

**ANALYSIS OF PROLONGED MICROSCOPE USAGE RELATED HEALTH DISORDERS****Dr. Sapam Chingkhei Lakpa\*<sup>1</sup> and Dr. P. Karkuzhali<sup>2</sup>**<sup>1</sup>Post Graduate, Dept of Pathology, Sree Balaji Medical College & Hospital, Chennai.<sup>2</sup>Professor and HOD, Dept of Pathology, Sree Balaji Medical College & Hospital, Chennai.**\*Corresponding Author: Dr. Sapam Chingkhei Lakpa**

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**ABSTRACT**

Health personnel using microscope for longer duration can result in discomfort and injuries which may lead to disability. Work related musculoskeletal disorders (MSDs) are medical conditions affecting the muscles, nerves, tendons, ligaments, joints, cartilage or intervertebral discs. Ergonomic risk factors are most likely to cause or contribute to an MSD. Based on questionnaire study conducted on laboratory doctors and technicians, few health issues related to prolonged use of microscope was surveyed. The majority of medical personnel using traditional microscope and improper sitting posture have frequent complaints of eye pain, neck pain and headache with varying degree of severity. Use of non-ergonomic microscope and improper chair height can affect the neutral spine position. Loss of such neutral spine position may lead to MSDs over a period of time. Epiphora, eye pain, dizziness and neck pain are more frequent in ametropic respondents. Frequency of resting intervals reduces frequency of complaints as shown, in the magnitude of complaints becoming lesser in more frequent resting intervals. Use of traditional microscope and improper sitting posture frequently leads to health problems such as microscope motion sickness, headache, eye pain, neck pain, low back ache, fatigability, and in long term may lead to cervical spondylosis and other MSDs. Such problems are less frequent in users of ergonomic microscopes and those practicing proper sitting posture and interval exercise.

**KEYWORDS:** Microscope, musculoskeletal disorders, ergonomics.**INTRODUCTION**

Health personnel using microscope for longer duration can cause discomfort and injuries which may lead to disability. Work related musculoskeletal disorders (MSDs) are medical conditions affecting the muscles, nerves, tendons, ligaments, joints, cartilage or intervertebral discs at their work place due to poor ergonomics and repetitive injuries. A recent study shows a high prevalence of musculoskeletal pain among microscope operators.<sup>[1]</sup> These researchers investigated the major possible risk factors associated with the development of MSDs. Hours of microscope work, duration of work, pace, lack interval breaks and poor workstation ergonomic conditions were associated with their findings. Ergonomic risk factors are most likely to cause or contribute to an MSD. If this is ignored then in long run it may lead to health problems and disabilities. And it will further affect the productivity and efficacy of the laboratory.

MSDs may be caused or aggravated by the presence of one or any combination of the following risk factors: repetition, awkward or static postures, high forces, and contact stress. In its early years, microscope manufacturers were focused in improvements in the

optical function ignoring the ergonomics.<sup>[2]</sup> There is a unanimous conclusion from most of the studies that occupational based injuries at the workplace are common where use of microscope is prolonged and extensive.<sup>[3]</sup> Despite of development in medical equipment, there are still high incidence of MSDs among microscope users such as pathologists, microbiologists, technicians, etc.

The International Ergonomics Association defines Ergonomics as “The scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance”.<sup>[4]</sup> Ergonomics is essential, not only in work place but also in day to day activities such as driving, playing, keyboard mouse layout, TV height and orientation, kitchen table height etc.

**AIM**

The purpose of this study is to investigate the problems faced by Medical Personnel in prolong use of microscope and the potential complications.

**MATERIALS AND METHODS**

This cross-sectional survey based study was designed to investigate some health issues related to prolonged use of microscope among doctors as well as lab technicians. The study was conducted in Sree Balaji Medical College and Hospital, Chennai, and the respondents were from same college as well as few other colleges in the country, the duration of study was from July 2016 to August 2016. Questionnaire responses were collected through Google Form and printed questionnaire forms from 50 Health Personnel (doctors & lab technicians). The questionnaire form link was sent to distant doctors through email and Whatsapp and their responses were automatically updated in the Google spreadsheet. The received data was analysed using Google spreadsheet app, and reports were generated. The data arranged in Google spreadsheet was then transferred to SPSS software for analysis.

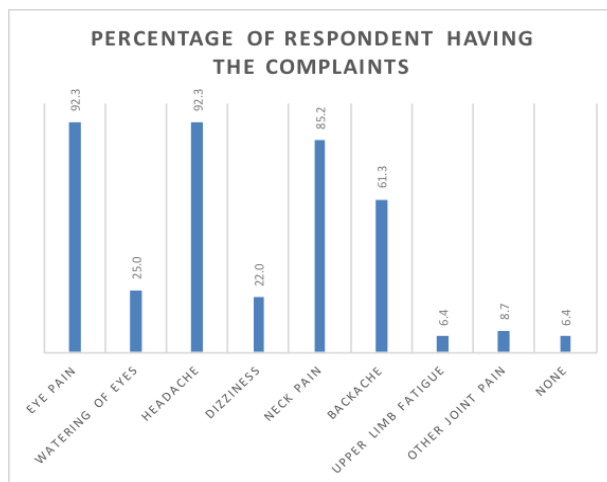
**Inclusion criteria:** Doctors and technicians in paraclinical departments who are using microscope regularly.

**Exclusion criteria:** Microscope users who joined the paraclinical departments less than 6 months. Incompletely filled forms and duplicate response forms were omitted in the study.

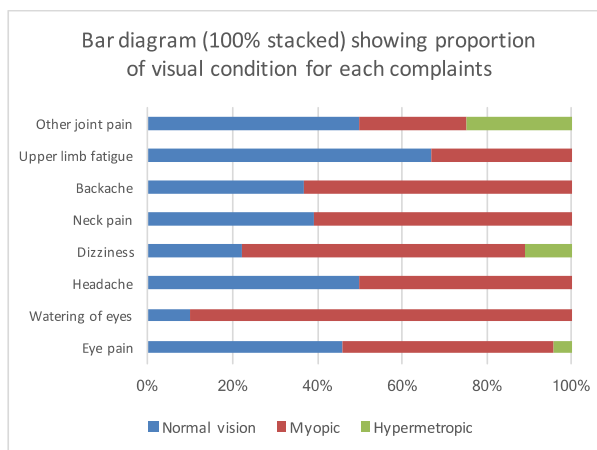
**RESULTS**

A large number of the complaints are associated with use of less ergonomic microscopes [Table 4]. Study also shows that the percentage of microscope users with adjustable chairs or chairs at proper height have less frequent complaints [Table 1]. Use of non-ergonomic microscope and improper chair height affects the neutral spine position. Loss of such neutral spine position may lead to MSDs in long run. The major problems faced by the respondents are eye pain, headache, neck pain and backache. Epiphora, eye pain, dizziness and neck pain are more frequent in ametropic respondents [Figure 2]. Frequency of resting intervals reduces frequency of complaints as shown in [Table 3]. The magnitude of complaints is lesser, in personnel practicing more frequent resting intervals [Table 5].

Though 68% of respondents, seldom or rarely use analgesics or other medications, quite a significant number of microscope operators use analgesics and other medications from time to time, which in long run may lead to its side effects. Study also shows few complications like gastritis, cervical spondylosis, migraine, frequent dizziness, frequent backache etc. which cannot be ignored as it affects the health of the microscope users and their work output. Work related MSDs has multifactorial cause, therefore one particular factor cannot explain the proportion of each complaint as given by the respondents.



**Figure 1: Bar diagram - showing percentage of respondent giving particular complaints.**



**Figure 2: Bar diagram (100% stacked) - showing proportion of visual conditions for each complaints.**

**Table 1: Chair type and frequency of complaints.**

	Rarely / Never	Occasionally	Frequently
Comfortable height	6	20	3
Inappropriate height	1	15	5

**Table 2: Visual conditions and frequency of complaints.**

	Rarely/ Never	Occasionally	Frequently
Normal vision	5	19	3
Ametropia	2	16	5

**Table 3: Frequency of interval rest and frequency of complaints relation.**

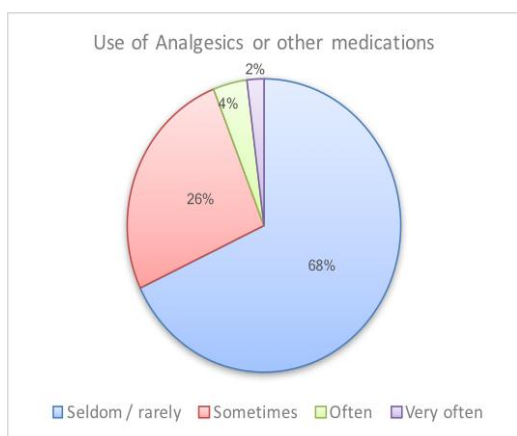
	Rarely / Never	Occasionally	Frequently
Every 15 min	4	24	2
Every 30 min	2	7	3
Every 1 hr	1	2	2
Seldom	0	2	1

**Table 4: Type of microscope and frequency of complaints relation.**

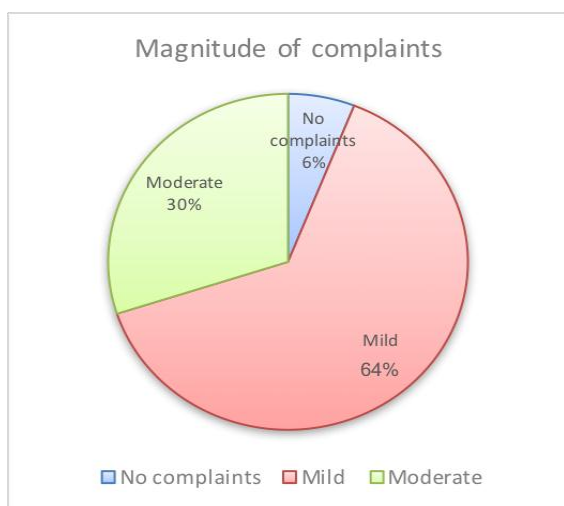
	Rarely / Never	Occasionally	Frequently
Ergonomic	2	8	1
Semi-ergonomic	2	17	1
Traditional	3	9	6

**Table 5: Frequency of interval rest and magnitude of complaints.**

	No complaints	Mild	Moderate
Every 15 min	3	22	5
Every 30 min	0	5	7
Every 1 hr	0	2	3
Seldom	0	3	0



**Figure 3: Pie diagram - showing frequency of use of medications for relieving the complaints.**



**Figure 4: Pie diagram - showing magnitude of complaints as perceived by the respondents.**

**DISCUSSION**

Musculoskeletal disorders (MSDs) affect the muscles, nerves, blood vessels, ligaments and tendons. Workers in many different industries and occupations can be exposed to risk factors, such as force, repetition,

awkward postures, static posture, quick motions, compression or contact stress, vibration etc. Exposure to these known risk factors for MSDs in the working environment where they perform routinely, increases the risk of injury to the individual. Work-related MSDs can be prevented. Ergonomics help to lessen muscle fatigue, increases productivity and reduces the number and severity of work-related MSDs. Our body is not well suited for long hours of microscope working. As there have been advancements in the quality of optics in microscopes, there have also been measures taken to improve the ergonomics of microscopes which can lessen the stress to the operator.<sup>[5]</sup> In spite of substantial advancements in technologies, usage of many of the microscopes have various Work related Musculoskeletal Disorders (WMSDs).

In a study conducted by Gopinadh A et al, it showed that majority of the participants experienced MSDs and the most common sites affected were back and neck <sup>[6]</sup>.

Florian Rudolf Fritzsche et al conducted a study amongst pathologists in Switzerland, it was found that MSDs affected more than 75% of pathologists with more than 40% having the symptoms during the last month.<sup>[7]</sup> They also concluded that increased working hours were associated with MSDs and improved ergonomic settings reduced the pain related to WMSDs.

To counter such problem arising in the microscope operators, Centres for Disease Control and Prevention (CDC) has laid guidelines regarding the permissible usage of microscope in a day to make operator comfortable on a long run.<sup>[8]</sup> The recommended time is five hours per day as shown in table 6.

**Table 6: CDC guidelines for improving microscope workstation ergonomics.**

<p>When designing the microscope workstation, one should take into account the dimensions of its potential users. Since laboratory personnel come in many different shapes and sizes, the workstation should be made as adjustable as possible. Ideally, the microscopist should be able to adjust the height of his or her chair, work surface, and microscope. The following are recommended for control of ergonomic hazards associated with the use of microscopes:</p> <ul style="list-style-type: none"> <li>• Don't use a microscope for more than 5 hours per day. Spread the use out over the entire work day, avoiding long uninterrupted periods of microscope work.</li> <li>• Try pulling the microscope toward the edge of the work surface to position the operator in a more upright posture.</li> <li>• Use a cut-out work table. This puts you close to the scope and gives an area for supporting forearms.</li> <li>• If possible, try elevating the microscope or placing it at an angle so you can look directly into the eyepiece. This can help position the operator in a more upright posture and reduce rounding of the shoulders and neck. Maintain neutral spine.</li> <li>• Provide arm rests to support the operator's forearms while using adjustment knobs.</li> <li>• Use an ergonomically designed chair that provides adequate back support, adjustable height, and adjustable seat angle.</li> <li>• Make sure there is adequate room under the work surface so the operator can pull the chair up to the ocular(s).</li> <li>• Provide footrests and discourage the use of foot rings on stools.</li> <li>• Provide sit-stand seats for areas where there is restricted leg room.</li> <li>• Encourage frequent breaks from microscopy work as well as stretching exercises (see Exercises and Stretches).</li> <li>• Use television systems where possible to eliminate the use of binocular eyepieces.</li> </ul>
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The other important precaution or practice is to maintain neutral spine position. There are three natural curves in healthy spine. The neck or cervical spine, which curves gently inward (lordosis), the mid back, or thoracic spine, which curves outward (kyphosis), The low back, or lumbar spine, which also curves inward (lordosis). A neutral spine alignment is when the pelvis is balanced between the two exaggerated anterior and posterior positions.<sup>[9]</sup> When the pelvis is in neutral, the bones at the top of the pelvis back–Posterior Superior Iliac Spine (PSIS)– and front– Anterior Superior Iliac Spine (ASIS)– are level.

The chair plays a vital role in WMSDs. In our study, we found that chair with adjustable height had lesser problems, whereas the fixed chair which are either too high or too low had more. A good habit is essential to maintain a proper posture keeping the neutral spine alignment.

Eye fatigue can be a serious issue if not managed properly.<sup>[10]</sup> This means that the optical length of the microscope should be adjusted so as to cause least discomfort for the operator's eyes.

To prevent MSDs, OSHA (Occupational Safety and Health Administration) has put forward guidelines for improving the ergonomics in laboratory microscope users.<sup>[11]</sup>

**Table 7: OSHA (Occupational Safety and Health Administration) Laboratory Safety: Ergonomics for the Prevention of Musculoskeletal Disorders.**<sup>[11]</sup>

#### Employers Should Train Workers to Avoid Ergonomic-Related Risk Factors When Using a Microscope

Workers should be encouraged to do the following when using a microscope:

- Sit close to the work surface.
- Avoid leaning on hard edges.
- Pad forearms and edges.
- Keep elbows close to their sides.
- Adjust chair, workbench, or microscope as needed to maintain an upright head position.
- Elevate, tilt or move the microscope close to the edge of the counter to avoid bending their neck.
- Use adjustable eyepieces or mount your microscope on a 30° angle stand for easier viewing.
- Keep scopes repaired and clean.
- Spread microscope work throughout the day and share it with several people, if possible.
- Take short breaks. Every 15 minutes, close the eyes or focus on something in the distance. Every 30-60 minutes, get up to stretch and move.

Recently there has been a lot of advancement in Telepathology in terms of speed, quality, interface, AI algorithms, availability and costs. There are chiefly two modalities of telepathology viz. Realtime telepathology

imaging system (RTIS, which is robotic) and Static image (store and forward, Whole Slide Imaging). Digital pathology, which is overlapping with Telepathology, has broader application. Whole Slide Imaging (WSI) is an important modality of Digital Pathology where image of the whole slide is scanned and stored for further use. Such data can be used for analysis or reporting slides, academic and research purposes, archiving, Static Image Telepathology etc. This technology creates a room for developing suitable and ergonomical form of microscopy to support high through put without stressing the health of the doctors or technicians. Digital pathology has the potential to take over majority of work load in this field, thus improving the output as well as minimizing the work related MSDs. Earlier, the technology was limited with image quality, storage, processing, its availability and most importantly the cost. In last one decade, there has been increased use of Digital pathology and many pathologists have adopted this for routine purposes, every year the cost of hardware is reducing thus making it more affordable.

Interestingly, some studies have shown that psychological factors can be contributory factors in work related musculoskeletal disorders (WMSDs).<sup>[12]</sup>

Since MSDs have slow onset, it is usually overlooked. Care should be taken as it has sustained deleterious effects affecting productivity, comfort at working environment and most importantly the health of the user. One should be aware of the few early signs of WMSDs such as early fatigue, less concentration, muscle stiffness.

#### CONCLUSION

Use of traditional microscope and improper sitting posture frequently leads to health problems such as microscope motion sickness, headache, eye pain, neck pain, low back ache, fatigability, and in long term may lead to cervical spondylosis and other MSDs. Such problems are less frequent in users of ergonomic microscopes and those practicing proper sitting posture and interval exercises. Following the guidelines laid by CDC and OSHA will significantly reduce the MSD problems associated with microscope use. In the work place, the colleagues can help each by correcting the posture and pointing out any potential factor that could lead to MSDs. Such habit could be mutually beneficial and it should be encouraged to others to do the same. The monitoring body should permit only ergonomic microscope to be used in laboratory. Digital pathology or telepathology is the new trend with lot of potential especially WSI. Besides good ergonomics, digital pathology provides the ease of sharing, collaborative study, archiving and it opens up spectrum of possibilities in teaching and research.



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