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Original Research Article

Work Related Musculoskeletal Disorders in Surgeons Performing Minimal Invasive Procedures in Mumbai & Navi Mumbai India

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ABSTRACT

Work-related musculoskeletal disorders (WRMSDs) are a group of disorders that are caused by occupational risk factors. The physical and cognitive requirements during surgery pose substantial ergonomic stress. The aim of this study was to find out the prevalence of WRMSD's in surgeons performing minimally invasive procedures in Mumbai & Navi Mumbai. Seventy five surgeons responded to the questionnaire. According to the results, 86% of the participating surgeons reported that they suffered from musculoskeletal problems which they attributed to the ergonomic issues encountered during surgery of which65 % surgeons experienced more than one site pain. The prevalence of pain was highest in low back (49.3%) followed by the other regions like neck, knee, shoulder, elbow, wrist and hand. The most commonly reported factors to which they attributed the pain and discomfort during surgery were awkward & sustained postures, prolonged standing & work place ergonomics. 45% surgeons informed that they were aware of ergonomic recommendations. Surgeons were of the opinion that adopting good postures, better surgical equipment, rest, stretching and ergonomic workstations can reduce their symptoms.

Key Words: surgeons, WRMSDs, minimally invasive surgery

INTRODUCTION

Musculoskeletal disorders (MSD) are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs. Work-related musculoskeletal disorders (WMSD or WRMSDs) are conditions in which:

1. The work environment and performance of work contribute significantly to the condition; and/or
2. The condition is made worse or persists longer due to work conditions. [1]

Work-related musculoskeletal disorders (WRMSDs) are a major concern all over the world, with many organisations working towards maintaining a safe & healthy workplace environment. The end outcome of these safeguard measures is optimization of productivity. Work-related musculoskeletal disorders have been extensively studied in populations where the risk is determined to be high. These include factory workers, farm labourers and those performing heavy manual loading on one

hand and those engaged in repetitive work in a sedentary desk job on the other. In the health care scenario sinologists, [2, 3] dentists, [4, 5] nurses [6,7] and surgeons [8, 9] have too received substantial attention. However, there is a necessity of research in surgeons performing minimal invasive surgery, particularly in the Indian setting.

Surgeons are no exception, when it comes to the risk of WRMSD. Medical technology is developing at a frantic pace. Various advances in diagnostic & interventional imaging, equipment, surgical navigation systems etc. have been incorporated into medical practice. This has led to numerous changes in the work scenario for surgeons in operating rooms. One such technological advancement in surgical technology is minimally invasive surgery (MIS).Due to obvious benefits; MIS is increasingly being recognized as the standard care for more and more diseases requiring surgical intervention. Most of the advantages with MIS are patient related. Less blood loss, less postoperative pain, reduced rate of surgical site infection, shorter hospital admissions, quicker return to productivity, and a superior cosmetic result are some well-established MIS advantages. [10,11]

With the advent of minimally invasive surgery, the operating room witnessed an increase in the complex interplay between surgeons and technologies. Several studies, which have analysed the ergonomic problems associated with laparoscopic surgery open surgery, [12-15] have revealed interesting findings. While performing a MIS, a surgeon encounters an altered operating environment. There is loss of tactile feedback due to substitution of instruments for the surgeon's hands. Indirect visualisation of the operating field by means of monitors leads to decoupling of the visual and motor axes, loss of depth perception, indirect visual input and loss of peripheral vision. All these factors pose mental and physical challenges to the surgeon. Compared with open surgery, laparoscopic surgery presents manipulation difficulties because the instruments are cumbersome, uncomfortable, and offer reduced freedom of movement. The largely static posture required during minimal access surgery (MAS), which is dictated by port placement and the site of the monitor, is known to cause eye strain and arm, shoulder, and spine discomfort. In addition, maneuvering instruments, which pass through access ports into the abdomen, increase muscle activity and require adoption of awkward positions of the upper limbs. As a result of these constraints, the physical workload in laparoscopic surgery is significantly increased over that required for an equivalent open procedure.

There is a high prevalence of musculoskeletal symptoms in this group as evidenced by a number of studies published till date. In a study done by M.A. van Veelenet al [16] in 2003, to evaluate the ergonomic problems encountered by medical teams in minimally invasive surgery, it was observed that the main causes of physical, perception, and cognitive problems were the positioning of apparatus and staff, work clothing, and the limited reach of apparatus and/or instruments. 50% of medical staff experienced perception problems and 63% had physical discomfort during surgical procedure. L.S.G. L. Waubenet al [17] did a study in 2006, to investigate whether ergonomic guidelines are applied in OT. In their survey they found that the surgeons reported discomfort in the neck, shoulders, and back (almost 80%).

Another survey conducted among surgeons working in the General Surgery departments in public hospitals of Hong Kong in 2009, showed a high prevalence rate of WMS symptoms in surgeons, mainly

in the neck (82.9%), low back (68.1%), shoulder (57.8%) and upper back (52.6%) regions. Sustained static and/or awkward posture was perceived as the factor most commonly associated with the neck symptoms by 88.9% of respondents. [8] Dr. Yogendra S. Modi [18] et al conducted a study, regarding awareness of ergonomic guidelines in laparoscopic surgeries, its practice among surgeons and comfort level during and after surgery, among the surgeons of various fields like digestive, urological, gynecological, and thoracic, in three medical colleges at Ahmedabad, India. 66% surgeons reported arm and shoulder pain while 32% reported neck pain during or after surgery.

There is limited research for both prevalence & ergonomic assessment in the Indian scenario. Indian cities like Mumbai and Navi Mumbai have a high density of population which puts a severe strain on the limited health care resources. Ergonomic guidelines are often not followed in operation theatre designing and layout due to lack of awareness. Hence the objective of this study was to determine the WRMSD's in surgeons performing minimally invasive surgeries in Mumbai & Navi Mumbai.

METHODOLOGY

For the survey, a questionnaire was formulated & validated with 3 experts in the field. Revisions were made based on comments regarding the language, format, and context issues of the questions. The questionnaire was largely structured but it included some open ended questions where necessary.

The survey Questionnaire contained information on three categories.

1. Demographic (age, gender, height & weight, hand glove size) and workload data (average number of operations and operating hours per week and type of operations, etc.)
2. History of musculoskeletal symptoms (modified version of the Standardised Nordic Questionnaire).The area of pain was marked and the surgeons were asked to report severity of symptoms on a scale for 1 to 10, 1 indicating mild pain and10 indicating severe pain or symptoms.
3. Ergonomic risk factors. The probable causative factors as well as relieving factors related to work related symptoms were included. This study followed a participatory ergonomics approach which states that involvement of the participant in addressing the solutions to the problems leads to greater carry-over of the benefits.

The survey was conducted on surgeons practising in general hospitals, hospitals attached with teaching institutes in private setup. The survey questionnaire was distributed by both hand delivery & email. The questionnaires were collected either on the same day or participants were contacted after a week for the same as per the convenience of the participants. 150 questionnaires were distributed. The response rate was 75/150 = 50%.

RESULTS

75 questionnaires were returned after completion. Before discarding any questionnaire one attempt was made for personal communication for the unfilled answers.

74% of the study participants were males &26% were female surgeons. There were fewer females because traditionally surgery has been a male dominant occupation. 90% of the participants were right handed by dominance & 10% were left handed. 54.6% participants had normal Body Mass Index (B.M.I.), 42.6% participants were overweight & 2.6% were in the category of type I obesity. 68% participants were working in either private clinics or hospital based set up, 21%

surgeons were working in hospital with attached teaching institute 11% are associated with both private set up & hospital attached teaching institute.

Table 1: The following table depicts the demographic and workload characteristics of the participating surgeons both affected & non-affected with WRMSD.

	Surgeons suffering from WRMSD	Surgeons not suffering from WRMSD
Percentage prevalence	86%	14%
Single site pain	21 % one area pain	-
More than one site pain	65 % more than one area pain	-
Male surgeons	85.9%	14.1 %
Female surgeons	88.8 %	11.2 %
Average age	43.9	40.2
Mean height	167.2	170.5
Mean weight	73.6	74.9
Glove size	7	7
Working years	14.7	9.9
Working hours/week	55.8	48.2
Surgeries/week	10.4	9.2
Surgery hours/week	17.8	16.6

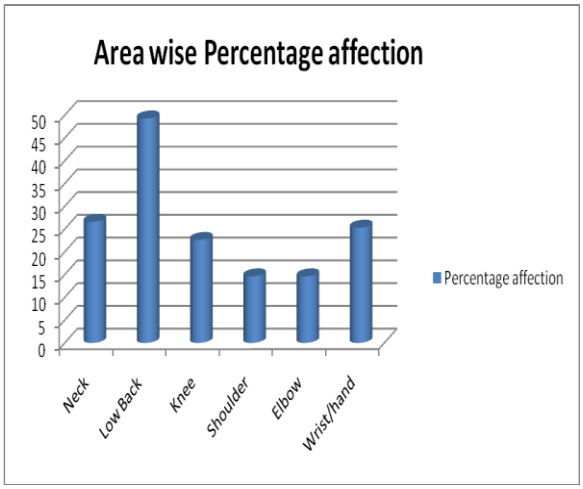

Figure 1: Regional Prevalence of WRMSD in surgeons performing minimally invasive surgeries

The regional prevalence of WRMSD in this population was as follows:

37 i.e. (49.3%) participants reported low back as site of pain, 20 i.e. (26.6%) participants reported neck as site of pain, 17 i.e. (22.6%) participants reported knee as site of pain, 11 i.e. (14.6%) participants reported shoulder as site of pain, 19 i.e. (25.3%) participants reported wrist and hand as site of pain and 11 i.e. (14.6%) participants reported elbow as site of pain.

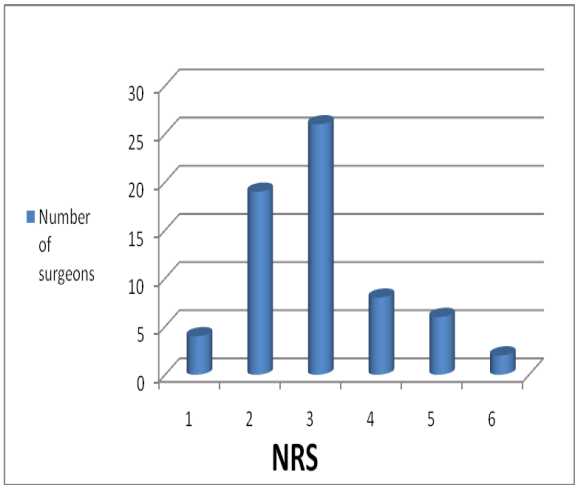

Figure 2- Severity of pain on NRS (Numeric Rating scale)

The figure above depicts the intensity of pain on NRS experienced by the participating surgeons. 65 participants complained of pain/symptom. The severity of pain on Numeric Rating Scale (NRS) is calculated on a scale of 0-10. The mean of the NRS of total 65 participants is 3.98(1.15).22% surgeons suffering from WRMSD reported that they undertook treatment for pain and/or discomfort.

Grace and Szeto [8] in their study of WRMSDs in surgeons observed that the surgeons apparently had a good insight of the salient occupational risk factors. The results of their regression analysis further confirmed that the physical risk factor score was the most significant predictor for all the four top regions of musculoskeletal symptoms.

To incorporate the elements of participatory ergonomics in our study as well, surgeons were asked their interpretation of the origin of symptoms. Out of the 65 participants suffering from symptoms, the various reasons that they attributed their pain/symptoms to were wrong posture (40%), work place ergonomics (24%), prolonged standing (24%) and long working hours (12%).

Among the participants that reported pain or symptoms, the various factors which they believed would help in relieving their symptoms of WRMSD were adopting good posture (34%), adequate rest (35%), stretching (15%), better surgical equipment designs (20%), work place ergonomics i.e. ergonomic workstation (15%) and adjustable surgical plinth (15%).

DISCUSSION

The term ergonomics is derived from the Greek words "ergon" meaning work and "nomos" meaning natural laws or arrangement. Ergonomics is "the scientific study of people at work, in terms of equipment design, workplace layout, the working environment, safety, productivity, and training". WRMSD are increasingly being recognised as important health issues among minimally invasive surgeons. Ergonomic assessment plays a crucial role in determining the risk and to initiating preventive & intervention strategies to control work related musculoskeletal disorders.

This study analysed the prevalence and distribution of work-related musculoskeletal disorders in surgeons performing minimally invasive surgical procedures, practicing in Mumbai and Navi Mumbai by using a self-report method of outcome measurement with the help of a validated questionnaire. Various methods of assessment have been described to estimate the prevalence rates such as self-report, interview, and clinical examination, with some differences. The questionnaire method is a cost effective and well accepted with results apparently similar when compared to the other two methods of assessment. [19] Hence we selected the questionnaire method.

The prevalence rate in this study for reported musculoskeletal symptoms is 86 % which is higher than the 15 to 18% prevalence rate reported in the Indian population. [20,21] This prevalence rate is comparable with that reported in dentists, nurses & sonologists who are considered as risk group in health care workers.

The neck pain could be related to the inappropriate height and viewing angles of the monitors. Higher monitors not placed directly in the line of vision lead to an awkward neck posture of extension coupled with rotations which are usually sustained for long durations. The role of prolonged repetitive upper limb task cannot be ignored in causation of neck pain. The back pain can be attributed to the prolonged standing, bent and twisted postures adopted repetitive work and precision work while performing surgeries. Other contributing causes for both neck & back painmay are unorganised work set-up, inadequate breaks & inadequate assistance.

Leino P, Magni G. have shown a clear link between psychological variables with neck pain & low back pain. [22] However the contributory role of aging and psychological and emotional stress could not be established in this study.

Shoulder pain is more likely if the arms are held in elevated or abducted for a prolonged duration the result of which is increased demand on the shoulder stabilisers and supraspinatus or bicipital tendinitis. Performing repetitive upper limb movement and uncomfortable instrument handles were considered highly associated with elbow, wrist and hand pain.

With increasing age and higher exposure to job stress, older surgeons would be expected to have a higher risk of developing musculoskeletal problems. In our study too, the mean age was higher in the group with WRMSDs. However there are studies which have reported younger workers to be at increased risk of musculoskeletal problems due to their lack of experience resulting in poorer job skills

and insufficient practice. [23,24,25] The ‘‘healthy worker effect’’ also suggests that those who are healthy are more likely to remain at work. [26,27]

In a research done by D. Falla, G. Jull and P. W. Hodges [28] in neck pain patients they concluded that the delay in neck muscle activity associated with movement of the arm in patients with neck pain indicates a significant deficit in the automatic feed forward control of the cervical spine. As the deep cervical muscles are fundamentally important for support of the cervical lordosis and the cervical joints, change in the feed forward response may leave the cervical spine vulnerable to reactive forces from arm movement. Similarly, there is evidence of inactivation of lumbar stabilisers following episode of acute low back pain, and which does not return spontaneously after the episode of pain subsides. The high recurrence rate of low back pain following the initial episode may be caused due to the lack of localized, muscle support. [29] Low back pain leads to impaired postural control, delayed muscle reflex responses following sudden trunk unloading and abnormal trunk muscle recruitment patterns. [30] All these factors emphasize the importance of monitoring and controlling spinal pain in surgeons.

The challenge involved in analysing WRMSD is the confounding influence of age, general health, stress, fatigue, sleep disturbance, anxiety, emotional distress, cognitive dysfunction, poor quality of life and pain threshold.

To prevent & minimise WRMSD in this group, the surgeons performing minimally invasive surgeries have to be made aware of simple ergonomic practices like adopting acceptable posture during surgery &adequate breaks between procedures. Spinal postures with greater than 20 degrees of flexion, lateral flexion or rotation and more than 5 degrees of extension pose a risk for spinal pain if adopted for longer durations. The monitors should be mounted in a manner that viewing angle is in the surgeon’s line of vision. Adjustable ceiling mounted monitors would be preferable monitors mounted on fixed height TV towers in the OT. The optimal monitor position is at least 1 m from the surgeon's eyes and at a declination that ranges from 0° to -15° from the surgeon's neutral gaze. [31-33]

In our study, 45% of surgeons reported that they were aware of ergonomic recommendations whereas 55% reported that they were unaware of the same. In a survey conducted by Yogendraet al, [18] 64% of the surgeons are aware about ergonomics. However, the practice of ergonomic guideline in terms of operating surface (table) height and monitor height was lower. 54% following the guideline in operating surface height and 4% surgeons were following guidelines for monitor height. In a survey conducted by L.S.G.L. Waubenet al [17] done in 2006, all 284 respondents believe in the importance of ergonomics although 89% of them were unaware of the ergonomic guidelines. The lack of ergonomic guidelines awareness is a major problem that poses a tough position for ergonomics in the operating room.” These statistics show that more surgeons should be made aware of ergonomic practices. These practices should not be limited to only height of monitor in the OT table. Issuing guidelines to operation theatres about all ergonomic factors in the operation theatre like appropriate lighting, temperature, assistant’s position, instrument& equipment reach distance, OT layout and other safety related ergonomic issues like floor clearance is the need of the hour.

Anti-fatigue mats and stools can be used to reduce lower extremity fatigue. Endurance of the upper limbs can be

incorporated with benefits to the surgeons exercise routine.

With increasing number of surgical procedures being done by the minimally invasive technique, it is likely that surgeons will be performing such procedures more extensively in the future. As such, they will be at even greater risk of developing WRMSDs if prompt & timely measures are not initiated. In a study of forty-five surgeons in three Massachusetts teaching hospitals by Gawande, Zinner, [34] et al, the most common risk factors relating to adverse events in the operation theatre included surgeon fatigue in addition to surgeon inexperience, communication breakdown and excessive workload. In a study titled "Burnout and Medical Errors among American Surgeons" conducted by Tait D. Shanafeltet al, they observed a strong relationship between surgeon distress and perceived medical errors. [35] Due consideration also needs to be given to time management to avoid overload and fatigue in surgeons. Appropriate ergonomic strategies can be helpful in accomplishing these objectives to an extent.

Looking to the future and the important issue of patient safety, we believe that ergonomics in the operation theatre focusing not only on the surgeon but the entire operating team will be a powerful stimulus in optimizing results & improvements in the patient safety culture.

CONCLUSION

The prevalence of WRMSDs in surgeons' performing minimal invasive surgery in our study was 86%. The areas reported were low back, neck, wrist, hand, knee, shoulder& elbow. In view of this high prevalence we recommend urgent ergonomic attention to the work setup and better ergonomic practices in surgeons performing minimally invasive surgeries.

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