

Ergonomic Microscope: Need of the Hour

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ABSTRACT

Background: Prolonged use of conventional microscope develops musculo-skeletal injuries like chronic pain syndrome, including shoulder, neck, back aches & fatigue. Since the problems go unnoticed, the injuries can lead to some serious permanent damages. This further leads to a compromise in the health and welfare of the person and the institute. Hence, an understanding about the ergonomics is the need of the hour in this postmodern era. In spite of few studies and surveys about ergonomics, there is still a steep rise in the musculoskeletal disorders.

Aim of the Study: The aim of our study was to gauge the general awareness of pathologists, microbiologists and oral pathologists towards ergonomics in their profession.

Materials and Methods: A cross-sectional survey based study was designed, which included a questionnaire. The questionnaire included multiple choice questions with four alternatives. Professionals (pathologists, microbiologists and oral pathologists)

were included in the survey. Teaching faculty (Professors, Associate Professors and Lecturers) and Post graduate students formed the study group.

Results and Observations: The response to the questionnaire was 100%. Less than 50% of oral pathologists were aware of the importance of ergonomics in their profession. The most common site affected was neck and back. One of the drastic observations was that, Oral Pathologists suffered from a combination of problems affecting neck, back, eyes, headache, shoulders, arms and wrists.

Conclusion: Increase in our understanding regarding ergonomically designed microscopes can increase our efficiency and in turn improve our general well-being. With improvements in ergonomics, professionals would be able to modify and optimize their working conditions. Certain guidelines need to be followed by the professionals to reduce chances of musculoskeletal disorders.

Keywords: Conventional microscope, CDC guidelines, Occupational injury, OSHA, Neutral spine, Work-related musculoskeletal disorder

INTRODUCTION

The International Ergonomics Association defines Ergonomics (or human factors) 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" [1]. A correct posture in dentistry is extremely important for the good health of the professional. In current times due to increased workload to professionals including Oral Pathologists, Musculoskeletal Disorders (MSDs) are on a high rise. According to "Occupational Health Clinics for Ontario Workers" MSDs are injuries and disorders of the musculoskeletal system. The musculoskeletal system includes muscles, tendons, tendon sheathes, nerves, bursa, blood vessels, joints/spinal discs, and ligaments [2]. 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 have excelled in their competence to make improvements in the optical function ignoring the comfort of the user [3]. Though prolonged usage of microscopes have been implicated to various deleterious effects, there is still lack of understanding of role of ergonomics in the field of pathologists and microbiologists [4].

In the past, few studies have been planned and executed to recognize microscope issues related to ergonomics for professionals with different body heights. There is a unanimous conclusion from most of the studies that occupational-based injuries at the workplace are common where use of microscope is extensive [5]. In our study, an attempt was made to identify the awareness levels of oral pathologists, general pathologists and microbiologists towards

ergonomics. To our knowledge there are very few studies done in this respect.

MATERIALS AND METHODS

The study comprised of cross-sectional survey approved by Research Advisory Committee of People's Dental Academy, Bhopal in the year 2014. The participants constituted professionals from the field of General Pathology, Microbiology and Oral Pathology in Bhopal. There were in all 132 participants. The participants included were Professors, Associate professors, Lecturers and Post Graduate students from the above mentioned departments. No under-graduate student was included in the survey. An informed consent was obtained from the participants. A structured closed ended questionnaire was designed for the survey [Table/Fig-1]. The questionnaire was in the form of multiple choice questions. The questions were designed in a way which would be simple to understand and answer. The questionnaire had demographic details (such as age, gender and profession) in the first segment. The next segment consisted of questions pertaining to knowledge, attitude regarding ergonomics and Musculoskeletal disorders. There was no kind of identification on the questionnaire, maintaining complete anonymity. The questions were aimed to gauge the awareness of the participants towards the importance of ergonomics in the use of microscopes. Questions such as knowledge of ergonomics, its importance were asked to the participants to know the awareness levels. The participants were asked to give a positive response regarding sites affected like back pain, neck pain, etc if they were more than a year old. The data recorded was subjected to statistical analysis (chi-square test).

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This questionnaire based study is a survey to assess awareness related to occupational risks of musculoskeletal disorders among microscope users.

(Please tick the suitable answer)

Age: 20-30yrs/30-40yrs/>40yrs

Gender: Male/female

Profession: pathology/microbiology/postgraduates

1. Have you heard about the term Ergonomics?
 - a) Yes
 - b) No
2. Does Ergonomics have any significance in medical /Dental profession?
 - a) Yes
 - b) No
3. Does Ergonomics have any significance in Pathology & Microbiology profession?
 - a) Yes
 - b) No
4. Which type of microscope do you prefer?
 - a) Monocular Microscope
 - b) Binocular microscope
 - c) Trinocular microscope with attached computer
 - d) Not specific
5. What kind of chair you preferably use while viewing microscope?
 - a) Chair with lower back support
 - b) chair with adjustable height
 - c) Both a and b
 - d) any chair is comfortable
6. Have you personally experienced any muscle or joint pain as a result of microscope usage?
 - a) Yes
 - b) No
7. If answer to previous question is 'yes' please specify the site?
 - a) Neck/ Back (total)
 - b) eye strain / headache
 - c) Shoulder, arms and wrist
 - d) All of above
8. Have you opted for any physiotherapy/medical treatment for back related problems.
 - a) Yes
 - b) No
9. Which is your most favorable posture while using microscope?
 - a) Neutral Spinal Posture
 - b) Lean forward towards eyepieces
 - c) Towards the Chair
 - d) None of the above
10. Which of the below term correctly depicts the abbreviation "MSD"?
 - a) Musculo-skeletal disorder
 - b) Mental structural disability
 - c) Myo-skeletal disorder
 - d) Mechanical stimulative disorder
11. Have you heard of other terms for MSD?
 - a) Cumulative trauma disorder
 - b) Over use syndrome
 - c) Repetitive stress injury
 - d) All of the above
12. Which is the most common site affected you feel due to long term microscope uses?
 - a) Neck/Back
 - b) Eye strain/Headache
 - c) Shoulder, arms and wrist
 - d) All of above
13. Which muscle is affected due to improper posture during microscope usage?
 - a) Sternocleidomastoid
 - b) Trapezius
 - c) Levator Scapulae
 - d) All of the above
14. Most common pathophysiologic mechanism of MSD?
 - a) Repetitive mechanical stress
 - b) Microischemia & accumulation of metabolites
 - c) Both a & b
 - d) None of above
15. Which of the following factors can lead to posture related muscle problems?
 - a) Repetitive movement
 - b) Insufficient Exercise
 - c) Prolonged sitting
 - d) All of the above
16. CDC (Center for disease Control and Prevention) has given some guidelines for duration for usage of microscope per day. Any idea of the maximum usage /day
 - a) 10 hours
 - b) 7 hours
 - c) 5 hours
 - d) 12 hours
17. Probable methods of precautions you recommend to avoid muscles injury due to prolonged usage of microscope?
 - a) Frequent breaks
 - b) Stretching exercises
 - c) Use of tilting & telescopic eyepiece
 - d) All of the above

Your answers will be treated as strictly confidential

THANK YOU FOR YOUR COOPERATION

[Table/Fig-1]: Questionnaire

RESULTS AND OBSERVATIONS

All the 132 professionals responded to questionnaire. Out of the total 132, 80 were males and 52 were females [Table/Fig-2]. Total number of General pathologists, Microbiologists and Oral Pathologists were 53, 37 and 42 respectively. Most of the respondents were of the age between 20 years and 40 years. On assessing general awareness regarding ergonomics, it was observed that around 50% of the participants were aware of ergonomics and almost the same number of people was aware of its significance [Table/Fig-3]. The results showed that the general pathologists were well informed about ergonomics and its importance in their professional

life. It was noted that by far the most common site affected due to long term use of microscope was neck and back followed by eyes, shoulders and arms & wrists by majority of the participants [Table/Fig-4]. Binocular microscopes were the most preferred type. The respondents were aware of neutral spine position and accordingly most of them preferred this posture compared to others [Table/Fig-5].

DISCUSSION

Ergonomics can be defined as 'an applied science concerned with designing and arranging thing people use so that the people and

Age	Gender		Total	Chi-Square Value	p-value
	Males	Females			
20-30 Y	30	29	59	4.289	0.117
30-40 Y	38	17	55		
>40 Y	12	6	18		
TOTAL	80	52	132		

[Table/Fig-2]: Distribution of respondents in age groups, gender

complained of combination of problems affecting neck, back, eyes, headache, shoulders, arms and wrists. This percentage was very high compared to General pathologists (1.9%) and Microbiologists (5.4%). The problems of general pathologists were concentrated on back and shoulders. This may be due to the fact that inspite of initial problems of eye and neck in Oral Pathologists, they may not be seeking medical treatment, leading to worsening of the symptoms. According to a study carried out in Switzerland, prevalence of

Response		General Pathologist N (%)	Microbiologist N (%)	Oral Pathologist N (%)	Chi-Square Value	p-value
Heard Of Ergonomics	YES	30 (56.6 %)	20 (54.1%)	16 (38.1%)	3.549	0.170
	NO	23 (43.6%)	17 (45.9%)	26 (61.9%)		
Significance In Pathology & Microbiology	YES	29 (54.7%)	19 (51.4%)	16 (38.1%)	2.761	0.251
	NO	24 (45.3%)	18 (48.6%)	26 (61.9%)		

[Table/Fig-3]: Awareness & significance of ergonomics

Response		General Pathologist N (%)	Microbiologist N (%)	Oral Pathologist N (%)	Chi-square value	p-value
Most Common Site Affected Due To Long Term Microscope Use	Neck/Back	36 (67.9%)	26 (70.3%)	14 (33.3%)	28.221	0.001
	Eye Strain/Headache	11 (20.8%)	5 (13.5%)	6 (14.3%)		
	Shoulder/Arms and Wrist	5 (9.4%)	4 (10.8%)	9 (21.4%)		
	All of Above	1 (1.9%)	2 (5.4%)	13 (31.0%)		
CDC Guidelines For Microscope Usage Per Day	10 h	5 (9.4%)	4 (10.8%)	7 (16.7%)	6.397	0.380
	7 h	15 (28.3%)	12 (32.4%)	11 (26.2%)		
	5 h	33 (62.3%)	18 (48.6%)	21 (50.0%)		
	12 h	0	3 (8.1%)	3 (7.1%)		

[Table/Fig-4]: Side-Effects due to prolonged usage of microscopes. CDC Guidelines

Response		General Pathologist N (%)	Microbiologist N (%)	Oral Pathologist N (%)	Chi-square value	p-value
Type of Microscope	Monocular	3 (5.7%)	3 (8.1%)	22 (52.4%)	38.732	0.0001
	Bionocular	42 (79.2%)	28 (75.7%)	20 (47.6%)		
	Trinocular	5 (9.4%)	4 (10.8%)	0		
	Not Specific	3 (5.7%)	2 (5.4%)	0		
Most Favorable Posture For Using Microscope	Neutral Spinal	34 (64.2%)	20 (54.1%)	25 (59.5%)	2.534	0.865
	Lean Forward Towards Eyepiece	11 (20.8%)	9 (24.3%)	9 (21.4%)		
	Towards Chair	6 (11.3%)	7 (18.9%)	5 (11.9%)		
	None	2 (3.8%)	1 (2.7%)	3 (7.1%)		

[Table/Fig-5]: Type of Microscope used & Favorable position for using microscope

things interact most efficiently and safely' [6]. Our body is not well suited for long hours of microscope working. As there have been advancements in the quality of visualization of tissue specimens by microscopes, there have also been steps taken to improve the workability of microscopes which can be less stressful for the operator [7]. In spite of this, pathologists and microbiologists have various Work related Musculoskeletal Disorders (WMSDs). The various MSDs caused due to conventional microscopes inspired us to conduct a survey to know if the professionals were well-aware of ergonomics. To our surprise, professionals although related to health profession, did not know the deleterious effects of traditional usage of microscopes. The results showed that 34.1% of Oral pathologists were aware about importance of ergonomics compared to 54.7% of General Pathologists. WMDS affect head and neck regions. Our study also has shown similar results. 33.3% of Oral Pathologists experienced neck and back problems as compared to 67.9% and 70.3% General Pathologists and Microbiologists. Gopinadh A et al., in their study showed that 73.9% of the participants experienced MSDs and the most common sites affected were back and neck [8]. Jain G and Shetty P observed that 62% of the participants were affected by MSDs [9]. In our study we found that General Pathologists and Microbiologists had similar results. Selective shoulder, arms and/or wrists problems were more frequent in Oral Pathologists. An important observation was that the Oral Pathologists (31%)

MSDs is common among pathologists. This was in accordance to our study. They concluded that while; increased working hours were positively associated with MSDs, and other factors such as working time at microscopes or ergonomic workplace settings were not. These findings may be due to the fact that ergonomic settings may have been made in the presence of already affected professionals. Also, there was relief in their pain when they shifted from conventional to ergonomic settings. In our study, we found that chair with lower back support or with adjustable heights were preferred for viewing. Despite this preference, still the participants had WMDS which may be because other working conditions like neutral position and working hours were not followed by them [10]. Our results showed that nearly 50% of the subjects were aware about the (Centres for Disease Control and Prevention) CDC guidelines regarding the permissible usage of microscope in a day to be comfortable to the operator on a long run. The recommended time is five hours per day. The key to good health is to maintain neutral spine position. In a study by Haile EL et al., only 5 out of 25 employees (20%) used the microscope in the neutral neck, shoulder and back postures. Most of the microscopes did not have arm support. In our study we found that 64.2% General Pathologists, 54.1% Microbiologists and 59.5% Oral Pathologists preferred neutral spine position [11]. The reason was this variation may be probably because the survey was carried out in a teaching institute and there was certain level of training and continuing teaching programs. There are 3 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 [12,13]. 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 used for such purposes play a vital role. A good exercise is to make a conscious effort to maintain a proper posture. Another way is to ask colleagues to check is the operator's posture is correct. The microscopes should be designed in such a way that the arms and wrists of the operator do not strain easily. Eye fatigue can be a serious issue if not addressed properly [14,15]. This means that the optical length of the microscope should be adjusted so as to cause least discomfort for the operator's eyes. According to Sundaragiri KS et al., neutral erect posture can be obtained if certain modifications are incorporated in the designing of microscopes. These include having an optical path (distance from the ocular lenses to the specimen being viewed) ranging between 45 to 55 cms. Also another consideration should be the angle of the eyepieces which should not go beyond 30° above the horizontal plane [16]. There may be few early signs of WMSDs such as early fatigue, less concentration, muscle stiffness. To standardize microscopes which are ergonomically designed few guidelines given by OSHA (Occupational Safety and Health Administration) {Laboratory Safety: Ergonomics for the Prevention of Musculoskeletal Disorders Fact Sheet} [17] should be followed [Table/Fig-6].

1	Sit close to the work surface.
2	Avoid leaning on hard edges.
3	Pad forearms and edges.
4	Keep elbows close to their sides.
5	Adjust chair/workbench/microscope for upright head position.
6	Elevate, tilt or move the microscope to avoid bending neck.
7	Use adjustable eyepieces or mount your microscope on a 30° angle stand for easier viewing.
8	Keep scopes repaired and clean.
9	Spread microscope work throughout the day and share it with several people, if possible.
10	Take short breaks. Every 15 min, close the eyes or focus on something in the distance. Every 30-60 min, get up to stretch and move.

[Table/Fig-6]: Laboratory Safety: Ergonomics for the Prevention of Musculoskeletal Disorders Fact Sheet (OSHA FS-3462-2011) [17]

Some authors have advocated that psychological factors can be contributing towards work related musculoskeletal disorders [18].

We are of the opinion that the working environment should be conducive for constructive work. The Reporting rooms in the Pathologists' working place should be designed in a way that all the things are easily accessible to the operator. Microscope can be connected to a monitor which may be as large as desired. With a competitive market, the operator can have the monitors from the best of the brands. This system not only can reduce eye strain and back strain, but also can have reproducible results.

We also take this opportunity to urge the institutes/organisations to have more and more continuing education programmes, so

as to educate professionals regarding ergonomically designed microscopes and work related musculoskeletal disorders which will in turn increase the efficiency of the operators. It has to be borne in mind that disorders caused by conventional microscopes are likely to have slow but sustained deleterious effects.

CONCLUSION

The adverse effects of using conventional microscopes have received less attention which has lead to various problems related to occupation. A new approach aimed at improving the workability of the professionals has to be adopted. We, through our study, wish to enlighten the readers and all those involved in our profession that WMSDs are like slow poison and hence precautions must be taken in order to prevent them.

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