs may help to optimize the visual comfort and abilities.
- Computer operators feel difficulty in eye coordination or eye focusing that can't be sufficiently corrected with contact lenses or eyeglasses.
- A program of vision therapy specifically required to treat these problems. Vision therapy, otherwise known as visual training, is a program of visual activities advised to improve visual comfort and visual abilities. It trains the brain and eyes to work together more efficiently.
- Educate the person about proper computer use and good preventive vision care.
- Regular eye exercises –these exercises reinforce the eye-brain coordination and thereby improve the visual abilities.
- Anti-glare screens-using a screen glare filter, reduces quantity of light reflected from computer screen.
- Good lighting - Proper positioning of computer screen to avoid glare, especially from overhead windows or lighting³⁵.
- Work station design – work station consists of a chair and a work surface. Computer operators should have enough work place to perform the each

task. Adequate accommodation should be there for monitor, central processing unit (CPU), mouse and keyboard.

- Proper seating posture - Chairs should be comfortably padded and fit to the body. Height of the chair should be corrected so the feet rest flat on the floor. Arms to be supported while typing and wrists shouldn't rest on the keyboard while typing.
- Correct the seat height so that the elbows are at the same height of the work surface as well as keyboard. While typing wrists are in a straight position.
- Preventing posture problems – avoiding long period of working in same position.
- Keyboard position – for keeping the arms in a comfortable position, it requires lower than the normal work surface. The upper arm should be placed nearly vertical and lower arm placed nearly in a horizontal position (90° angle).
- Mouse position – it should be placed as near to the keyboard as possible. Use a keyboard tray wide enough to keep the mouse adjacent to the keyboard.
- Wrist rests – they keep the wrists in a straight position.
- Proper viewing & Positioning of computer screen – computer users find it is more comfortable to visualize a computer screen with the eyes are looking downward. Maximally, the computer monitor should be 15 to 20

degrees below the level of eye (about 4 or 5 inches) as measured from center of the monitor and 20 to 28 inches from the eyes.

Reference materials - These materials should be placed below the level of monitor and above the level of keyboard. If this is not possible, a document holder may be used nearby the screen. The main goal is to position the documents so we may not need to move the head to look from the document to the monitor.

- Using artificial tear solutions⁴⁴.
- Taking regular breaks - Try to rest the eyes when using the computer for long periods. A good rule of thumb is the 20/20/20 rule, this states that take rest for every 20 minutes of computer viewing, look into the distance for 20 seconds, at a distance of 20 feet. This exercise cause the eye muscles to relax and allowing them to receive the fresh oxygenated blood, thereby eliminates the lactic acid, and in turn help to remove the computer vision syndrome⁴⁹.
- Frequent blinking – keeps the anterior surface of eye moist and reduces the chances of computer dry eye.

INTERVENTION

YOGIC EXERCISES

Nowadays, the interest for practice of breathing exercises and asanas has increased in general population for substantial health benefits produced by these practices. However, if practiced with proper yogic attitude, asanas become yogasanas and breathing exercises become prayanamas.

There are different types of yogasanas and pranayamas. If they learned properly and practice appropriately, they improve the quality of life enormously.

Alternative medicine is being accepted as an adjunct to the standard therapies of western medicine¹⁶. Yoga has become popular in western countries as a means of exercises and fitness training⁵⁴. Yoga and relaxation methods have been used to help alleviate the musculoskeletal disorders and symptoms of computer dry eye⁵⁵.

Yogic exercise has been shown to be useful in reducing mental stress, computer related musculoskeletal symptoms, improvement of nerve function due to reduction of compressive stresses in median nerve and brachial plexus and also due to enhancement of micro circulation⁵⁶.

Yogic exercises are very ancient and they are not linked with any particular religion. Yoga is a Sanskrit word and it means “to yoke” or “to join”. Hatha yoga

YOGIC EXERCISES



is a type of yoga consists of asanas and it can improve flexibility and strength, where the word “Asana” means “to sit”. They are used to improve physical fitness and health⁵⁷.

Most of the asanas are based on the principle of rhythmic, alternate contraction and relaxation of a group of muscles. Asana should performed in a slow and steady manner and should avoid the all jerky movements. When it is performed and maintained for some time, it results in stretching of a group of muscles and reflex relaxation of inverse group of muscles and it results in increased blood flow and oxygen.

Mental activity during the procedure of yoga is very important and it is advised to do the practice of asana with eyes closed. We should regulate the breathing during the practice of asana. All extensions should be performed during inspiration of breath, and all flexions should be performed during expiration. It should proceed from simple to difficult and we should never feel fatigue, if it is there they should rest in “shavasana”.

The performance of different asanas or exercises should be started slowly and it should be relax than fatigue the muscles. It is better to perform exercises that are challenging, exciting and satisfying.

Yogic exercises increase the neuromuscular excitability and also increase the conduction velocity of the nerve indicating a faster propagation of motor nerve impulse.

Difference between asanas and physical exercises⁵⁷.

Asanas	Physical exercise
1)Static, based on the principle of relaxation.	1)Repetitive movements and produces fatigue and stress.
2)Minimum energy consumption.	2)Maximum energy consumption.
3)Involves the whole body and mind.	3)involves essential muscles.
4)Relaxes the mind	4)Does not relax the mind.
5)After effect is soothing.	5)After effect is exhausting.

The four most popular and widely accepted yoga are:

- Hatha yoga
- Raja yoga
- Tantra yoga
- Integral yoga

Hatha yoga

Hatha yoga includes practice of pranayamas, asanas and kriyas. It mainly aims at perfection of the body. A hathayogi attains a healthy body and greater longevity.

During the practice of Hatha Yoga, both the pathological and physiological improvement takes place as a result of regular practice. Yoga is an adjunct to medical and psychological part of treatment when practiced regularly.

Postures of certain asanas:

Namaste: Keep the hands in prayer position. This position gently extends and stretches the fingers and wrists and it provides an isometric resistance exercise of the flexors and extensors of the fingers and wrists which in turn increases the space within the carpal tunnel, and also decreases compression⁴².

Dandasana: Danda means “stick”. Position of the spinal cord during this asana helps to strengthen the muscles supporting the spine. It promotes tone of the hip flexors, abdominal and back muscles.

Parvatasana: In this asana body assumes the shape of a hill. This asana makes the spine flexible.

Bharadvajsana: This asana helps to stretch the spine, shoulder and hip and also helps to relieve sciatica and low back pain.

Urdhvahastasana: This asana helps to improve posture, strengthens thigh, hip and shoulder.

Half Uthanasana: ‘Ut’ means a particle indicating deliberation and intensity. ‘TAN’ means a word to stretch extend. In this asana spine is in a deliberate and an intense stretch.

Garudasana: The word Garuda means an eagle. This asana helps to remove the stiffness of the shoulders.

Tadasana: The word Tada means mountain. In this asana one would stands firm and erect like a mountain. So, the body weight is distributed evenly on the feet and helps to maintain spinal elasticity.

Urdhvamukhasvanasana: This asana helps to strengthen the shoulders, spine, arms and wrists. It provides increase in flexibility of the spine and gives a fresh blood supply.

Savasana: The Sanskrit word “Shava” means “Corpse”. So savasana is otherwise known as corpus posture. This posture produces complete relaxation of the body, decreases anxiety, calms the heart and nerves and regulates the circulation. The aim of this asana is to create free flow of life energy in and out of the body and it helps for the perfect functioning of the body. This asana removes fatigue and promotes calmness of mind⁵⁸. It promotes psychosomatic health and improve the ability of the body to combat stressful conditions⁵⁸.

EYE EXERCISES



Eye exercises to improve eyestrain

Fortunately, simple exercises can help rejuvenate the eyes. Eye care professionals recommend these eye exercises. When mindfully practiced, these simple eye exercises rest the overused muscles, reduce tension in the eyes, face and help to strengthen the muscle that helps in eyes focus. “By making the eyes more adaptable and flexible, we can keep the eye problems from getting worse, and we can improve them.

Like other muscles, the eye muscles also react to stress and chronically over-contracted, causing eyestrain, which in turn produces many eye related problems. Therefore, relaxation practice is the key technique and it is the main tool of yogic eye therapy. Yogic eye exercises help to reduce eye related symptoms and also increases the stamina of eye muscles.

When you rub your eyes while staring at a screen, everyone should do the following exercises. They can be practiced individually, or as a sequence, and can be repeated throughout the day as needed.

Palming:

Rub the hands together for 10 to 15 seconds till they feel warm and energized. Place the hands gently over the eyes, with the heels of the hand resting on the cheeks, the palms over the eyes, and the fingertips resting on the forehead. Should not give pressure directly over the eyeballs, but hollow the hands slightly

and make a curtain of darkness in front of the eyes. Close the eyes, breathe deeply, and relax. Continue this procedure for just a few seconds or up to five minutes. When you are ready to emerge, gently remove the hands from the face and open the eyes slowly.

Eye Rolling :

In this procedure you have to sit upright with a long spine and take a relaxed breath. Relaxes the muscles of the eyes and face. Direct your gaze up toward the ceiling, without turning the head. Then slowly rotate the eyes in a clockwise direction, making as large a rotation as possible. Then gently focus on the objects in the periphery, and make the movement to feel smooth. Repeat this three times, then gently close the eyes and relax. Then perform this same eye-rolling movement three times in an anticlockwise direction.

Focus Shifting:

In this procedure you have to relax and breathe comfortably. Then hold your one arm straight out in front of you in a relaxed fist, with the thumb pointing up. Then you have to focus on your thumb. While focusing, slowly move the thumb towards the nose till you can no longer clearly focus on it. Then lengthen the arm back to its original outstretched position and maintaining the focus on the thumb. Repeat this up to 10 times.

Distance Gazing:

Rest your gaze on a distant object. Make a focus on the distant object as clearly as possible. Relaxes the face and eyes. After taking a deep breath, slowly shift the gaze to another distant object. Repeat this procedure again.

Studies related to carpal tunnel syndrome and computer vision syndrome

A case control study done by **Stallings SP et al⁵⁹** in women about the relationship of obesity and carpal tunnel syndrome and statistically significant association was found between obesity and carpal tunnel syndrome.

Atterbury MR et al⁶⁰ in their nested case control study of hand and wrist work related musculoskeletal disorders in carpenters concluded that median motor nerve neuropathy increased among carpenters.

Jagga, V et al⁶¹ studied that occupation and its association with carpal tunnel syndrome and concluded that occupations involving more hand and wrist activities increases the risk of developing carpal tunnel syndrome.

Abida Ellahi et al⁶² studied that health disorders associated with prolonged computer use and found that computer operators who were using computer for more than four hours daily were more likely to develop carpal tunnel syndrome, computer vision syndrome, stress and musculoskeletal disorder.

Shrawankumar et al⁶³ studied that work – related carpal tunnel syndrome – current concepts and proposed that ergonomic interventions reduces the number of work – related carpal tunnel syndrome cases and concluded that job ergonomic modifications with programs that reduce the psychosocial stress level will reduce the number of work - related CTS cases.

Frost P et al⁶⁴ studied that occurrence of carpal tunnel syndrome in relation to sustained high velocity and high force manual work and found that industrial repetitive, forceful work and work place factors were the contributing factors in carpal tunnel syndrome.

Stevens JC et al⁶⁵ studied that the frequency of carpal tunnel syndrome in computer users at a medical facility and concluded that frequency of carpal tunnel syndrome among computer users was similar to that in the general population.

Marklin RW et al⁶⁶ in their studies on wrist and forearm posture from typing on split and vertically inclined computer keyboards showed increased incidence of carpal tunnel syndrome among workers with forceful tasks on the musculoskeletal system.

AlirezaDehghani et al⁶⁷ in their studies on prevalence of ocular symptoms and signs among professional computer users showed that the dry eye, eye burning and tearing, asthenopia and musculoskeletal problems were more common in video display users and concluded that 65% of video display users were suffered

from eye strain and suggested that the middle point of video display terminal should be 5 to 6 inches below the level of straight line of the users vision.

Nakaishi H et al⁶⁸ studied that abnormal tear dynamics and symptoms of eyestrain in operators of visual display terminals and concluded that more than 30% of computer users were developed computer dry eye.

Psihogios JP et al⁶⁹ studied about field evaluation of monitor placement effects in video display terminal users and suggested that more higher level of video display terminal causes palpebral fissure more wide opened and resulted in dry eyes.

Portello JK et al⁷⁰ studied that blink rate, incomplete blinks and computer vision syndrome and ^{found} that prolonged usage of visual display terminal tasks decrease the blink amplitude, blink rate and blink quality and leads to tear film instability.

Yoon KC, Jeong IY et al⁷¹ in their studies on interleukin-6 and tumor necrosis factor- alpha levels in tears of patients with dry eye syndrome showed that long standing dry eye disease and accompanying ocular surface inflammation may alter the goblet cell density and cell morphology.

MATERIALS

&

METHODS

MATERIALS AND METHODS

STUDY DESIGN:

This is a cross-sectional study followed by an interventional study.

STUDY PLACE AND STUDY PERIOD:

This study was conducted in Monet Computer Centre, Tirunelveli. The study period extended from February 2015 to July 2015.

STUDY SUBJECTS:

A total of 110 regular computer users working in the computer centre, both males and females in the age group between 20 to 40 years were screened, among them 102 were found to be symptomatic and 100 participants gave consent for the study. Among the study group with the symptoms of carpal tunnel syndrome and computer vision syndrome were subjected to intervention.

INCLUSION CRITERIA:

- Regular computer users (10 to 15 hours/week) who have been in the same occupation for the last twelve months.
- Age between 20 to 40 years.
- Persons with the symptoms of CTS based on the Boston Carpal Tunnel Syndrome Questionnaire for interventional study.
- Persons with symptoms of CVS for interventional study.

EXCLUSION CRITERIA:

- Any physical deformity of the upper limbs and neck which prevents the performance of the tasks.
- Previous history of musculoskeletal trauma.
- History of diabetes mellitus.
- History of thyroid disease.
- Subjects with previously diagnosed neuropathy or diseases associated with neuropathy.
- Subjects using contact lenses.
- Previous history of intraocular surgery.
- Subjects with known visual problems.
- Persons using topical medications such as corticosteroids, anti-glaucoma drugs
- Subjects with ocular infection.
- Subjects with lacrimal gland disorders.
- Subjects allergic to fluorescein.

Materials used for the study:

1. Proforma – To get the detailed history of the subjects with carpal tunnel syndrome and computer vision syndrome and for recording the biochemical and clinical findings of the subjects.
2. Portable weighing machine – To record the body weight in kilograms.
3. Standardized Mercury sphygmomanometer – To record blood pressure in millimeter of mercury.
4. Semi Auto Analyzer – For hemoglobin estimation.
5. Slit lamp – for measuring tear film breakup time.
6. Schirmer's strip – To record wetting of filter paper.
7. Computerized RMS EMG EP MARK II equipment – To record the median motor nerve conduction velocity.

METHODOLOGY

This study was approved by Ethical Committee of Tirunelveli Medical College. The study was done among regular computer users. After getting consent from the computer centre authorities, the study was proceeded.

All the regular computer users were invited to participate in the study. They were screened for eligibility for the participation in the study. Informed consent

form was given to the eligible participants and the participants who have given informed written consent were enrolled for the study.

Descriptive data like name, age, sex, height, weight, body mass index, average number of working hours per week, years of employment, handedness, associated medical or surgical conditions, personal history regarding smoking and alcoholism were included on a pretested questionnaire.

All the study group were subjected to hemoglobin estimation. It was estimated by using semi auto analyzer.

Hemoglobin estimation

Principle: Drabkin's principle (cyan methemoglobin method). In this procedure hemoglobin is converted into cyanmethemoglobin by means of drabkin's reagent. This drabkin's reagent consists of NaHCO_3 1 gm, potassium ferricyanide 200 mg, potassium cyanide 50 mg and distilled water 1 litre. To know the absorbance of solution photoelectric colorimeter is used.

Method: 5 ml of Drabkin's reagent is taken in a test tube. To this reagent 20 microliter of whole blood is pipetted and added. The mixture is allowed to stand for 15 to 20 minutes, measurement was taken in photoelectric colorimeter by using 540 nm wavelength. The standard solution absorbance was 0.30, and the result is interpreted as a value of gm/dl. It is an accurate method of hemoglobin estimation. Hemoglobin content was calculated by the following formula:

COLLECTION OF BLOOD SAMPLE



$$\text{Hb content (gm/dl)} = \frac{\text{absorbance of test}}{\text{absorbance of standard}} \times 100$$

Normal values –males 14.0 to 17.5 gm/dl, Females 12.3 to 15.3 gm/dl

Mild anaemia -10 to 11 gm/dl

Marked anaemia - < 10 gm/dl

HEIGHT:

Height of the individuals recorded by using non elastic inch tape which was fastened to a vertical wall. The subjects were instructed to stand erect with their back in contact with the wall. Height was recorded to the nearest 0.5 cm and noted down.

WEIGHT:

Weight was measured by using standard portable weighing machine to the nearest 0.1kg.

BMI of the study group calculated by using following formula:

$$\text{BMI} = \text{weight in kg} / \text{height in m}^2.$$

BLOOD PRESSURE:

Blood pressure was recorded in the sitting posture by using standard sphygmomanometer.

MEASUREMENT OF HEIGHT



MEASUREMENT OF BLOOD PRESSURE



By using self-administered Boston Carpal Tunnel Questionnaire symptom severity and functional status were assessed. By taking mean scores of eleven questions overall symptom severity score was calculated. Similarly by taking mean scores of all eight activities overall functional status score was obtained.

Both sensory and motor system clinical examination was done by assessing the power of abductor pollicisbrevis, opponenspollicis and flexor pollicisbrevis. Examination was also done by looking thenar muscle wasting.

By using Computerized EMG/NCV/VEP equipment median motor nerve conduction velocity (MNCV) was assessed.

Median Motor Nerve Conduction Velocity (Median MNCV)

MNCV is defined as speed of conduction of impulses through the median nerve and it was measured by computerized RMS EMG EP MARK II Equipment.

Surface electrodes were used. This equipment used filter frequency of 2Hz to 10 Hz in motor conduction. Initially the nerves were stimulated with a low voltage current and then it was progressively increased till we obtained a maximal response curve.

Principle

By using surface electrodes the median nerve was stimulated. They are patch like electrodes which are placed on the skin lies over the nerve at various

locations. With a very minimal electrical impulse one electrode stimulates the nerve. The other electrode records the resulting electrical activity. The distance between electrodes and the time taken for the electrical impulse to travel between electrodes are used to calculate the conduction velocity. The electrical impulse may produce a sensation like an electric shock. During actual test by increasing the strength of the stimulus may produce discomfort for some subjects and there should be no residual pain once the test is over. This procedure was done to diagnose nerve destruction or damage.

Procedure:

- Switch on the computerized NCV equipment, then enter the patient information.
- Select the median nerve and the side to be tested.
- Clean the area and skin overlying the median nerve at the region of elbow and wrist with spirit. Skin preparation is essential to give a good contact between skin and the electrodes and to eliminate the artifacts.
- The electrodes used were soaked in normal saline to minimize the skin resistance and thereby enhancing the conduction.
- With the help of conductive jelly, recording surface electrodes were placed near to the motor point of abductor pollicisbrevis and the reference electrodes were placed 3 cm distal to recording electrodes at the first metacarpophalangeal joint. In between stimulation and recording electrodes

NERVE CONDUCTION STUDY



the ground electrode was placed. These electrodes were then fixed firmly to the site with the help of plaster or sticking tapes. Correct placement of electrodes is important.

- These electrodes were connected to cathode ray oscilloscope through a pre amplifier.
- Then at the stimulation point the stimulator was placed i.e. at the wrist three cms proximal to the distal part of wrist crease and then near the volar crease of brachial pulse. It should be placed properly as indicated in stimulation site window.

Nerve conduction velocity is recorded as follows

- a. The time taken by the impulse to travel from elbow to wrist measured in m/sec is produced by difference between the two latent periods.
- b. Measure the distance between elbow and wrist point of stimulus in mm and from this median nerve conduction velocity is calculated by following formula

$$\text{Median motor nerve conduction velocity (m/sec)} = \frac{\text{distance between proximal and distal stimulation in mm}}{\text{proximal latency} - \text{distal latency (msec)}}$$

Normal values – 52 to 62 m/sec.

Proximal latency (Lp) - conduction time from near point of stimulus to the muscle.

Distal latency (Ld) – conduction time from distal point of stimulus to the muscle.

$$NCV = D \text{ mm} / Lp - Ld \text{ M/S}$$

D = distance between two stimulus point

Lp = proximal latency in msec

Ld = distal latency in msec

Tear film breakup time (TBUT)

To measure the tear film breakup time, we applied sterile strip of fluorescein in the lower eyelid fornix and the subject was instructed to blink three times and then asked to look straight forward without blinking. The tear film was noted with the help of slit lamp microscope. The time interval between complete blink to appearance of first break or the dry spot in the tear film was measured with the help of stop watch. Less than 10 seconds of tear film breakup time was considered consistent with computer dry eye syndrome.

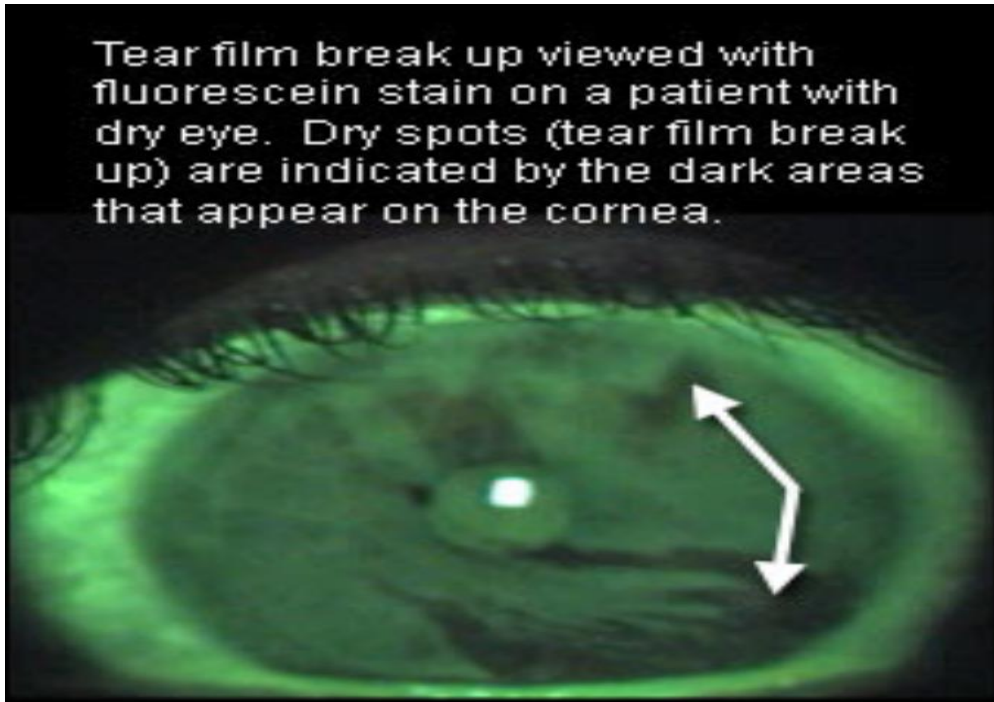
Five minutes after the TBUT, a Schirmer I test was done to evaluate the basal and reflex tear secretion. This test was performed without anaesthesia. In this test, we used a schirmer filter paper strip to measure the amount of tears produced

SCHIRMER'S TEST



TBUT

Tear film break up viewed with fluorescein stain on a patient with dry eye. Dry spots (tear film break up) are indicated by the dark areas that appear on the cornea.



SLIT LAMP



over five minutes. At the junction of middle and lateral third of the lower eyelid the strips were placed. It was done under ambient light. The subjects were instructed to look forward and to blink normally during the procedure. Wetting of the filter paper in five minutes was measured. Less than 6 mm of wetting was considered consistent with computer dry eye syndrome.

INTERVENTION

YOGIC EXERCISES

Physical inactivity produces sluggishness in the body as well as in the mind. The subjects were instructed to practice yogic exercises. They were asked to do the yogic exercises daily for half an hour in the morning as well as in the evening. Also they were instructed to do the eye exercises frequently. Total period of this intervention was six months. They were reviewed every month for strict adherence to the yogic exercises and for reassessment of their health problems. After end of this follow up study, blood pressure recorded, height and weight taken, BMI calculated, median motor nerve conduction velocity was recorded, tear film break up time was calculated and the schirmer I test was repeated. The results was tabulated, compared with pre test findings, statistically analyzed to find the significance of variations before and after the yogic exercises.

STATISTICAL ANALYSIS

Present study was done among regular computer users to determine the prevalence of carpal tunnel syndrome and computer vision syndrome and also assess the correlation of various variables with CTS and CVS.

Sample size was 100. Health problems associated with prolonged computer use were analyzed and we studied about the carpal tunnel syndrome and computer vision syndrome. Among the study population, the distribution of carpal tunnel syndrome was 38%, distribution of computer vision syndrome was 62% and combined carpal tunnel and computer vision syndrome was 25%.

The results of yogic exercises intervention were analyzed.

ANALYSIS PLAN

- To compare quantitative variable of group before and after the intervention “paired t test” was used.
- Difference between groups were considered statistical significant at $p < 0.05$.

RESULT ANALYSIS

RESULTS

TABLE – 1: Symptoms and signs of CTS

Symptoms and signs	No. of participants with CTS	Percentage
Hand weakness	06	15.78%
Tingling	04	10.52%
Numbness	10	26.31%
Hand / wrist pain	34	89.47%
Nocturnal exacerbations	04	10.52%
Difficulty in holding things	03	7.89%
Thenar muscle wasting	01	2.63%

Out of 38 participants with CTS, the most common symptom was hand / wrist pain (89.47%) followed by numbness (26.31%), hand weakness (15.78%), nocturnal exacerbations (10.52%), tingling (10.52%), difficulty in holding things (7.89%) and thenar muscle wasting (2.63%).

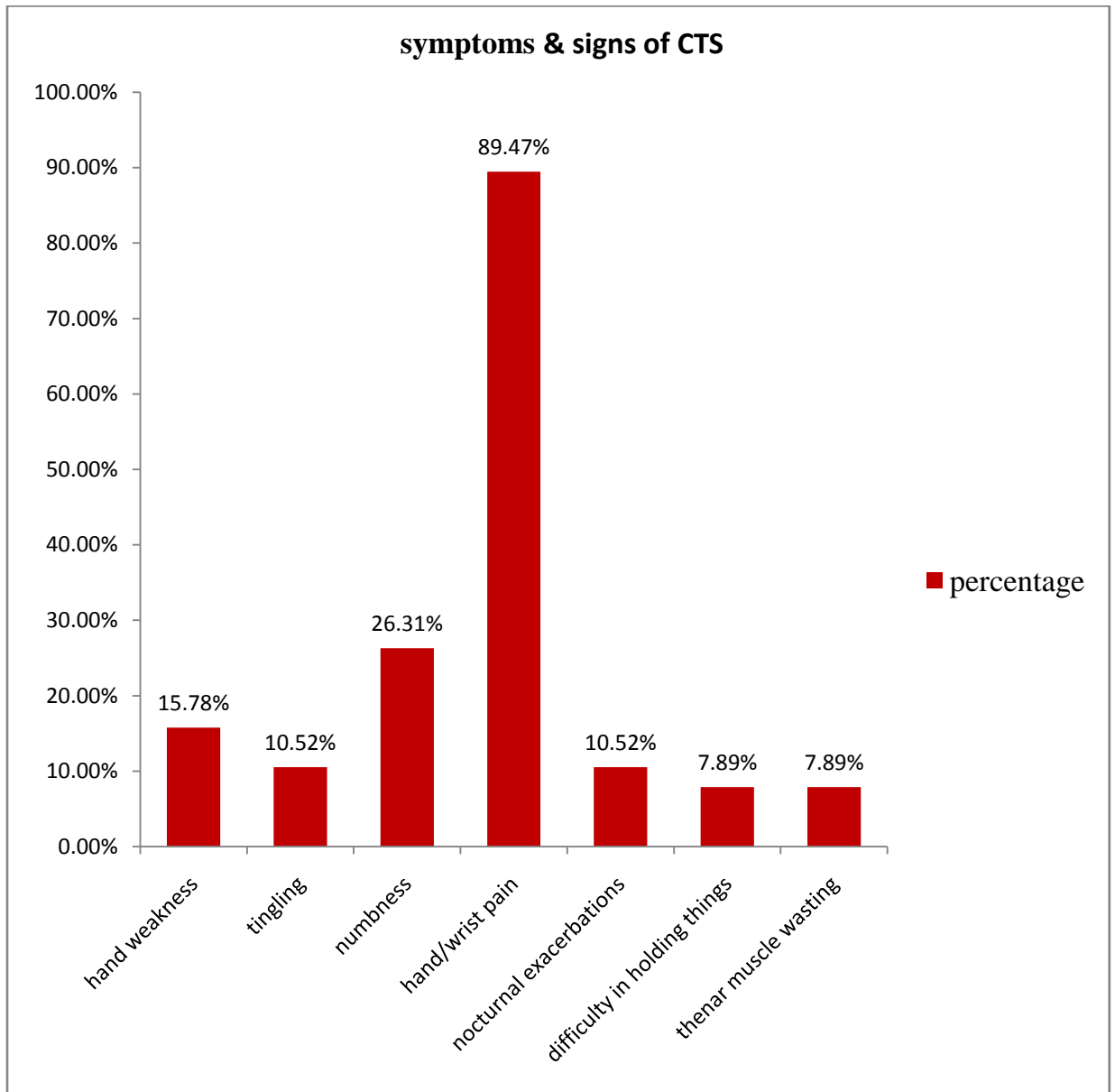


TABLE II : symptom severity score and functional status score before and after intervention.

Variables	Before intervention	After intervention
Symptom severity score	1.504 ± 0.119	1.175 ± 0.114
Functional status score	1.4539 ± 0.098	1.08 ± 0.082
P value	<0.05	
significance	Significant	

After the intervention of yoga symptom severity score and functional severity score decreased and the mean difference was statistically significant (p <0.05)

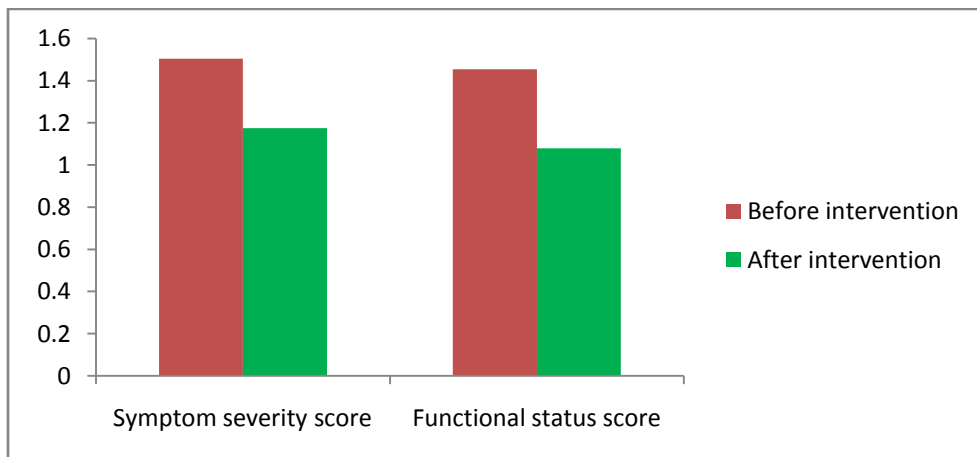
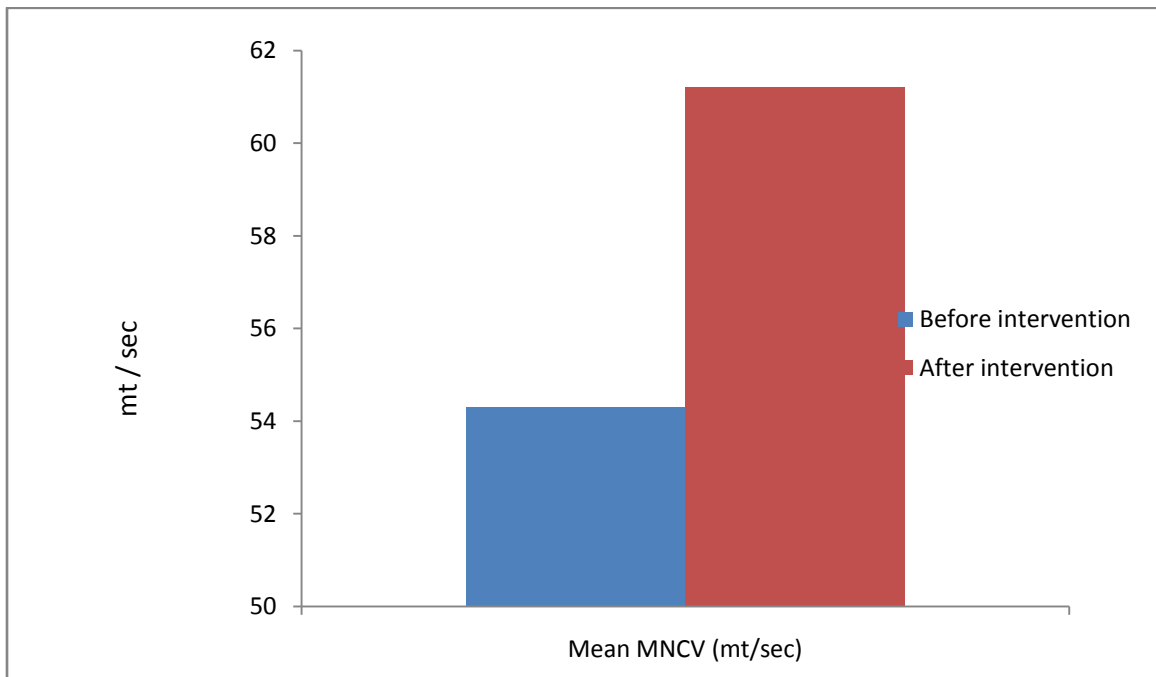


TABLE III : Median nerve conduction velocity before and after intervention

MNCV (mt/sec)	Before intervention	After intervention
Mean	54.301	61.216
SD	2.402	2.691
P value	<0.05	
significance	Significant	

P value < 0.05 –statistically significant.



After the yogic intervention the study group has shown increased median motor nerve conduction velocity and it was statistically significant ($p < 0.05$).

TABLE IV: Comparison of BMI before and after intervention

parameters	BMI before	BMI after
mean	24.408	24.302
SD	2.258	2.173
P	>0.05	
significance	Not significant	

P value > 0.05 – not significant.

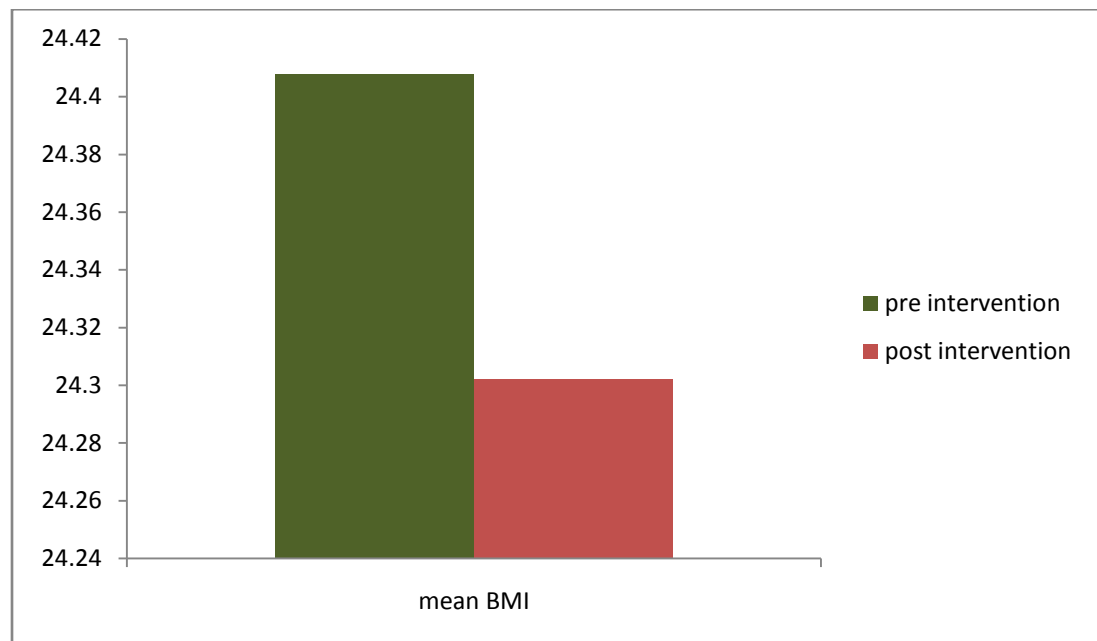


TABLE V: Blood pressure before and after intervention

Parameters	S.BP(mm Hg)		D.BP(mm Hg)	
	Mean	126.32	125.32	82.76
SD	6.949	5.813	4.703	3.872
P	>0.05			
Significance	Not significant			

P value > 0.05 – not statistically significant.

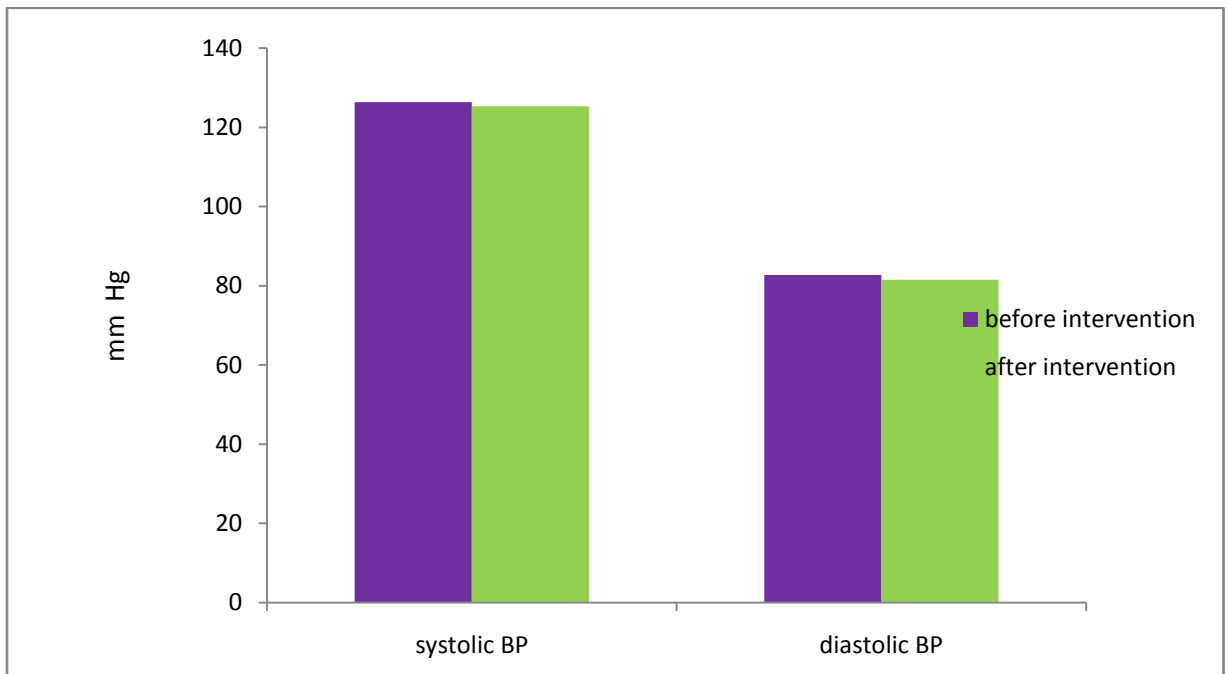


TABLE VI: Duration of work and nerve conduction velocity

Working hours (hours/ week)	MNCV (mt/sec)	
	Mean	SD
< 30 (No = 11)	59.92	0.6572
>30 (No =27)	54.34	2.657
P	<0.05	
significance	Significant	

P value < 0.05 –statistically significant.

Median motor nerve conduction velocity was decreased among workers with duration of working hours >30hrs/wk.

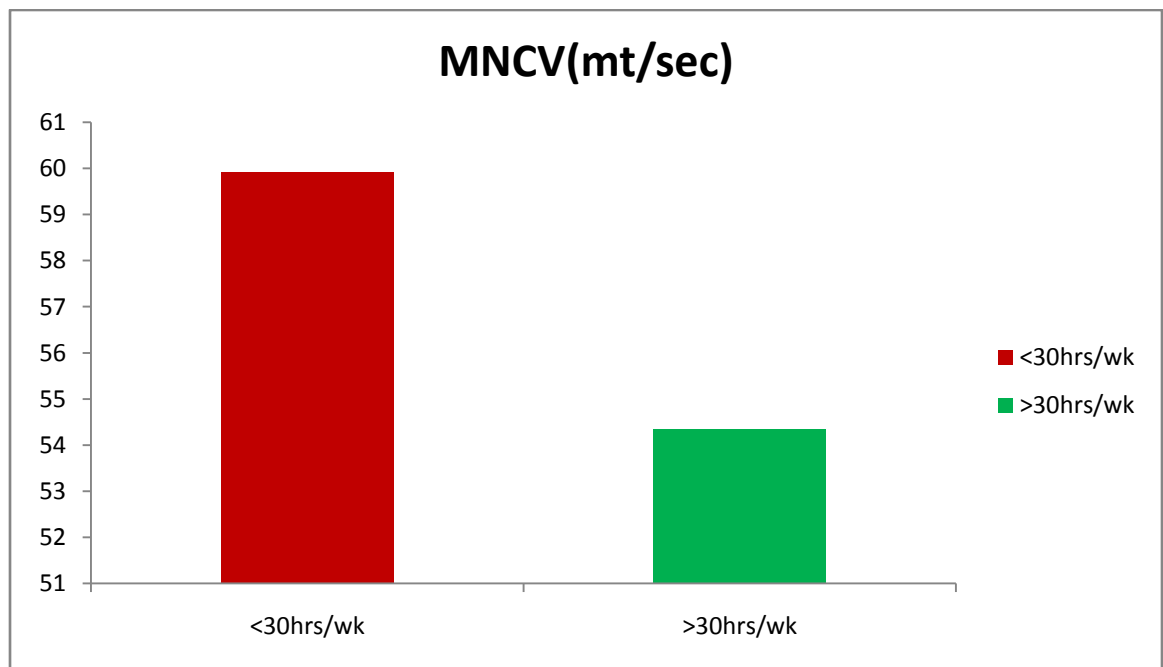


TABLE VII: Nerve conduction velocity in relation to Age

Age	MNCV(mt/sec)	
	Mean	SD
<30 yrs (N= 5)	60.562	0.7082
31 -40 yrs (N = 33)	55.748	3.4617
P value	<0.05	
significance	Significant	

P value < 0.05 – statistically significant.

Median motor nerve conduction velocity was decreased among workers with age between 31 – 40 years.

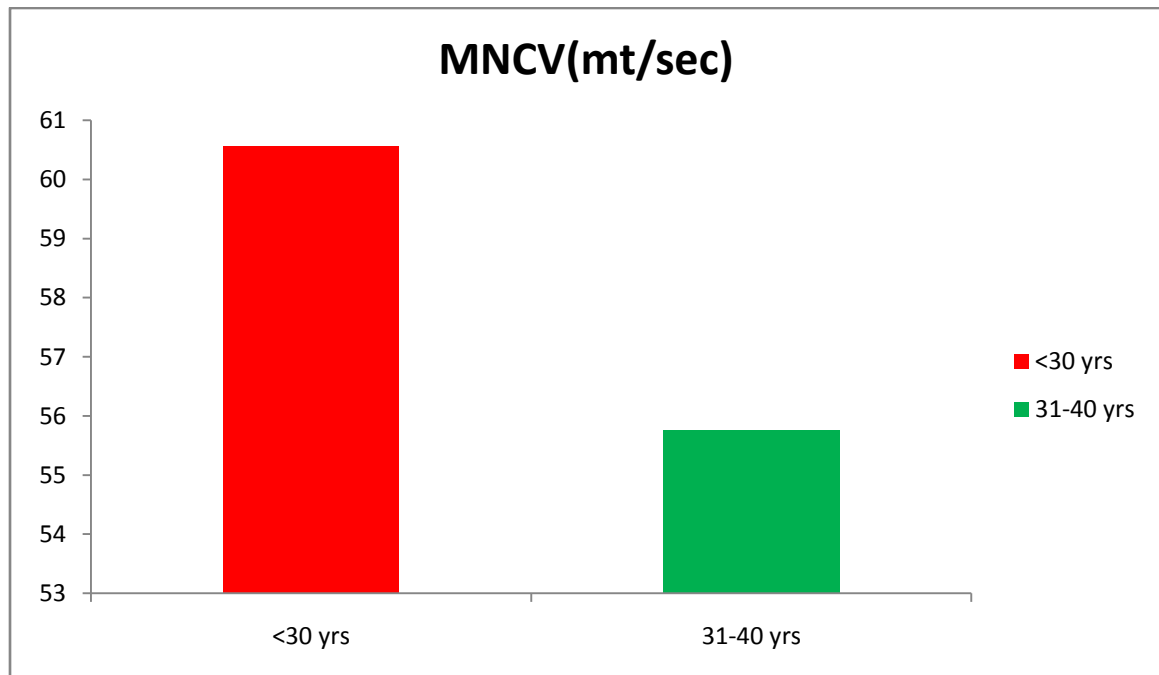


TABLE VIII: Sex distribution of CTS

sex	No. of participants with CTS	Percentage
males	18	47.37%
females	20	52.63%

Out of 38 participants with CTS, prevalence rates were found to be more in females than in males, but this difference was not statistically significant.

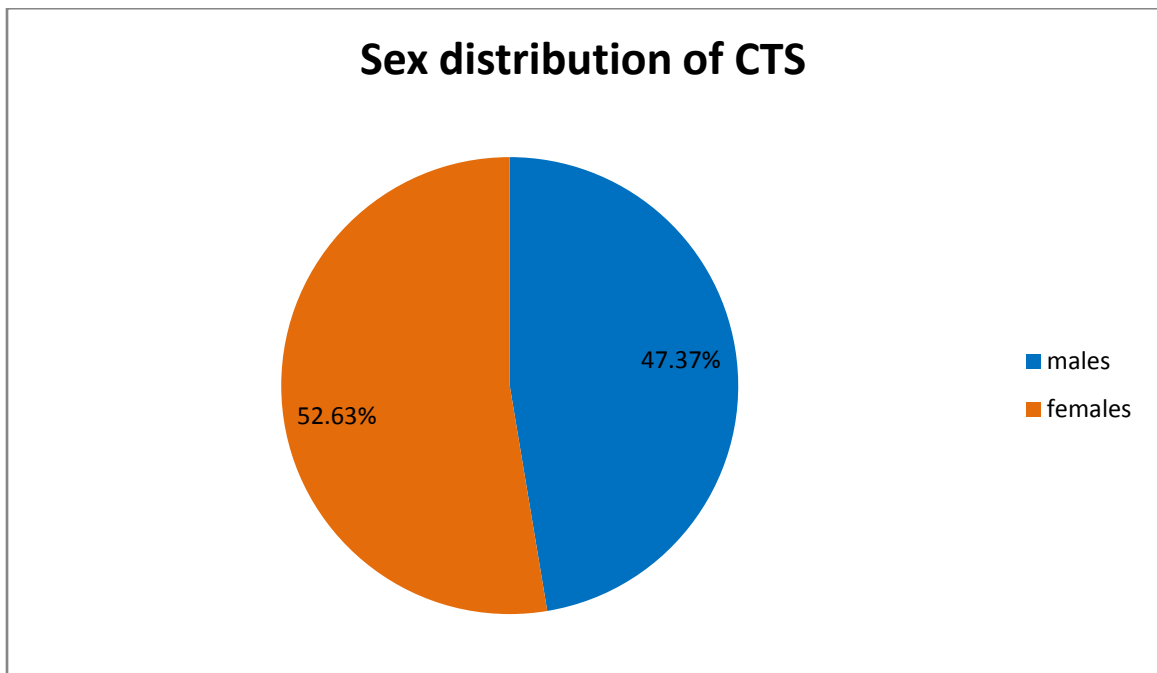


TABLE IX: Body Mass Index and MNCV

BMI	No. of participants with CTS	Mean MNCV (mt/sec)
<25	22	57.274
25 - 30	15	55.090
>30	1	56.120

In the group with BMI > 30, the MNCV was 56.120, in the group with BMI 25-30 the mean MNCV was 55.090, in the group with BMI <25 the mean MNCV was 57.274.

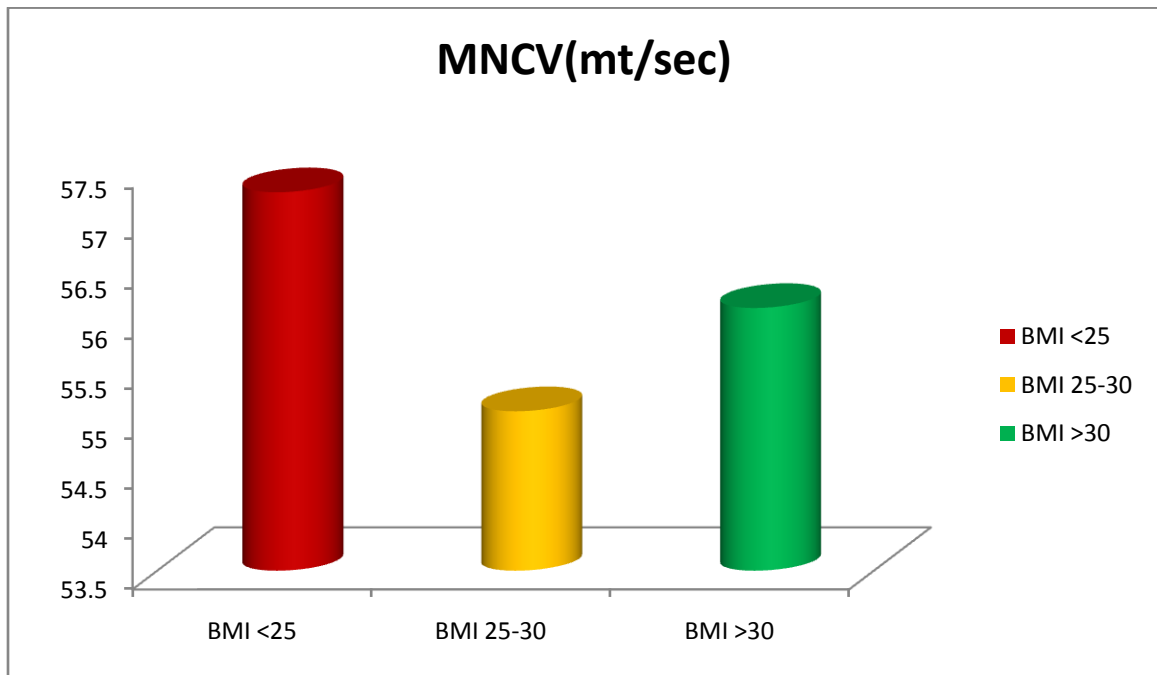


TABLE X: Duration of work and TBUT

Working hours (hrs/wk)	TBUT (sec)	
	Mean	SD
< 30 hrs (No = 36)	6.0556	1.5482
>30 hrs (No = 26)	4.576	1.0648
P value	<0.05	
significance	Significant	

P value (<0.05) statistically significant

There was significant reduction in TBUT among computer users with working hours >30 hrs/wk.

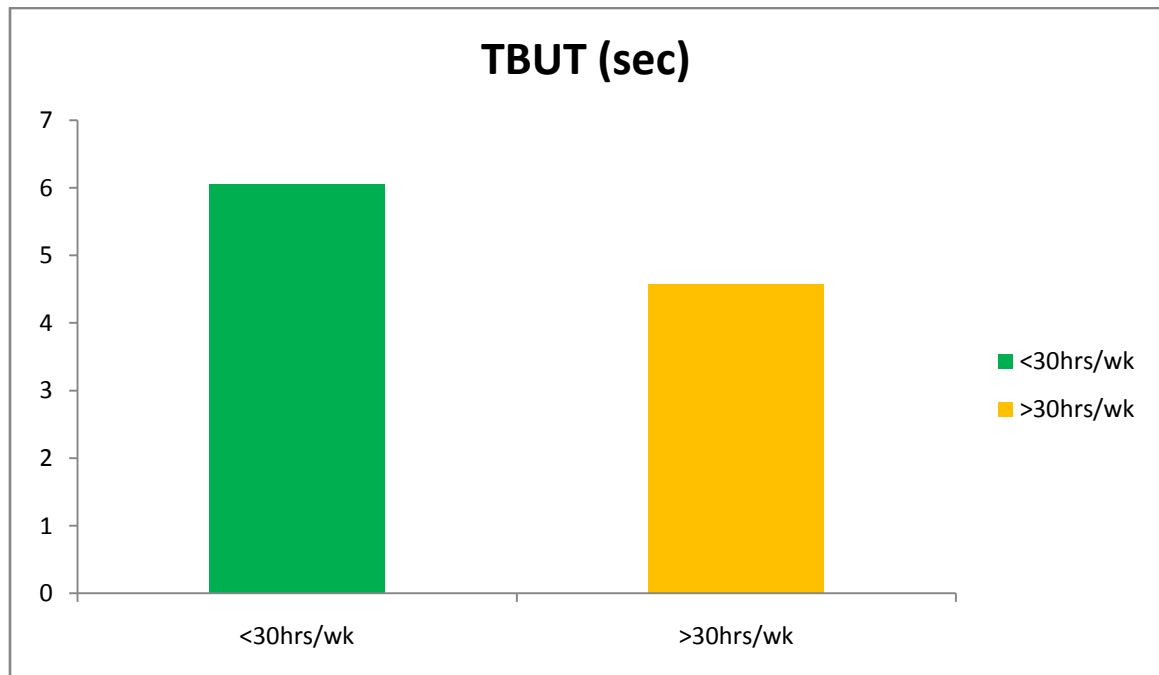


TABLE XI: Schirmer’s test and duration of work

Working hours (hrs/wk)	Schirmer’s test (sec)	
	Mean	SD
< 30 hrs (No = 36)	6.750	0.9673
>30 hrs (No = 26)	4.484	1.1204
P value	<0.05	
significance	Significant	

P value (<0.05) - statistically significant.

There was significant reduction in TBUT among computer users with working hours >30 hrs/wk.

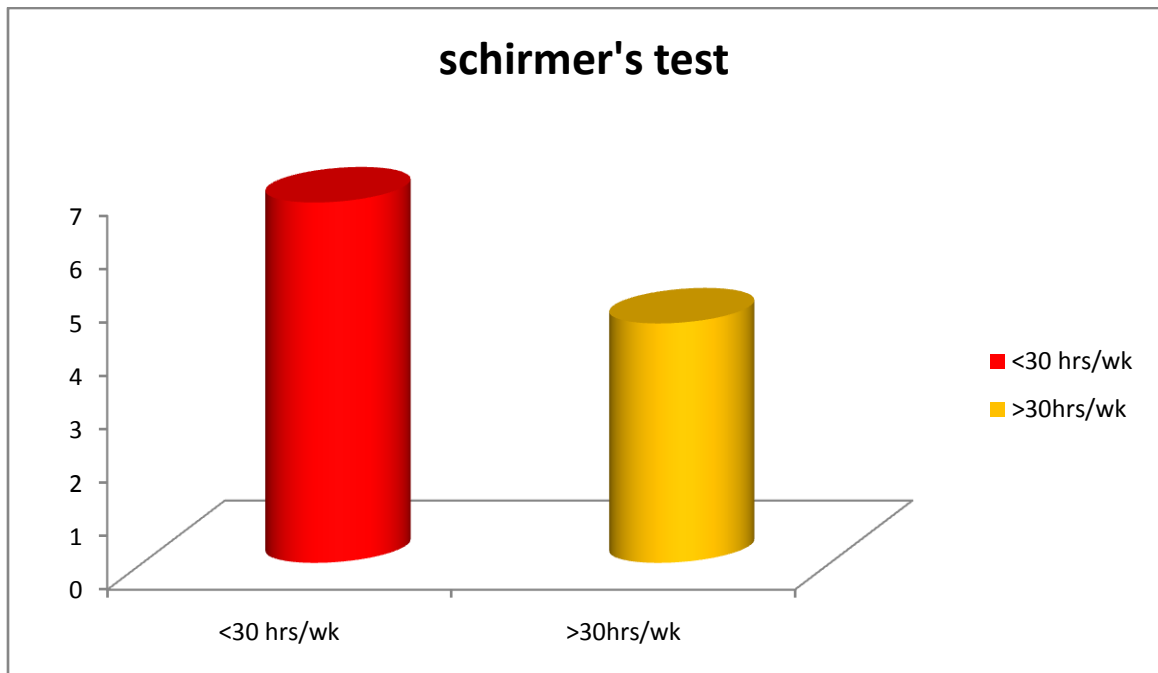


TABLE XII : Comparison of dry eye symptom score before and after intervention

parameters	Before intervention		After intervention	
	Mean	SD	Mean	SD
Symptom score	11.451	1.066	6.887	1.117
P value	<0.05			
significance	Significant			

P value (<0.05) - statistically significant.

There was significant reduction in dry eye symptom score after intervention.

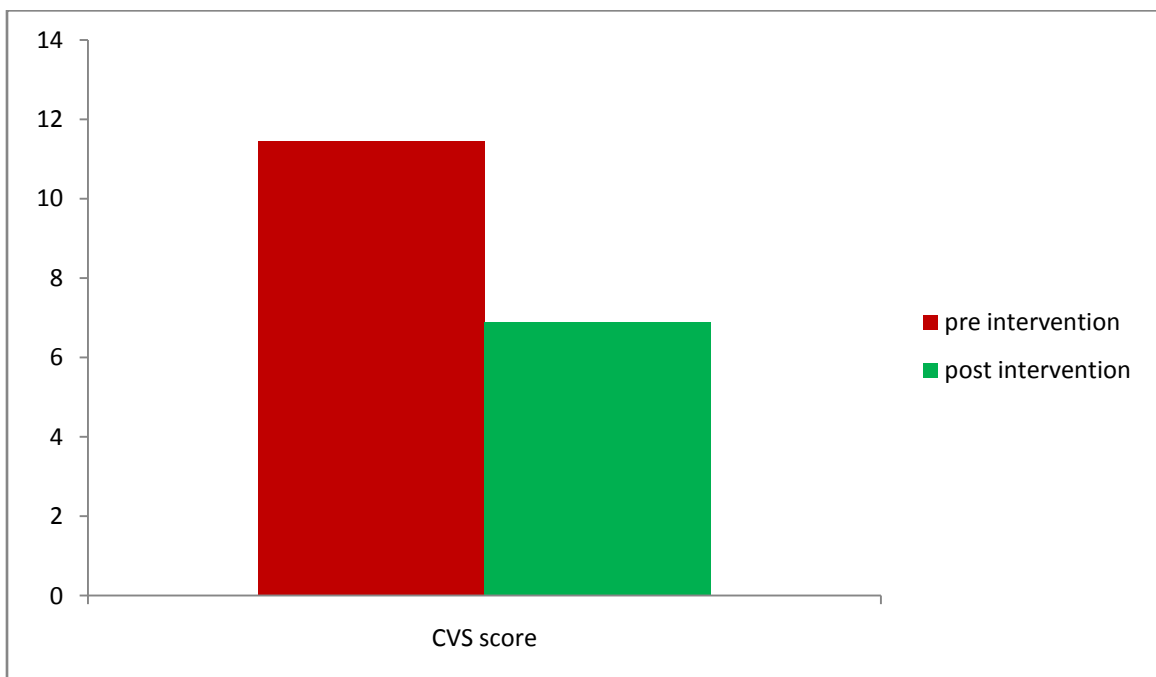


TABLE XIII : Comparison of TBUT before and after intervention

Parameters	Before intervention		After intervention	
	Mean	SD	Mean	SD
TBUT (sec)	5.43	1.543	10.50	0.987
P value	<0.05			
significance	Significant			

P value statistically significant (p<0.05)

There was significant increase in TBUT after intervention.

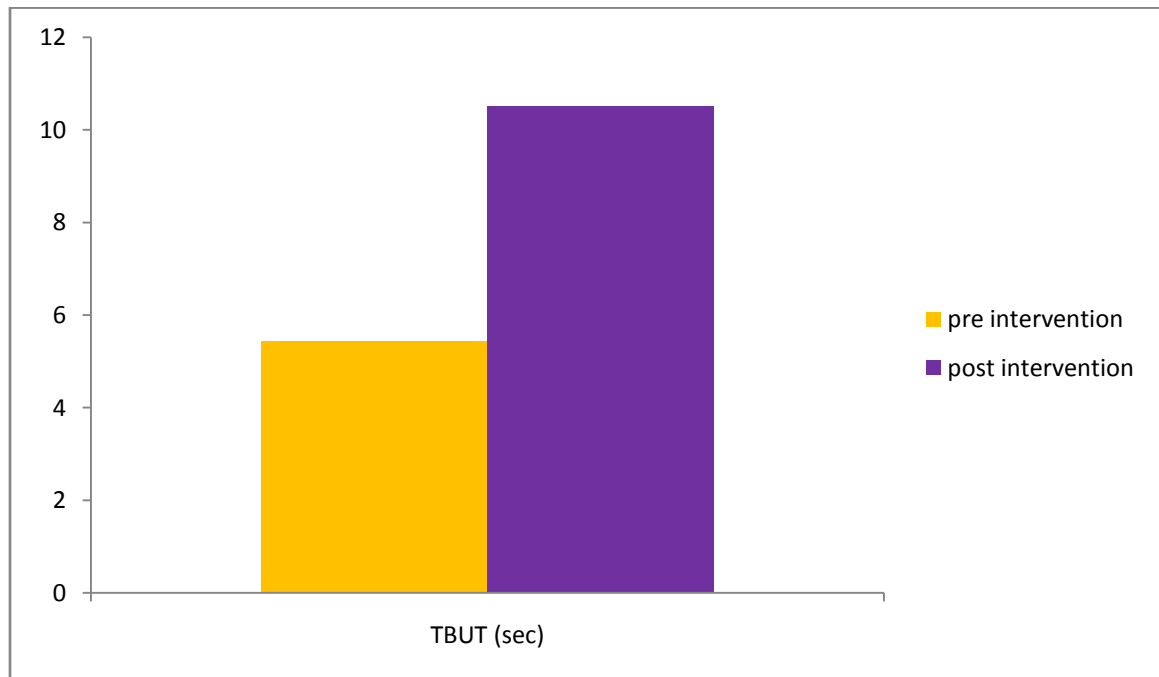


TABLE XIV : Comparison of Schirmer's test before and after intervention

Parameters	Before intervention		After intervention	
	Mean	SD	Mean	SD
Schirmer's test (sec)	5.951	1.395	12.709	1.206
	<0.05			
P value	<0.05			
significance	Significant			

P value (0.05) - statistically significant.

There was significant increase in Schirmer's test after intervention.

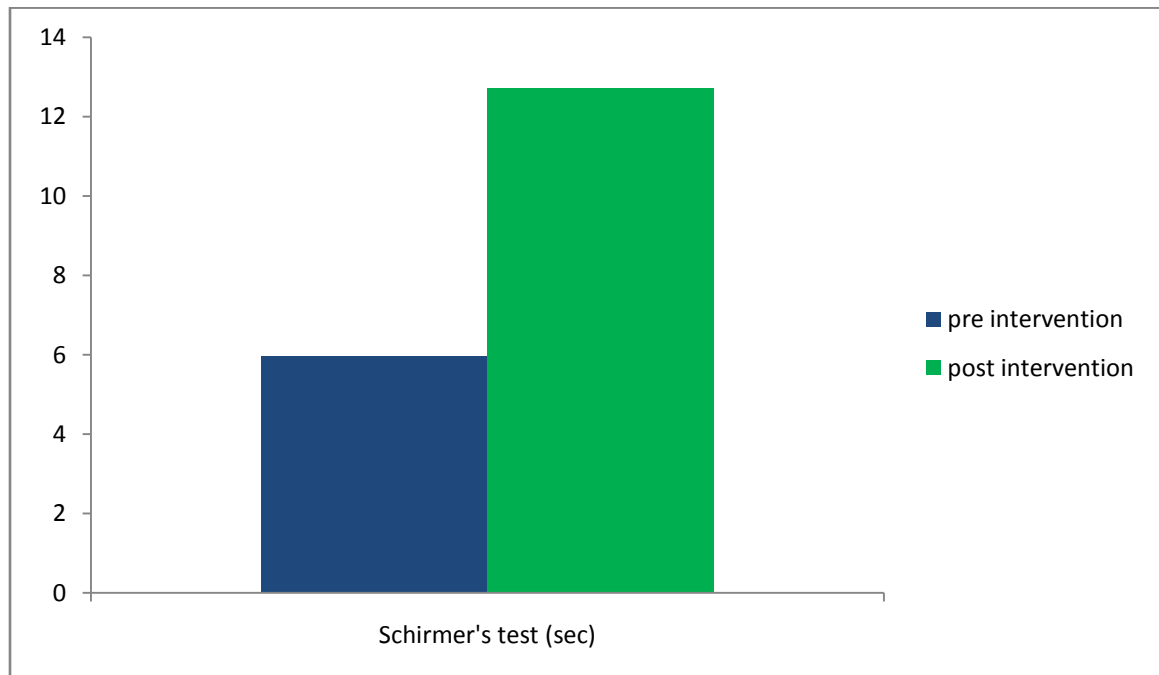


TABLE XV: Age distribution of CVS

Age	No of participants with CVS	Percentage
<30 yrs	3	4.84%
31 -40 yrs	59	95.16%

3 persons were <30 years, 59 persons were between 31-40 years.

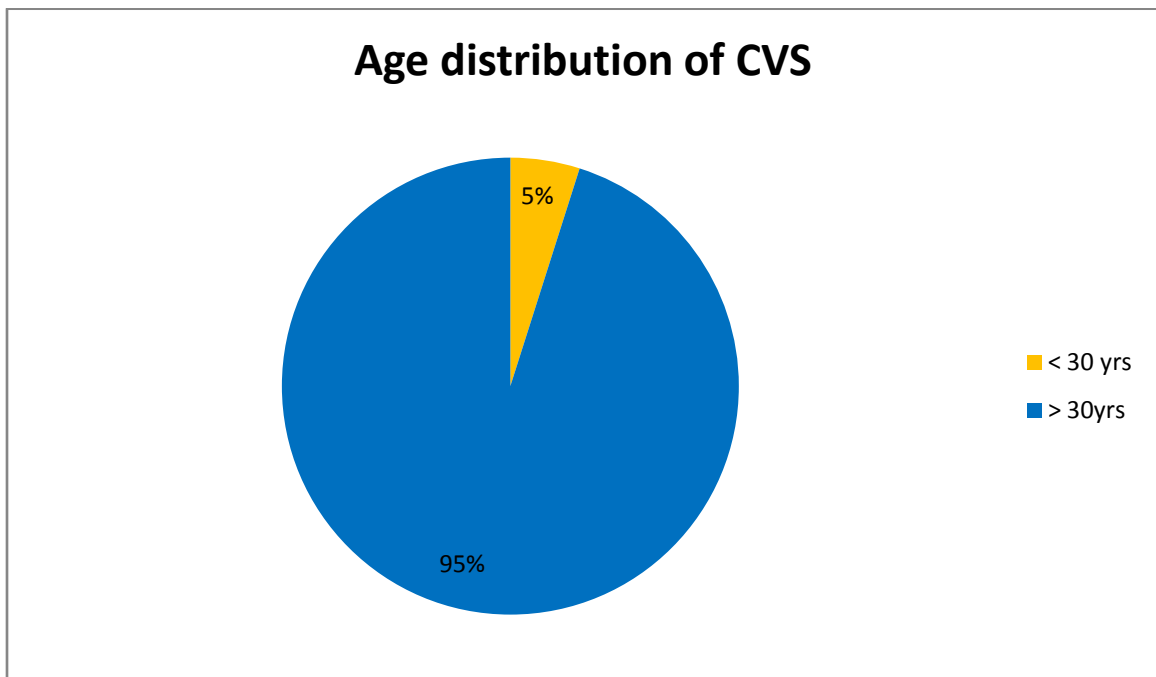


TABLE XVI: Sex distribution of CVS

sex	No. of participants with CVS	Percentage
males	32	51.61%
females	30	48.39%

32 males were have CVS, 30 females were have CVS.

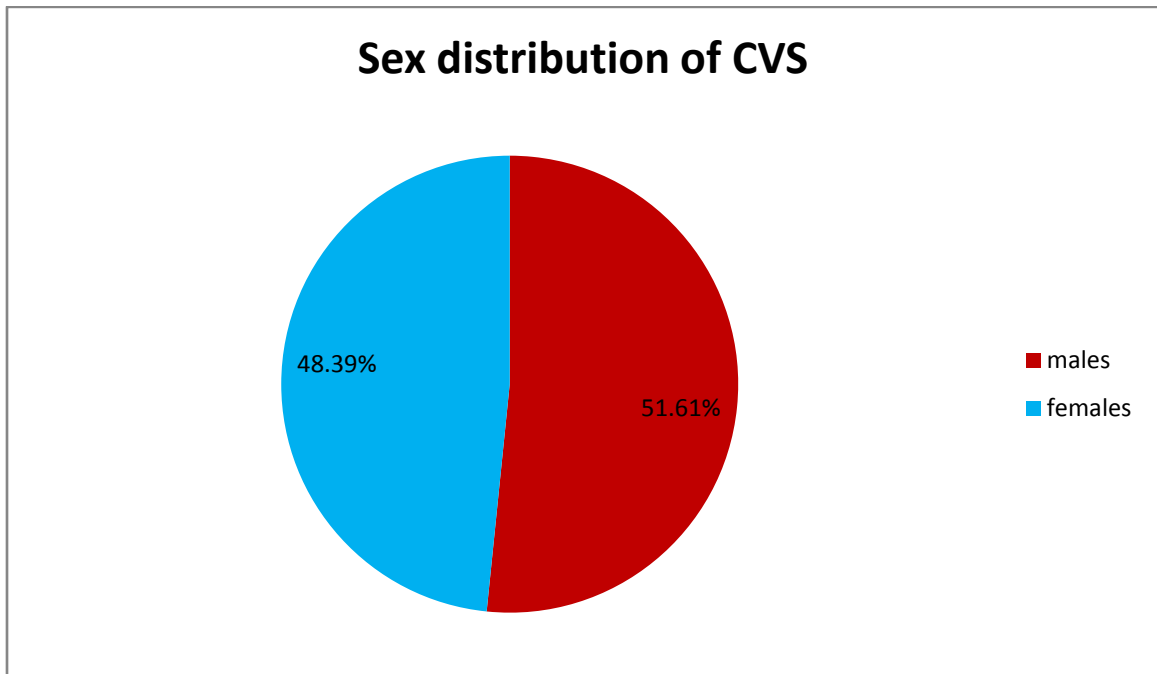
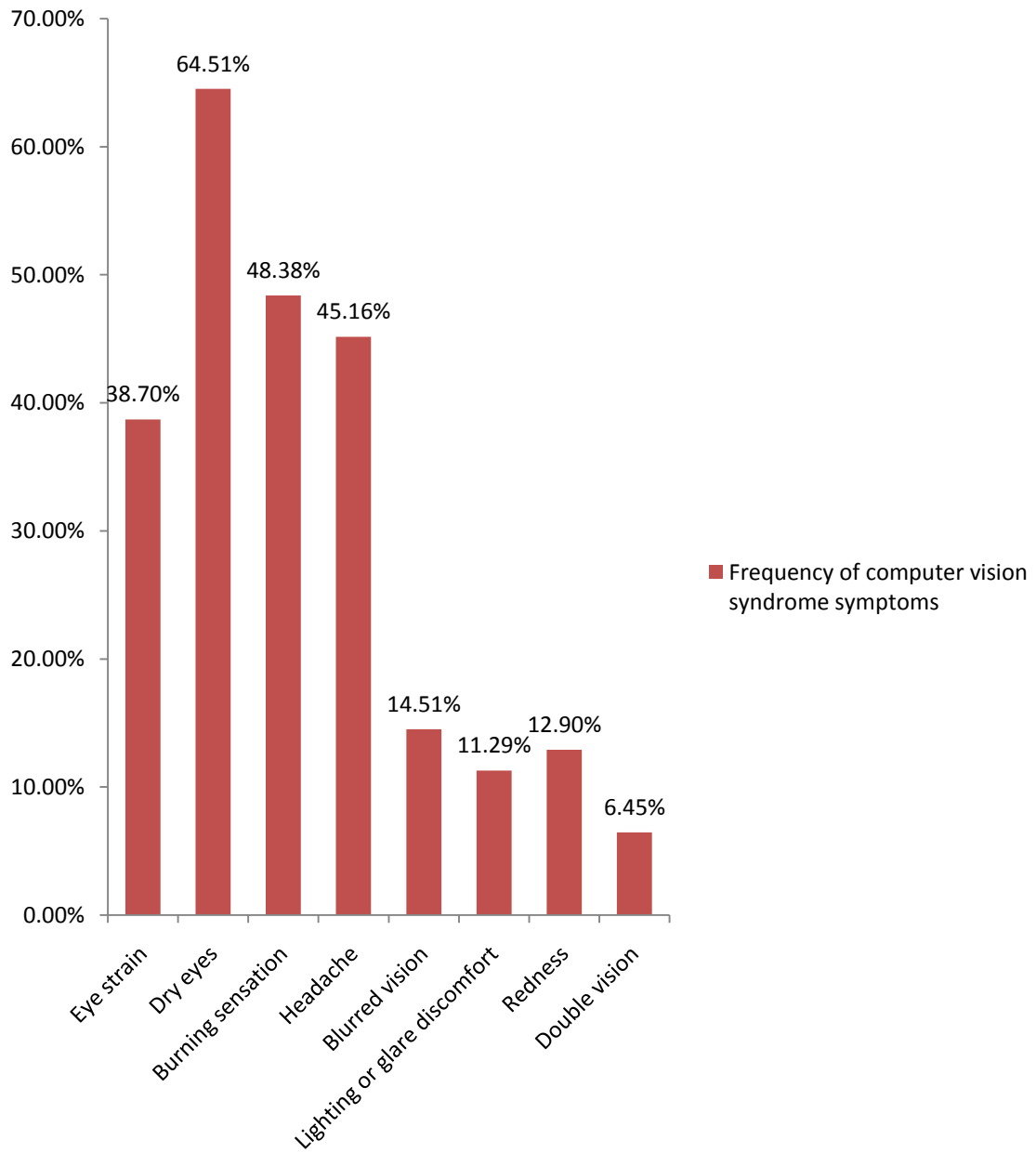


TABLE XVII : Frequency of computer vision syndrome symptoms

symptoms	No of participants with CVS	Percentage
Eye strain	24	38.70%
Dry eyes	40	64.51%
Burning sensation	30	48.38%
Headache	28	45.16%
Blurred vision	9	14.51%
Lighting / glare discomfort	7	11.29%
Redness	8	12.90%
Double vision	4	6.45%

Out of 62 participants with CVS, the most common symptom was dry eyes (64.51%) followed by burning sensation (48.38%), headache (45.16%), eye strain (38.70%), blurred vision (14.51%), redness (12.90%), light or glare effect(11.29%) and double vision (6.45%).

Frequency of computer vision syndrome symptoms



DISCUSSION

DISCUSSION

Increasing use of computers has brought about the development of various health concerns. These health concerns resulting from poorly designed workstations, prolonged physical inactivity, poor seating posture are a growing trend in workplaces.

Health related problems such as carpal tunnel syndrome and computer vision syndrome are among the top reported injuries. Characteristic features of these disorders include wrist and hand pain, weakness, numbness, eye pain, eye irritation, dry eye, redness and eye fatigue. These problems are far easier to prevent than cure. By ergonomically having good work place equipment, good workstation, using alternative techniques like yoga and exercises can prevent development of these health related problems⁷². Everyone should aware of these health related problems. There are lot of studies which showed the relationship between computer use and its health related problems.

For this study, a group of 100 computer users who were using computers regularly for more than 15 hours/week were selected. A questionnaire was given to all of them to know the presence of carpal tunnel syndrome and computer vision syndrome. The set of questions were more or less similar to another study done by **Sen A et al**⁷³ at Malaysia. The prevalence of computer related health disorders was noted. In this study prevalence of carpal tunnel syndrome among the regular computer users was 38% and also showed that symptom severity score and

functional status score has decreased after yogic intervention. This correlates with a similar study conducted by **Sheman et al**⁷⁴. So this study proved the effectiveness of yogic exercises on relaxation of muscles and ligaments.

In the present study, the median motor nerve conduction velocity has shown better improvement after yoga intervention which is in accordance with the study done by **Jaggi et al**⁵⁷. This proved that the compression of nerve fibres running through the carpal tunnel was reduced due to the relaxation effect of yoga. The symptom severity score and functional status score were analyzed before and after intervention and there was significant reduction in the score at the end of the study. This correlates with a similar study done by **Vidya S Joshi et al**⁷⁵.

Among the CTS participants, increased working hours was associated with a reduced median motor nerve conduction velocity. This correlates with a study done by AA **Ganeriwal et al**⁷⁶. The reason for this is due to the continuous physical stress imposed upon the nerve fibres with prolonged working period.

In the present study prevalence of CTS higher among the females when compared to males. This correlates with a study done by **De krom MC et al**⁷⁷. This could be due to the crowded carpal bones and narrow carpal tunnel present in females.

In the present study, prevalence of computer vision syndrome was 62% and also showed that CVS assessment questionnaire score has decreased after

intervention which correlates with a similar study done by **HiremathJyoti et al**⁷⁸. This showed that yogic eye exercises definitely reduces the eye strain and improves symptoms.

Long term computer use causes a lot of health disorders with the eyes being the most commonly involved organ. Working with a computer for a long duration without a break leads to eye strain which correlates with a study done by **N Kozeis et al**⁷⁹.

Studies by **TellesS et al**⁸⁰ showed the improvement in visual related problems following yoga training. Similarly, in this study also there is positive correlation between yogic eye exercises and relaxation which helps to reduce eyestrain. After intervention the participants of our study group felt extremely good. There was definite physical as well as emotional well-being. There was great reduction in subjective symptoms like eye pain, dry eye, headache, backpain, irritability, etc. Their working capacity without becoming exhausted had increased.

Out of 62 participants, the TBUT test results showed that there was an average improvement of 5 seconds and after applying paired “t” test, this was statistically significant. Regarding Schirmer’s test, the results showed an average improvement of 6 seconds and it was statistically significant. It shows that regular yogic eye practices surely help in improving the tear film, thereby reducing the

symptoms of computer vision syndrome. This was correlated with the studies done by **Shirlytelles et al**⁸¹.

When the BMI was analyzed before and after intervention, there was no significant change in the BMI at the end of the study. This could be due to the fact that the interventions were not focused on a weight reduction measure.

Analysis of systolic and diastolic blood pressure before and after intervention showed not much reduction in both mean systolic as well as diastolic blood pressure. Since most of them were already normotensive subjects.

The informative lectures helped generate awareness of working environment, including ergonomics, which also helped to alleviate the symptoms. Other treatment modalities such as use of computer glasses, artificial tears etc. are also suggested to help overcome CVS. To summarize, regular computer users with CTS and CVS can be advised yogic exercises for improvement of computer related health problems.

SUMMARY
&
CONCLUSION

SUMMARY AND CONCLUSION

- ❖ Extensive and prolonged computer use has given rise to computer related health disorders. Carpal tunnel syndrome and computer vision syndrome are the common problems among them. Yogic exercises help to reduce these problems. Thus, the objective of the study was to know the efficacy of yoga.
- ❖ The present study has been undertaken to find out the prevalence of carpal tunnel syndrome and computer vision syndrome among regular computer users.
- ❖ For this study, 100 regular computer users in the age group 20 to 40 years were selected. A questionnaire given regarding their symptoms of carpal tunnel syndrome and computer vision syndrome and the prevalence of CTS and CVS detected.
- ❖ Among the computer users' 38 persons having carpal tunnel syndrome and after intervention their symptom severity score and functional status score have decreased.
- ❖ Computer users with increased working hours showed decrease in median motor nerve conduction velocity.
- ❖ Median motor nerve conduction velocity after yogic exercises was increased and it was statistically significant.

- ❖ The study showed 62 persons having computer vision syndrome and the frequency of symptoms reduced after intervention.
- ❖ Computer users with increased duration of work without break showed decrease in TBUT and after the intervention there was statistically significant increase in TBUT.
- ❖ The study also shows a statistically significant increase in Schirmer's test after intervention.
- ❖ The improvement in CTS and CVS was statistically significant. This indicates poor work station design, improper posture, working in a computer for a longer duration without taking break accelerates the symptoms and these can be corrected or reduced by regular yogic exercises and special attention should be given to these regular computer users.
- ❖ To conclude, regular computer users with CTS and CVS can be advised yogic exercises for improvement of computer related health problems.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Blehm C, Vishnu S, Khattak A, Mitha S, Yee RW. Computer vision syndrome: a review. *Surv Ophthalmol* 2005;50(3): 253-262
2. Lic CW, Chen TW, Wang MC, Chen CH, Lee CL, Huang MH. Relationship between carpal tunnel syndrome and wrist angle in computer workers. *Kaobsiung J Med Sci* 2003;19:617-623.
3. Jones CS, Orr B. Computer related musculoskeletal pain and discomfort among high school students. *Am J Health Studies* 1998;14:26-30.
4. Franzblau A, Flaschner D, Albers JW, Blitz S, Werner R, Armstrong T. Medical screening of office workers for upper extremity cumulative trauma disorders. *Arch Environ Health* 1993;48:164-170.
5. Heinrich J, Blatter BM, Bongers PM. A comparison of methods for the assessment of postural load and duration of computer use. *Occup Environ Med*. 2004;61:1027-31.
6. Barr AE, Barbe MF, Clark BD. Work related musculoskeletal disorders of hand and wrist; epidemiology, pathophysiology and sensorimotor changes. *J Orthop Sports Phys Ther*. 2004 October;34(10):610-27.
7. Sun P, Liu Z, Yu H, Mirkin MV. Effect of mechanical stress on the kinetics of heterogeneous electron transfer. *Langmuir* 2008;24(18):9941-9944.

8. Faucett J, Rempel D. VDT-related musculoskeletal symptoms; Interactions between work posture and psychosocial work factors. *Am J Ind Med* 1994;26(5):597-612.
9. Giannini F, Cioni R, Amico PD et al. A new clinical scale of carpal tunnel syndrome: validation of the measurement and clinical neurophysiological assessment. *Clinical neurophysiology* 2002;113:71-7.
10. Miljanović B, Dana R, Sullivan DA, Schaumberg DA. Impact of dry eye syndrome on vision-related quality of life. *Am J Ophthalmol*. 2007;143:409–15.
11. Cardona G, García C, Serés C, Vilaseca M, Gispets J. Blink rate, blink amplitude, and tear film integrity during dynamic visual display terminal tasks. *Curr Eye Res*. 2011;36:190–7.
12. Apostol S, Filip M, Dragne C, Filip A. Dry eye syndrome. Etiological and therapeutic aspects. *Oftalmologia*. 2003;59:28–31.
13. Uchino M, Schaumberg DA, Dogru M, Uchino Y, Fukagawa K, Shimmura S, et al. Prevalence of dry eye disease among Japanese visual display terminal users. *Ophthalmology*. 2008;115:1982–8.
14. Parcarelli E, Quilter D. Repetitive strain injury: A computer users guide. New York: John Wiley & Sons Inc; 1994.
15. Jens wahlstrom, Ergonomics, musculoskeletal disorders and computer work, *occupational medicine* 2005;55: 168-176.

16. Jonas WB. Alternative medicine-Learning from the past examining the present, advancing to the future. JAMA 1998;280(18):1616-7.
17. Iyengar BKS. Light on yoga. London: George Alien & Unwin Ltd:1968.
18. Joshi SM. Computer related health disorders. Bombay hospital journal 46(1) 37-40, 2004
19. Ekman a, Anderson A, Hagberg M, WigaeusHjelm E. Gender differences in musculoskeletal health of computer and mouse users in the Swedish work force. Occup Med 2000;50:608-13.
20. C.J.Chang,B.C.Amick,C.C.Menendez,J.n.Katz,P.W.Johnson,M.Robertson, and J.T.Dennerlein, "Daily computer usage correlated with undergraduate students' musculoskeletal symptoms," Am.J.Ind.Med.,vol.50,no.6,pp.481-488,2007.
21. Rosenbaum RB, Ochoa JL carpal tunnel syndrome and other disorders of the median nerve, 2nded, Amsterdam, The Netherlands; Butterworth-Heimann; 2002;67,106.
22. Dawson DM, Hallet M, Millender L (1983). Entrapment Neuropathies. 1st Ed. Boston: Little Brown and Company
23. Atroshi I, Gummesson C, Johnsson R, Ornstein E, Ranstam J, Rosen I (1999). Prevalence of carpal tunnel syndrome in a general population. JAMA,281(2):153-8.
24. Michlovitz S, conservative intervention for carpal tunnel syndrome. JOSPT. 2004;39; 589-600.

25. J.S.D.Mieog, J.M.Bliss, R.C.Coombes, and C.J.H.van de velde, "carpal tunnel syndrome and musculoskeletal symptoms in postmenopausal women with early breast cancer treated with exemestane or tamoxifen after 2-3 years of tamoxifen: Lancet Oncol., vol.13, no.4, pp.420-32, May 2012.
26. Minnihan R. carpal tunnel synd: A rising statistic among laboratory workers. Articles mi_hb034/is_200304/ai_n5787095.25/08/2004
27. Unger J (2004). Diabetic neuropathy: Early clues, effective management. Consultant, 44(12): 1549-56
28. Feuerstein M, Miller VL, Burrell LM, Berger RBS. Occupational upper extremity disorders in the federal work force: prevalence, health care and expenditures and patterns of work disability. J Occup Environ Med 1998;40(6):546-55.
29. Kao SY. Carpal tunnel syndrome as an occupational disease. J Am Board Fam Pract. 2003; 16(6): 533-42.
30. Slater RR. Carpal tunnel syndrome : Current concepts. J. South orthrop Assoc 1999; 8(3):203-13.
31. Allers, A. work place preventive programs cut costs of illness and injuries; Occupational health and safety, 1989, vol 58, pp26-29.
32. Ackland T, Hendrie G. Training the non-preferred hand for fine motor control using a computer mouse. International Journal of Industrial Ergonomics 2005;35(2):149-55.
33. Thompson, WD 1998, 'Eye problems and visual display terminals-the facts and the falacies', Ophthalmic Physiol Opt; 18(2): 111-9.

34. Torrey, J 2003, 'Understanding computer vision syndrome'. *Employment Relations Today*, Vol.30, Issue 1: pp.45-51.
35. Anshel, J 2007, 'visual ergonomics in the workplace', *American Society of Safety Engineers, ASSE Professional Development Conference*, June 24-27, 2007, Orlando Florida, No:07-0413.
36. Divjak, M & Bischof, H 2009, 'Eye blink-based fatigue detection for prevention of computer vision syndrome', *MVA 2009, IAPR conference on machine vision applications*, May 20-22 2009, Yokohama, Japan.
37. Standring S. *Gray's Anatomy: The anatomical basis of clinical practice*. 39th Ed. Edinburgh: Elsevier Churchill Livingstone; 2005.
38. Ashworth NL. *Clinical Evidence: Carpal tunnel syndrome*. Issue 13. London, England; BMJ Publishing; 2005
39. Werner RA, Andary M. Carpal tunnel syndrome: Pathophysiology and clinical neurophysiology. *Clinical Neurophysiology* 2002; 113(9): 1373-81.
40. Van Dijk MAJ, Reitsma JB, Fischer JC, Sanders GTB. Indications for requesting laboratory tests for concurrent diseases in patients with CTS: A systemic review. *Clinical chemistry* 2003;49(9): 1437-44.
41. D Arcy CA, McGee S, Does this patient have carpal tunnel syndrome? *JAMA* 2000; 283(23):3110-7.
42. Sequeira W. Yoga in treatment of carpal tunnel syndrome. *The Lancet* 1999; 353:689-90.

43. Pal GK, Pal P. Textbook of practical physiology. 2nd Ed. Chennai: Orient LongmannPvt Ltd; 2005.
44. Rathore, KS. Bagdi, P & Rathore, S 2010, Computer vision syndrome: An update.
45. Chakrabarti, M 2007, What is computer vision syndrome? Kerala journal of Ophthalmology, vol XIX, No 3.
46. Maissa, C & Guillon, M 2010, 'Contact lens anterior eye', Journal of the British contact lens association; vol.33:issue 4, pp.176-182.
47. Chiemeke, SC, Akhahowa, AE & Ajayi, OB 2007, 'Evaluation of vision-related problems amongst computer users: a case study of University of Benin, Nigeria', 2007, vol.1, WCE 2007, July 2-4, London, U.K.
48. Izquierdo, JC, Garcia, Buxo, C & Izquierdo, N 2004, 'Factors leading to the computer vision syndrome: an issue at the contemporary workplace', Bol. Assoc. Med., P.R, vol.96, no.2, pp.103-110.
49. UCSD. (2005). "Take Frequent Breaks: Healthy Choices for Computer Users".
50. Sweere, H.C. (2002). "Ergonomic Factors Involved in Optimum Computer Workstation Design: A Pragmatic Approach".
51. Grandjean, E., W. Hunting, et al (1984). "Preferred VDT workstation settings, body posture and physical impairments."
52. Catherine cook and Robin Burgers –Limerick; guidelines for computer workstations vol.17 (1). March 2003.

53. Wall, M.D.,M.P.J.M.V.Riel,et al (1992). "Improving the sitting posture of CAD/CAM workers by increasing VDU monitor working height." Ergonomics 35(4): 427-436.
54. RaubJA.Psychophysiologic effects of Hatha Yoga on musculoskeletal and cardiopulmonary function: a literature review. A Altern complement Med 2002;8(6): 797-812.
55. GarfinkelMS,SinghalA,KatzWA,AllanDA,ReshetarR,Schumacher HR. Yoga based intervention for carpal tunnel syndrome.JAMA 1998;280(18):1601-3.
56. MichlovitzSL.Conservative interventions for carpal tunnel syndrome. Journal of orthopaedic and sports physical therapy.2004;34(10):589-600.
57. JaggiO.P.Yogic and Tantric Medicine Vol.5 New Delhi: Atmaran and sons; 1990.
58. Neurophysiological studies in Yoga in health and diseases, Dr.N.Sathyaprabha,International symposium on Yogism, Dec.2010.
59. A case control study of obesity as a risk factor for CTS in a population of 600 patients presenting for independent medical examination.Stallings SP. J Hand Surg Am.1997 Mar;22(2):211-5.
60. AtterburyMR,Linke JC. Nested case control study of hand and wrist work related musculoskeletal disorders in carpenters.Am J Ind Med.196 Dec;30(6):695-701.

61. Jagga, V., Lehri, A. Occupation and its association with carpal tunnel syndrome- A Review. *Journal of Exercise Science and Physiotherapy*, vol.7, No.2:68-78, 2011
62. Abida Ellahi, computer users at risk: health disorders associated with prolonged computer use, *E3 journal of business management and economics*; vol.2(4). pp.171-182, October, 2011
63. Shrawankumar, work related carpal tunnel syndrome: current concepts, *Journal of musculoskeletal research*, vol.7, No.2(2003) 87-96.
64. Frost P, occurrence of carpal tunnel syndrome in relation to sustained high velocity and high force manual work, *Scand J Work Environ Health*. 1998; 24:285-292.
65. Stevens JC, The frequency of CTS in computer users at a medical facility. *Neurology*. 2001; 56:1568-1570.
66. Marklin RW, Simoneau GG, wrist and forearm posture from typing on split and vertically inclined computer keyboards. *Hum factors* 41:559-569, 1999.
67. Alireza Dehghani, prevalence of ocular symptoms and signs among professional computer users, *JRMS/ November & December 2008*; vol13, No 6.
68. Nakaishi H, Yamada Y, Abnormal tear dynamics and symptoms of eyestrain in operators of video display terminals. *Occup environ med* 1999; 56(1): 6-9.
69. Psihogios JP, Sommerich CM, A field evaluation of monitor placement effects in VDT users. *Appl Ergon* 2001; 32(4):313-325.

70. Portello JK, Rosenfield M, Chu CA(2013) Blink rate,incomplete blinks and computer vision syndrome. *Optomvissci* 90:482-487.
71. Yoon KC, Jeong IY, Park YG, Yang SY (2007) Interleukin-6 and tumor necrosis factor – alpha levels in tears of patients with dry eye syndrome. *Cornea* 26:431-437.
72. Keir PJ, Bach JM, Effect of computer mouse design and task on carpal tunnel pressure. *Ergonomics* 42: 1350-1360.
73. A Sen, Stanley Richardson, a study of computer related upper limb discomfort and computer vision syndrome, *J.HumanErgol.*,36:45-50,2007.
74. Sheman KJ, Cherkin DC, ErroJ,MegliorettiDL,Deyo RA. Comparing yoga, exercise and self care book for chronic low back pain. *Amm Intern Med* 2005;143(12): 849-56.
75. Vidya S Joshi, Anjana S Bellad, Effect of yogic exercises on symptoms of musculoskeletal disorders of upper limbs among computer users: a randomized controlled trial, *Indian J Med Sci* 2011, oct;65(10): 424-8.
76. AA Ganeriwal, DA Biswas, The effects of working hours on nerve conduction test in computer operators, *Malays orthop J.*2013 Mar;7(1):1-6.
77. De Krom MC, KnipschildPG,Kester AD, Thijs CT, Carpal tunnel syndrome – prevalence in general population. *J ClinEpidemiol.* 1992;45(4):373-6.
78. HiremathJyoti, Kumar Ashwani, computer vision syndrome- prevention and management, *Int J Ayu Pharm Chem* 2015 vol 2 issue 2.

79. N Kozeis, Impact of computer use on children's vision, Hippokratia. 2009 Oct-Dec;13(4):230-231.
80. TellesS, NaggarathnaR, Nagendra HR. Improvement in visual perception following yoga training. J Indian Psychol. 1995;13:30-32.
81. Shirlytelles, KV Naveen, ManojDash, Effect of yoga on self related visual discomfort in computer users. Head and face med, 2006;2:46.

ANNEXURES

PROFORMA

I PERSONAL DETAILS:

- a) Name :
- b) Age : yrs
- c) Sex : M [] F []
- d) address:
- e) office/working place:
- f) Wt (kgs) Ht (m) BMI(kg/m²)

II HISTORY :

A) Personal history:

- 1) Handedness: Right [] Left []
- 2) H/O associated medical/surgical illness : [yes] [no]
- If yes, name of the condition and treatment particulars
- 3) do you have any eye problems? [Yes] [no]
- 4) have you ever consulted a doctor/ eye specialist for an eye problem? [yes] [no]

B) Personal habits :

Alcohol consumption : yes [] no []

 If yes, duration and quantity

Smoking : yes [] no []

 If yes, duration and quantity

C) Family history :

D)Occupational history :

i) years of employment :

ii) Working hours per week:

E) Symptoms of carpal tunnel syndrome :

Yes[] no[]

If yes,what are the symptoms and their duration?

i)hand weakness

ii)numbness

iii)tingling

iv)hand/wrist pain

v)difficulty in grasping

vi)nocturnal exacerbation of symptoms

F) Self- administered Boston carpal tunnel questionnaire for symptom severity and functional status

Part I

CARPAL TUNNEL SYNDROME QUESTIONNAIRE (CTSQ)

The following questions refer to your symptoms for a typical twenty four hour period during the past two weeks (circle one answer to each question)

SEVERITY SCALE:

0 = None or Never; 1 = Mild; 2 = Moderate; 3 = Severe ; 4=Very severe

QUESTION	SEVERITY SCORE				
	0	1	2	3	4
1. How severe is the hand or wrist pain that you have at night?	1				
2. How often did hand or wrist pain wake you up during a typical night in the past two weeks (times/day)?					
3. Do you typically have pain in your hand or wrist during the daytime?					
4. How often do you have hand or wrist pain during the daytime (times/day)?					
5. How long, on average, does an episode of pain last during the daytime (minutes)?					
6. Do you have numbness (loss of sensation) in your hand?					
7. Do you have weakness in your hand or wrist?					
8. Do you have tingling sensations in your hand or wrist?					
9. How severe is numbness (loss of sensation) or tingling at night?					
10. How often did hand numbness or tingling wake you up during a typical night during the past two weeks?					
11. Do you have difficulty with the grasping and use of small objects such as keys or pens?					

OVERALL SYMPTOM SEVERITY SCORE -

PART II - FUNCTIONAL STATUS SCALE

0=none or never; 1=mild; 2=moderate; 3=severe; 4=very severe

S.no	Question	0	1	2	3	4
1	Writing	0	1	2	3	4
2	Buttoning of clothes	0	1	2	3	4
3	Holding a book while reading	0	1	2	3	4
4	Gripping of a telephone handle	0	1	2	3	4
5	Opening of jars	0	1	2	3	4
6	Household chores	0	1	2	3	4
7	Carrying of grocery bags	0	1	2	3	4
8	Bathing and dressing	0	1	2	3	4

OVERALL FUNCTIONAL STATUS SCORE –

G) Symptoms of computer vision syndrome

Yes [] no []

If yes, what are the symptoms and rate their severity

symptoms	Absent(0)	Mild(1)	Moderate(2)	Severe(3)
Eye strain				
Dry eyes				
Burning sensation				
Headache				
Blurred vision				
Lighting or glare discomfort				
Redness				
Double vision				

OVERALL SCORE –

H)GENERAL EXAMINATION :

Pulse rate:

BP :

D)CLINICAL EXAMINATION :

1.Motor system

i. Thenar muscle wasting – present / absent

If present , Right hand /left hand /both hands

ii. power - abductor pollicisbrevis right - grade

left - grade

Flexor pollicisbrevis right - grade

left - grade

opponenspollicis right - grade

left - grade

2.sensory system

Any loss of sensation - present / absent

If present what sensation ? -right /left

Ophthalmic examination:

Visual acuity – right and left

Field of vision – right and left

Colour vision – right and left

J) INVESTIGATIONS :

Median MNCV (m/sec) -right and left side

Schirmer'stest - right and left side

TBUT – right and left

FBS (mg/dl)

Hb content (gm/dl)

Patient Name _____

Date _____

CONSENT FORM

DR.S.Subhalakshmi, Postgraduate student in the department of physiology, Tirunelveli Medical College, Tirunelveli is studying the Carpal tunnel syndrome and computer vision syndrome among regular computer users and effect of yogic exercises in them. The procedures involved are clinical examination, relevant blood investigations and applications of yogic exercise interventions. The procedure was explained to me clearly. After knowing about the details of the procedure, I gave my valid consent to participate in the study. The data obtained can be very well used for research and other publication purpose.

Name :

Place :

Signature :

MASTER CHART

Data of Study Group

s.no	sex	handedness	work hrs	Ht Pre	Wt Pre	BMI Pre	Ht Post	Wt Post	BMI Post	BP Pre	BP Post	Sys Pre	Sys Post	Dias Pre	Dias Post	HB Pre	HB Post
1	M	R	32	170	78	26.98	170	78	26.98	130/88	130/80	130	130	88	80	15	15
2	M	R	32	168	76	26.92	168	76	26.92	136/88	130/80	136	130	88	80	15	15
3	M	R	32	176	80	25.82	176	78	25.18	134/80	130/80	134	130	80	80	14	14
4	M	R	32	170	70	24.22	170	70	24.22	130/84	130/80	130	130	84	80	14	14
5	M	R	22	168	66	23.38	168	66	23.38	130/80	130/80	130	130	80	80	14	14
6	M	R	18	177	70	22.34	177	70	22.34	130/86	130/86	130	130	86	86	14	14
7	M	R	20	173	74	24.72	173	74	24.72	130/80	130/80	130	130	80	80	15	15
8	M	R	32	175	78	25.46	175	75	24.48	130/80	130/80	130	130	80	80	14	14
9	M	R	32	176	68	21.95	176	68	21.95	128/80	128/80	128	128	80	80	14	14
10	M	R	34	164	72	26.76	164	72	26.76	130/80	130/80	130	130	80	80	16	16
11	M	R	24	169	70	24.5	169	70	24.5	120/80	120/80	120	120	80	80	14	14
12	M	R	26	170	78	26.98	170	78	26.98	140/90	130/90	140	130	90	90	14	14
13	M	R	26	171	68	23.25	171	68	23.25	126/80	124/80	126	124	80	80	15	15
14	M	R	28	168	66	23.38	168	66	23.38	130/80	130/80	130	130	80	80	14	14
15	M	R	24	165	60	22.03	165	60	22.03	120/80	120/80	120	120	80	80	14	14
16	M	R	20	164	69	25.65	164	69	25.65	128/80	130/80	128	130	80	80	15	15
17	M	R	18	170	66	22.83	170	66	22.83	128/80	130/80	128	130	80	80	14	14
18	M	R	18	176	65	20.98	176	65	20.98	120/80	120/80	120	120	80	80	14	14
19	M	R	20	174	66	21.79	174	66	21.79	120/80	120/80	120	120	80	80	14	15
20	M	R	20	159	70	27.68	159	70	27.68	130/86	130/80	130	130	86	80	14	14
21	M	R	18	178	73	23.04	178	73	23.04	130/80	130/80	130	130	80	80	14	14
22	M	R	16	160	74	28.9	160	74	28.9	140/90	130/80	140	130	90	80	15	15
23	M	R	20	162	78	29.72	162	78	29.72	144/94	144/94	144	144	94	94	15	15
24	M	R	18	179	82	25.59	179	82	25.59	120/80	120/80	120	120	80	80	14	14
25	M	R	20	180	80	24.69	180	76	23.45	120/80	120/80	120	120	80	80	14	14
26	M	R	24	170	69	23.87	170	69	23.87	126/86	126/80	126	126	86	80	14	14
27	M	R	28	179	80	24.96	179	78	24.34	128/86	126/80	128	126	86	80	14	14
28	M	R	29	176	70	22.59	176	70	22.59	120/80	120/80	120	120	80	80	14	14
29	M	R	18	170	76	26.29	170	76	26.29	144/92	130/90	144	130	92	90	14	14
30	M	R	32	172	66	22.3	172	66	22.3	120/80	120/80	120	120	80	80	14	14
31	M	R	28	158	64	25.63	158	64	25.63	120/80	120/80	120	120	80	80	15	15
32	M	R	24	170	70	24.22	170	70	24.22	130/80	128/80	130	128	80	80	14	14
33	M	R	24	172	79	26.7	172	79	26.7	132/84	130/80	132	130	84	80	15	15
34	M	R	24	173	80	26.72	173	80	26.72	134/86	130/80	134	130	86	80	14	14
35	M	R	34	170	86	29.75	170	82	28.37	130/80	130/80	130	130	80	80	14	14
36	M	R	32	169	89	31.16	169	85	29.76	140/96	130/90	140	130	96	90	14	14
37	M	R	32	168	75	26.57	168	75	26.57	130/86	130/80	130	130	86	80	14	14
38	M	R	26	169	74	25.9	169	74	25.9	120/80	120/80	120	120	80	80	14	14
39	M	R	26	169	68	23.8	169	68	23.8	120/86	120/86	120	120	86	86	14	14

40	M	R	26	170	66	22.83	170	66	22.83	128/86	120/80	128	120	86	80	14	14
41	M	R	26	165	68	24.97	165	68	24.97	130/84	130/80	130	130	84	80	14	14
42	M	R	26	166	69	25.03	166	69	25.03	130/88	130/88	130	130	88	88	14	14
43	M	R	18	164	70	26.02	164	70	26.02	120/80	120/80	120	120	80	80	14	14
44	M	R	16	163	77	28.98	163	77	28.98	126/88	126/88	126	126	88	88	14	14
45	M	R	18	167	76	27.25	167	76	27.25	136/86	136/86	136	136	86	86	15	15
46	M	R	20	166	80	29.03	166	80	29.03	140/90	130/88	140	130	90	88	15	15
47	M	R	20	180	82	25.3	180	82	25.3	130/80	130/80	130	130	80	80	14	14
48	M	R	18	160	60	23.43	160	60	23.43	130/80	130/80	130	130	80	80	14	14
49	M	R	16	174	70	23.12	174	70	23.12	130/80	130/80	130	130	80	80	14	14
50	M	L	18	177	74	23.62	177	74	23.62	130/80	130/80	130	130	80	80	14	14
51	M	R	18	173	76	25.39	173	76	25.39	134/84	134/84	134	134	84	84	14	14
52	M	R	20	172	74	25.01	172	74	25.01	130/84	130/84	130	130	84	84	14	14
53	M	R	18	174	80	26.42	174	80	26.42	132/86	132/86	132	132	86	86	14	14
54	M	R	32	169	80	28.01	169	80	28.01	144/94	140/90	144	140	94	90	14	14
55	M	R	35	169	80	28.01	169	80	28.01	144/92	140/90	144	140	92	90	15	14
56	M	R	34	170	80	27.68	170	77	26.64	130/86	130/80	130	130	86	80	14	14
57	F	R	24	150	58	25.77	150	58	25.77	120/86	120/88	120	120	86	88	11	11
58	F	R	24	158	60	24.03	158	60	24.03	120/84	120/84	120	120	84	84	11	11
59	F	R	24	156	62	25.47	156	62	25.47	120/86	120/86	120	120	86	86	11	11
60	F	R	24	160	55	21.48	160	55	21.48	120/70	120/80	120	120	70	80	10	10
61	F	R	18	160	55	21.48	160	55	21.48	120/70	120/70	120	120	70	70	10	11
62	F	R	18	156	53	21.77	156	53	21.77	120/70	120/70	120	120	70	70	10	11
63	F	R	20	157	58	23.53	157	58	23.53	120/70	120/70	120	120	70	70	10	11
64	F	R	20	157	63	25.55	157	63	25.55	120/80	120/80	120	120	80	80	12	12
65	F	R	18	158	64	25.63	158	64	25.63	124/86	120/80	120	120	86	80	12	12
66	F	R	18	160	60	23.43	160	58	22.65	128/86	130/80	124	130	86	80	12	12
67	F	R	16	160	60	23.43	160	60	23.43	128/84	130/80	128	130	84	80	10	10
68	F	R	20	164	61	22.67	164	61	22.67	120/80	120/80	120	120	80	80	10	10
69	F	R	20	166	67	24.31	166	67	24.31	130/80	130/80	130	130	80	80	10	10
70	F	R	20	162	68	25.91	162	68	25.91	130/86	130/86	130	130	86	86	11	11
71	F	R	20	159	65	25.71	159	65	25.71	130/86	130/86	130	130	86	86	11	11
72	F	R	26	158	53	21.23	158	53	21.23	120/80	120/80	120	120	80	80	9	10
73	F	R	28	157	61	24.74	157	61	24.74	128/84	128/86	128	128	84	86	10	10
74	F	R	22	156	53	21.77	156	53	21.77	120/80	120/80	120	120	80	80	10	10
75	F	R	28	157	52	21.09	157	52	21.09	120/80	120/80	120	120	80	80	10	10
76	F	R	34	155	60	24.97	155	60	24.97	128/86	126/80	128	126	86	80	11	12
77	F	R	32	155	60	24.97	155	58	24.14	120/80	120/80	120	120	80	80	11	11
78	F	R	32	149	51	22.97	149	51	22.97	124/84	120/82	124	120	84	82	11	11
79	F	R	26	150	50	22.22	150	50	22.22	120/80	120/80	120	120	80	80	10	10
80	F	L	26	148	49	22.37	148	49	22.37	120/80	120/80	120	120	80	80	10	10
81	F	R	24	152	49	21.2	152	49	21.2	110/80	110/80	110	110	80	80	9	9

82	F	R	22	162	56	21.33	162	56	21.33	120/80	120/80	120	120	80	80	10	10
83	F	R	18	166	65	23.58	166	65	23.58	124/82	124/80	124	124	82	80	11	11
84	F	R	22	164	61	22.67	164	61	22.67	120/84	120/84	120	120	84	84	11	11
85	F	R	24	163	61	22.95	163	61	22.95	120/80	120/80	120	120	80	80	10	10
86	F	R	32	162	58	22.1	162	58	22.1	120/80	120/80	120	120	80	80	11	11
87	F	R	32	160	59	23.04	160	59	23.04	126/84	120/80	126	120	84	80	12	12
88	F	R	32	169	60	21	169	60	21	120/80	120/80	120	120	80	80	10	10
89	F	R	18	158	55	22.03	158	55	22.03	120/80	120/80	120	120	80	80	11	11
90	F	R	18	153	52	22.21	153	52	22.21	120/80	120/80	120	120	80	80	10	10
91	F	R	32	152	51	22.07	152	51	22.07	120/80	120/80	120	120	80	80	12	12
92	F	R	32	151	54	23.68	151	54	23.68	128/86	120/80	128	120	86	80	11	11
93	F	R	32	150	52	23.11	150	52	23.11	120/80	120/80	120	120	80	80	11	11
94	F	R	26	148	49	22.37	148	49	22.37	120/84	120/84	120	120	84	84	10	10
95	F	R	26	152	55	23.8	152	55	23.8	126/84	126/84	126	126	84	84	11	11
96	F	R	24	152	55	23.8	152	55	23.8	120/80	120/80	120	120	80	80	11	11
97	F	R	24	157	52	21.09	157	52	21.09	116/80	120/80	116	120	80	80	10	10
98	F	R	32	158	55	22.03	158	55	22.03	120/80	120/80	120	120	80	80	11	11
99	F	R	32	154	60	25.29	154	58	24.45	130/90	128/88	130	128	90	88	12	12
100	F	R	34	158	62	24.83	158	60	24.03	128/88	126/80	128	126	88	80	10	10

DATA OF CTS GROUP

S.no	Age	Sex	Handedness	work Hrs	BMI Pre	BMI Post	HB Pre	HB Post	BP Pre	BP Post	Functional Pre	Functional Post	SSS Pre	SSS Post	NCV Pre	NCV Post
1	38	M	R	32	26.98	26.98	15	15	130/88	130/80	1.5	1.25	1.63	1.45	54.5	59.96
2	32	M	R	32	26.92	26.92	15	15	136/88	130/80	1.5	1.25	1.63	1.45	53.22	59.24
3	34	M	R	32	25.82	25.18	14	14	134/80	130/80	1.5	1.12	1.45	1.36	56.34	62.67
4	34	M	R	32	24.22	24.22	14	14	130/84	130/80	1.5	1.12	1.45	1.27	58.1	64.78
5	34	M	R	32	25.46	24.48	14	14	130/80	130/80	1.5	1	1.45	1.27	53.11	60.6
6	38	M	R	34	21.95	21.95	14	14	128/80	128/80	1.5	1	1.45	1.27	51.12	57.98
7	29	M	R	34	26.76	26.76	16	16	130/80	130/80	1.5	1	1.45	1.27	59.45	61.75
8	28	M	R	28	25.65	25.65	15	15	128/80	130/80	1.25	1	1.63	1.27	61.12	63.42
9	36	M	R	28	22.83	22.83	14	14	128/80	130/80	1.25	1.12	1.63	1.27	60.46	64.34
10	33	M	R	28	20.98	20.98	14	14	120/80	120/80	1.5	1.12	1.63	1.27	60.78	64.56
11	38	M	R	28	21.79	21.79	14	15	120/80	120/80	1.5	1	1.63	1.27	59.34	64.34
12	37	M	R	34	27.68	27.68	14	14	130/86	130/80	1.5	1	1.63	1	49.23	54.34
13	33	M	R	34	29.75	28.37	14	14	130/80	130/80	1.5	1	1.36	1.09	55.55	62.68
14	33	M	R	32	31.16	31.16	14	14	140/96	130/90	1.5	1.12	1.36	1.09	56.12	62.56
15	35	M	R	32	26.57	26.57	14	14	130/86	130/80	1.5	1.12	1.36	1.09	58.12	65.85
16	35	M	R	32	28.01	28.01	14	14	144/94	140/90	1.5	1.12	1.36	1.09	53.31	62.12
17	36	M	R	35	28.01	28.01	15	14	144/92	140/90	1.25	1.12	1.36	1.27	49.56	54.32
18	36	M	R	34	27.68	27.68	14	14	130/86	130/80	1.25	1	1.63	1.09	53.78	60.12
19	33	F	R	24	21.48	21.48	10	11	120/70	120/70	1.5	1	1.63	1.09	59.12	59.47
20	33	F	R	24	21.77	21.77	10	11	120/70	120/70	1.5	1	1.63	1.09	60.21	66.16
21	32	F	R	24	23.53	23.53	10	11	120/70	120/70	1.5	1.12	1.63	1.09	59.67	66.54
22	32	F	R	26	25.55	25.55	12	12	120/80	120/80	1.5	1.12	1.63	1.09	59.68	65.76
23	36	F	R	26	25.63	25.63	12	12	124/86	120/80	1.5	1	1.45	1.09	59.87	64.56
24	36	F	R	34	23.43	23.43	12	12	128/86	130/80	1.5	1.12	1.45	1.27	52.32	61.12
25	35	F	R	28	23.43	22.65	10	10	128/84	130/80	1.5	1.25	1.45	1.27	59.12	66.23
26	35	F	R	34	24.97	24.97	11	12	128/86	126/80	1.25	1.12	1.36	1.09	57.34	63.38
27	29	F	R	32	24.97	24.97	11	11	120/80	120/80	1.25	1	1.36	1.09	60.56	65.45
28	30	F	R	32	22.97	22.97	11	11	124/84	120/82	1.5	1.12	1.36	1.09	56.21	63.53
29	26	F	R	26	23.58	23.58	11	11	124/82	124/80	1.5	1	1.36	1.09	60.45	62.91
30	26	F	R	32	22.1	22.1	11	11	120/80	120/80	1.5	1.12	1.45	1.09	61.23	64.21
31	36	F	R	32	23.04	23.04	12	12	126/84	120/80	1.5	1.12	1.45	1.09	57.59	63.24
32	34	F	R	32	21	21	10	10	120/80	120/80	1.5	1	1.63	1.09	56.23	63.21
33	30	F	R	32	22.07	22.07	12	12	120/80	120/80	1.5	1	1.63	1.09	57.31	64.26

34	34	F	R	32	23.68	23.68	11	11	128/86	120/80	1.5	1.12	1.36	1.27	53.62	60.12
35	34	F	R	32	23.11	23.11	11	11	120/80	120/80	1.25	1.12	1.36	1.09	55.46	63.62
36	33	F	R	32	22.03	22.03	11	11	120/80	120/80	1.5	1.25	1.63	1.09	51.46	58.18
37	36	F	R	32	25.29	24.45	12	12	130/90	128/88	1.5	1	1.63	1.09	49.52	55.46
38	34	F	R	34	24.83	24.03	10	10	128/88	126/80	1.5	1	1.63	1.27	52.34	58.94

DATA OF CVS GROUP

S.no	Age	Sex	Handedne ss	work hrs	BMI Pre	BMI Post	BP Pre	BP Post	HB Pre	HB Post	Dry eye symp Pre	Dry eye symp Post	TBUT Pre	TBUT Post	Schirmer Pre	Schirmer Post
1	38	M	R	32	26.98	26.98	130/88	130/80	15	15	9	6	3	9	7	12
2	32	M	R	32	26.92	26.92	136/88	130/80	15	15	10	8	5	9	6	12
3	34	M	R	32	25.82	25.18	134/80	130/80	14	14	10	8	4	9	5	12
4	34	M	R	32	24.22	24.22	130/84	130/80	14	14	10	8	4	9	5	13
5	34	M	R	32	25.46	24.48	130/80	130/80	14	14	10	7	5	10	6	11
6	38	M	R	32	21.95	21.95	128/80	128/80	14	14	11	7	5	11	6	12
7	29	M	R	34	26.76	26.76	130/80	130/80	16	16	11	7	4	11	5	13
8	30	M	R	24	24.5	24.5	120/80	120/80	14	14	12	11	4	10	8	13
9	32	M	R	26	26.98	26.98	140/90	130/90	14	14	12	10	5	11	7	14
10	32	M	R	26	23.25	23.25	126/80	124/80	15	15	12	9	4	10	6	15
11	33	M	R	28	23.38	23.38	130/80	130/80	14	14	11	8	5	11	8	14
12	35	M	R	24	22.03	22.03	120/80	120/80	14	14	11	8	4	10	8	14
13	39	M	R	20	24.69	23.45	120/80	120/80	14	14	11	8	3	9	7	12
14	40	M	R	24	23.87	23.87	126/86	126/80	14	14	12	7	6	11	9	15
15	37	M	R	28	24.96	24.34	128/86	126/80	14	14	12	7	7	12	7	12
16	37	M	R	29	22.59	22.59	120/80	120/80	14	14	12	7	8	13	7	14
17	36	M	R	32	22.3	22.3	120/80	120/80	14	14	12	8	8	12	8	14
18	39	M	R	28	25.63	25.63	120/80	120/80	15	15	12	8	4	10	7	14
19	32	M	R	24	24.22	24.22	130/80	128/80	14	14	10	6	3	9	8	13
20	35	M	R	24	26.7	26.7	132/84	130/80	15	15	10	6	4	10	7	15
21	35	M	R	24	26.72	26.72	134/86	130/80	14	14	10	6	5	11	6	15
22	33	M	R	34	29.75	28.37	130/80	130/80	14	14	10	6	4	10	5	12
23	33	M	R	32	31.16	29.76	140/96	130/90	14	14	10	7	4	9	4	12
24	35	M	R	32	26.57	26.57	130/86	130/80	14	14	11	7	4	9	5	13
25	32	M	R	26	25.9	25.9	120/80	120/80	14	14	11	6	7	12	4	12
26	29	M	R	26	23.8	23.8	120/86	120/86	14	14	11	5	6	11	7	12
27	31	M	R	26	22.83	22.83	128/86	120/80	14	14	11	6	4	11	6	12
28	32	M	R	26	24.97	24.97	130/84	130/80	14	14	11	6	8	12	8	12
29	34	M	R	26	25.03	25.03	130/88	130/88	14	14	12	7	7	11	7	12
30	35	M	R	32	28.01	28.01	144/94	140/90	14	14	12	7	4	10	4	11

31	36	M	R	35	28.01	28.01	144/92	140/90	15	14	12	7	5	10	5	12
32	36	M	R	34	27.68	26.64	130/86	130/80	14	14	12	7	4	10	4	10
33	34	F	R	24	25.77	25.77	120/86	120/88	11	11	12	6	6	10	6	12
34	34	F	R	24	24.03	24.03	120/84	120/84	11	11	12	6	7	11	6	12
35	35	F	R	24	25.47	25.47	120/86	120/86	11	11	13	6	6	12	8	14
36	35	F	R	26	21.48	21.48	120/70	120/80	10	10	13	6	8	11	8	12
37	32	F	R	26	21.23	21.23	120/80	120/80	9	10	12	7	6	11	7	13
38	36	F	R	28	24.74	24.74	128/84	128/86	10	10	11	6	8	11	7	12
39	36	F	R	22	21.77	21.77	120/80	120/80	10	10	11	5	6	11	6	13
40	37	F	R	28	21.09	21.09	120/80	120/80	10	10	12	5	6	10	6	13
41	35	F	R	34	24.97	24.97	128/86	126/80	11	12	13	6	4	10	4	12
42	33	F	R	32	24.97	24.14	120/80	120/80	11	11	13	6	5	11	6	12
43	33	F	R	32	22.97	22.97	124/84	120/82	11	11	12	7	3	9	3	11
44	34	F	R	26	22.22	22.22	120/80	120/80	10	10	11	8	6	10	6	15
45	34	F	L	26	22.37	22.37	120/80	120/80	10	10	11	6	8	11	6	13
46	35	F	R	24	21.2	21.2	110/80	110/80	9	9	11	7	8	12	6	12
47	35	F	R	22	21.33	21.33	120/80	120/80	10	10	10	7	7	11	7	13
48	36	F	R	22	22.67	22.67	120/84	120/84	11	11	10	6	7	11	6	14
49	32	F	R	24	22.95	22.95	120/80	120/80	10	10	13	7	6	12	6	13
50	36	F	R	32	22.1	22.1	120/80	120/80	11	11	13	8	4	10	4	12
51	36	F	R	32	23.04	23.04	126/84	120/80	12	12	13	8	5	10	4	12
52	34	F	R	32	21	21	120/80	120/80	10	10	13	8	5	10	5	11
53	35	F	R	32	22.07	22.07	120/80	120/80	12	12	13	6	7	11	5	11
54	34	F	R	32	23.68	23.68	128/86	120/80	11	11	14	8	5	10	4	11
55	34	F	R	32	23.11	23.11	120/80	120/80	11	11	12	7	5	10	4	12
56	33	F	R	26	22.37	22.37	120/84	120/84	10	10	11	7	7	11	6	13
57	32	F	R	26	23.8	23.8	126/84	126/84	11	11	11	7	6	10	6	14
58	34	F	R	24	23.8	23.8	120/80	120/80	11	11	11	6	8	12	6	14
59	35	F	R	24	21.09	21.09	116/80	120/80	10	10	10	6	8	12	7	14
60	33	F	R	32	22.03	22.03	120/80	120/80	11	11	12	6	5	10	4	15
61	36	F	R	32	25.29	24.45	130/90	128/88	12	12	12	6	4	9	4	12
62	34	F	R	34	24.83	24.03	128/88	126/80	10	10	12	6	4	10	4	12

DATA OF BOTH CTS AND CVS GROUP

s.no	Age	Sex	Handedne ss	Work Hrs	BMI Pre	BMI Post	HB Pre	HB Post	BP Pre	BP Post	MNCV Pre	MNCV Post	TBUT Pre	TBUT Post	Schirmer Pre	Schirmer Post
1	38	M	R	32	26.98	26.98	15	15	130/88	130/88	54.5	59.96	3	9	7	12
2	32	M	R	32	26.92	26.92	15	15	136/88	136/88	53.22	59.24	5	9	6	12
3	34	M	R	32	25.82	25.18	14	14	134/80	134/80	56.34	62.67	4	9	5	12
4	34	M	R	32	24.22	24.22	14	14	130/84	130/84	58.1	64.78	4	9	5	13
5	34	M	R	32	25.46	24.48	14	14	130/80	130/80	53.11	60.6	5	10	6	11
6	38	M	R	32	21.95	21.95	14	14	128/80	128/80	51.12	57.98	5	11	6	12
7	29	M	R	34	26.76	26.76	16	16	130/80	130/80	54.56	61.75	4	11	5	13
8	33	M	R	34	29.75	28.37	14	14	130/80	130/80	55.55	62.68	4	10	5	12
9	33	M	R	32	31.16	29.76	14	14	140/96	140/96	56.12	63.56	4	9	4	12
10	35	M	R	32	26.57	26.57	14	14	130/86	130/86	58.12	65.85	4	9	5	13
11	35	M	R	32	28.01	28.01	14	14	144/94	144/94	53.31	62.12	4	10	4	11
12	36	M	R	35	28.01	28.01	15	15	144/92	144/92	49.56	54.32	5	10	5	12
13	36	M	R	34	27.68	26.64	14	14	130/86	130/86	53.78	60.12	4	10	4	10
14	35	F	R	34	24.97	24.97	11	11	128/86	128/86	57.34	63.38	4	10	4	12
15	33	F	R	32	24.97	24.14	11	11	120/80	120/80	54.34	61.12	5	11	6	12
16	33	F	R	32	22.97	22.97	11	11	124/84	124/84	56.21	63.53	3	9	3	11
17	36	F	R	32	22.1	22.1	11	11	120/80	120/80	56.84	64.21	4	10	4	12
18	36	F	R	32	23.04	23.04	12	12	126/84	126/84	57.59	63.24	5	10	4	12
19	34	F	R	32	21	21	10	10	120/80	120/80	56.23	63.21	5	10	5	11
20	35	F	R	32	22.07	22.07	12	12	120/80	120/80	57.31	64.26	7	11	5	11
21	34	F	R	32	23.68	23.68	11	11	128/86	128/86	53.62	60.12	5	10	4	11
22	34	F	R	32	23.11	23.11	11	11	120/80	120/80	55.46	63.62	5	10	4	12
23	33	F	R	32	22.03	22.03	11	11	120/80	120/80	51.46	58.18	5	10	4	15
24	36	F	R	32	25.29	24.45	12	12	130/90	130/90	49.52	55.46	4	9	4	12
25	34	F	R	34	24.83	24.03	10	10	128/88	128/88	52.34	58.94	4	10	4	12