

Health hazards and safety measures in Orthopaedic Surgery

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ABSTRACT

Orthopaedic surgeons face higher occupational risks (due to noise, radiation, chemicals, blood borne pathogen etc.) than other medical and surgical specialists. We can avoid these by following evolving guidelines and take basic preventive measures. In cases where sharps are used, hands-free technique is recommended. Surgeons should be cautioned against noises generated by drills (mean 90 dB), trapped suction tip "whistles" in tissue (up to 96 dB) etc., by updating equipment's, change from pneumatic to battery powered tools, regular hearing tests and hearing protection. Effects of radiation exposure in procedures requiring C Arm fluoroscope lead to dermatitis, skin cancer, bone marrow suppression, thyroid gland changes, cataract, congenital defects in the employee's offspring, cardiovascular risk etc. Radiation can be minimized by using ALARA principles, lead apron, use of the mini c-arm in case of small body parts and by avoiding horizontal fluoroscopy whenever possible. Radiation at 18 inches from primary beam was only 0.1%. Arthroscopic surgery allows only fewer degrees of freedom in movement, leading to higher muscle effort these can be minimized by following Principles of ergonomics e.g., standing posture that allows the body frequent position changes, short breaks for stretching. There is established guidelines for "Resident Surgeon Work Duty Hours" to avoid burnout and stresses due to loaded shifts. Conclusion: The importance of ensuring early awareness and education about health hazards and safety practices in orthopaedic surgery alongside prompt intervention is duly emphasized.

Keywords: Health hazards; occupational risks, orthopedic procedures; radiation

INTRODUCTION

Occupational health encompasses all aspects of health and safety in the workplace and focuses towards primary prevention of risks. Occupational hazards are any condition of a job that can result in illness or injury. WHO classified health hazards into seven different groups as biological (e.g.-needle stick, hepatitis, HIV), chemicals (e.g.-PMMA, bovie smoke), physical (noise, radiation), ergonomic (e.g.-posture), psychosocial (Stress, violence), fire and explosion and contact with electricity. Healthcare workers encounter many hazards in addition to the usual workplace related activities.^(1,2) Governments and organizations continue to neglect Healthcare work environment in spite of knowing the

occupational risks.⁽³⁾ Aims of this study is to quantify the behavior among orthopedic surgeon regarding using safety measures, to ensure awareness of health and safety practices, and to know measures of decreasing health hazards.

Materials and method:

This study is based battery of questionnaire asked to fifty orthopaedic surgeons having more than 8 year of experience and working in different centers of Bihar. We also reviewed the literature published in the past to know where we and health system of our state stand.

Result: based on Questionnaire:**Table I: Biological**

Parameters/Questions	%	Remarks
a) Early reporting of needle stick injury	None	This question is irrelevant to most (80%) as they were not sure about where to report these injuries. Therefore only 10 out of fifty (20%) participants able to answer this.
b) Know where to report work related injury.	20%	
c) Changing outer gloves if operation time is more than one hour.	22%	13 out of 50 surgeons use only one pair of gloves in most of the orthopaedic surgery. Therefore, we found only 37 answers as relevant out of which only 11 surgeons have habit of changing outer glove.
d) Habit of hands-free technique while using sharp objects.	76%	
e) Status of Immunization of Hepatitis B vaccine	94%	Most of the surgeon immunized or having a booster dose within last five years although no one tend to check serum antibodies against hepatitis B.
f) Awareness of availability of post exposure prophylaxis	38%	All 19 positive response came from those working in multispecialty hospital(41 out of 50)

Table II: Chemical

Parameters/Questions	%	Remarks
a) Using suction for surgical smoke ideally	18%	We consider ideal or appropriate suction when the orthopaedic surgeon use suction tip at approximately 5cm distance and felt that it worked really well.

Table III: Physical: Noise

Parameters/Questions	%	Remarks
a) Updating equipment used in operation theater at regular interval	62%	We consider regular check of battery powered tools, tourniquets, orthopaedic instruments etc. at interval of six month or less as appropriate.
b) Using hearing protection in operation theater	0%	Although most of them know about it but not never think to use ear protection
c) Prefer using battery powered over pneumatic tools	46%	
d) Regular hearing tests for employees	0%	

Table IV:Physical: Radiation

Parameters/Questions	%	Remarks
a) Use of Lead Apron	92%	(decreases radiation dose by 1/ 4 in lateral & 1/16 in PA views)
b) Lead Goggles	02%	(decreases radiation dose by 1/ 30)
c) Thyroid Guard	30%	(decreases radiation dose by 1/ 2.5)
d) Using personnel dosimeter	0%	
e) Have trained technician for using c arm	42%	
f) Habit to store lead apron safely after use.	8%	Most of them don't know how to store lead apron appropriately. Using a defective lead apron do more harm than good because of a false sense of security.
g) Know well about radiation hazards and safety guidelines	36%	
h) Expressed great	92%	

concern of radiation		
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Table V: Ergonomic

Parameters/Questions	%	Remarks
a) Taking short breaks/stretching in between arthroscopic/ minimally invasive/ prolonged surgery.	0%	Most (66%) of them don't know about ergonomic guidelines
b) Doing yoga relaxation exercise on regular basis	20%	
c) Musculoskeletal problem/pain	54%	
d) Low back ache	32%	It is most common site of musculoskeletal pain.

Table VI: Psychosocial

Parameters/Questions	%	Remarks
a) Have adequate protection against violence at workplace	14%	
b) Have sound sleep	88%	We consider sleep as sound if it was continuous and for at least more than 6 hours without any disturbance
c) Have access to employee social support program	0%	42% of them don't know that something like this program also exists in our health system

Discussion

Biological hazards: blood borne infection

Most of the surgeon (80%) working in government setup are not aware about where to report work related injury. Hasak et al in his study showed thirty-three percent of injured personnel had at least one unreported injury, in our study twenty percent of surgeon have work related injury sustained in operation theatre due to sharp instruments and needle

stick.⁽⁴⁾ 94% of them included in the study group were vaccinated against Hepatitis B and take extra precautions while operating a seropositive case. 22% of them have habit of changing outer gloves if operative time was more than one hour(approx.). 38% of them are sure about availability of post exposure prophylaxis. All of them know about hands-free technique as a safety measure to decrease the incidence of these injuries while 76% of them developed the habit of this technique while using a

sharp object. More than half of the them(62%) keep the instruments at check used in operation theater at regular interval (every 6 months or less than that).

Chemical hazards: Surgical smoke

Surgical smoke contains both bacteria, viruses, more than 80 different chemicals including formaldehyde (irritant and carcinogen), acetaldehyde (carcinogen), benzene (carcinogen), toluene (respiratory, eye irritant, and neurotoxin).^(5,6) The US National Institute for Occupational Safety and Health(NIOSH) recommends a specialized device designed to remove and filter smoke from the operative field; which should be kept at approximately 5 cm from the source.⁽⁷⁾ In our study all of them know about using suction for surgical smoke. Although very few (18%) use it ideally and near effectively by keeping the suction device near to source of smoke(as guided by NIOSH).

Physical hazards: Noise and radiation

Noise in the operation theatre is also considered as physical hazard as it can cause hearing loss. Willett and colleagues⁽⁸⁾ reported that long-term exposure to power instruments showed some deafness in 50% of orthopedic personnel. Siverdeen et al. Recommended exposure limit (REL) according to NIOSH for occupational noise exposure is 85 decibels for average 8 hours per day. (85 dBA as an 8 hr. TWA/time weighted average).⁽⁹⁾ Exposures at and above this level are considered hazardous. In our study, none of them use hearing protection in Operation Theater and not even undergo regular hearing tests for employees. All of them use battery powered tools if supplied with implant personnel but only half(46%) of them owned these.

Radiation due to fluoroscopy has both somatic and genetic effect.^(10,11,12) It may cause minor somatic effect like erythema of exposed skin to major issues like malignancy of skin, brain, thyroid, bone marrow suppression, aging by shortening of telomere length, hypertension by causing thickening of carotid intima media etc.⁽¹³⁾ in our study, three participants reported redness of dominant hand and seven of them reported

most of them suffered post radiation headache occasionally. Genetic effect like increase in infertility as well as congenital diseases among offspring of health workers are not uncommon. In our study two (4%) of the participants visited infertility clinic in past. Although they are not sure about cause of infertility but correlating radiation as a cause. It is scientifically proven that radiation as well as stress at workplace due to loaded shifts etc are major cause of these problems. Although these can also be due to increasing age of marriage and unemployment related stress.

We should also make ourselves aware about the safe limit of maximum dose of radiation for our body. although there is no guideline from our country so we should rely on united states as well as European guidelines which says < 50 msv/year and <20 msv/year respectively.^(14,26) We should follow ALARA (As Little as Reasonably Achievable)⁽¹⁵⁾ and DEBT (distance, exposure, barriers, and time) concepts to reduce the dose external radiation.^(16,17,18,19,20) To reduce internal radiation, maintaining hygiene to control contamination and using personal protective equipment (PPE). We should try to use less fluoroscopy images in pulse mode while doing interlock nailing as well as internal fixation, which can be possible by improvising our surgical technique for less dependency on c-arm. PPE accentuate most of the radiation e.g., 90 to 99 % by Leaded gowns⁽²¹⁾, 30%-70% by leaded glasses.^(22,23) 90% by thyroid gland shields,⁽²¹⁾ 7% to 50% by that radioprotective gloves⁽²⁴⁾. Although radioprotective gloves are not recommended as it may cause more harm than good, because it can give a false sense of security.⁽²⁴⁾ In this study most of the orthopaedic surgeon use lead apron on regular basis (96%) while using fluoroscopy. Only one (2%) out of fifty use lead goggles, and one third of them, (30%) use thyroid guard. None of them are using personnel dosimeter. Although very few of them(8%) have habit of storing PPE safely after use.



Fig.1: Improper storage of lead apron after use

Fan et al concluded in his study that inadequate radiation knowledge tends to induce more radiation concerns associated with higher psychological distress in orthopedic surgeons.⁽²⁵⁾ Adequately trained operator and regular orientation programme are few important interventions which every institutional administration should have. In our study, 42% participants have trained technician for using C-arm. In this study only 36% of participants knew well about radiation safety and hazards but 92% expressed great concern of radiation which is comparable to 43.23% (115/266) and 78.20% (208/266) respectively in study done by Fan et al.⁽²⁵⁾

Ergonomic and psychosocial hazards

Ergonomy is the science of fitting the job to the worker and practice of designing equipment and work tasks to match the capability of the worker.⁽²⁶⁾ Maintaining static positions for long periods of time during prolong surgeries and operating in nonergonomic positions can create more physical stress results in rapid fatigue, muscle pain, and cramping, and strain that can persist even after the operation is complete.^(27,28) To prevent these injuries, orthopaedic surgeons must operate in its most neutral position with more ergonomic instruments. Although

differences in hand size have been well understood, surgical instruments are still being produced “one size fits all.” Ideally, they should be improved for ergonomic ease.⁽²⁸⁾ In our study no one developed a habit to take short breaks for stretching while performing arthroscopic or prolonged surgery although most of us aware about the fact that these simple measures prevent musculoskeletal problem significantly.

Burnout at workplace is not uncommon. It includes emotional exhaustion, depersonalization and loss of personal accomplishment. Its manifestations are psychological, emotional and also physical.⁽²⁹⁾ Hui et al performed a systematic review using 14 papers were selected and identified various risk factors and protective factors associated with burnout although not able to extract uniform rate of burnout among orthopaedic surgeons of different centers, different seniority. key determinants of burnout in orthopaedics as well as other specialties include personal (e.g., irritable behavior during operation), family, working environment and career factors.⁽³⁰⁾ Burnout affects the healthcare sector, especially surgeons with a mean of 40% rate in a study done by Clinique les Lauriers.⁽²⁹⁾ In our study, 20% participants use to reduce stress by doing yoga or other relaxation exercise on regular basis. Most of them(88%) use to have sound sleep more than 6 hours.

Panagioti et al in a meta-analysis addressed effect of intervention to reduce stress and burnout, and concluded the benefits with employee social support program(ESSP).⁽³¹⁾ In western world ESSP is in practice to solve these issues. In our study, it is found that ESSP is not in practice in Bihar. Violence is other major concern increased by changing human behavior and media involvement in health sectors. Rarely participants have access to adequate protection against violence at workplace(14%).

Conclusion:

Orthopaedic surgeons are at risk of many issues related to their health which can be prevented by educating them, making them aware and by avoiding certain risk-taking behavior. It can be done by change and enforce rules and procedures. Stress related issues can be minimizing by rotating work that are physically tiring and maintaining a clutter-free environment at workplace. We need to

encourage them by early reporting of injuries and clutter-free environment at workplace

Controversies, limitations and future trend:

Considering whole bunch of occupational health hazards, we are lacking in many parameters in this study. Few parameters in questionnaire have not simple straight answers. Controversial answers like few of the surgeon wear thyroid lead guard occasionally. Therefore, we consider the answer as yes only if someone used it in more than 50% of fluoroscopy guided orthopaedic surgery. Being a cross sectional study done on only fifty orthopaedic surgeon including more working in urban (82%) than rural health setups. Participants required to recall past memory to answer most of the questions. Thus, the result could have recall bias and limit generalizability to rural health facilities. A prospective and predominantly observational study including large number of surgeons with uniform selection of urban as well as rural health sectors in India will control most of these limitations. Few studies stressed upon importance of early awareness and education as a preventive measure to reduce these hazards.⁽³²⁾ Nevertheless, this study provides useful information to make orthopaedic surgeons and health workers aware about occupational health risks and safety measures.

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