A Survey of Work-Related Musculoskeletal Disorders Among Otolaryngologists

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Abstract There are increased reports of prevalence of work-related musculoskeletal disorders (WRMSDs) in surgeons performing minimal access surgeries. Due to the nature of the speciality, otolaryngologists spend their work days in performing markedly precise procedures in small workspaces i.e. the patients' ear, nose and throat. Due to this, they frequently adopt awkward neck, back and shoulder postures while using devices like otoscope, endoscope and microscope. The field of otolaryngology has barely received any attention with respect to ergonomic assessment. Thus, the aim of this study was to find out the prevalence of WRMSDs in otolaryngologists in Mumbai and Navi Mumbai. A pre-validated, structured questionnaire was distributed to 150 otolaryngologists. Seventy-three otolaryngologists responded to the questionnaire. The questionnaire comprised of demographic and workload data, report of musculoskeletal symptoms and otolaryngologists' interpretation of casual and preventive factors of symptoms at workplace. Response rate of the survey was 48.6%. The total prevalence of WRMSDs in the otolaryngologists was 87.67%. Majority of those surveyed reported that they suffered from musculoskeletal problems which they attributed to the ergonomic flaws encountered

during surgery (60.27%) and OPD (69.86%) respectively. Pain and discomfort during surgery experienced by the surgeons were most frequently attributed to the awkward and sustained postures adopted during surgery. Effective time management, ergonomically apt postures, intermittent change of posture, using back rest and availing skilled assistance during OPD and surgery, were the self-assessed corrective measures suggested by the respondents. The otolaryngologists' job profile puts them at high risk for WRMSDs.

Keywords Ergonomics · Otolaryngologists · Work related musculoskeletal disorders

Introduction

Work-related musculoskeletal disorders (WRMSDs) are increasingly being considered as an important health issue among surgeons performing minimally invasive procedures. Work-related musculoskeletal disorders have been extensively studied in populations where the risk is estimated to be high for example, in industrial workers, laborers, as well as those engaged in repetitive work or sedentary desk jobs, like software professionals. In the health care scenario sonologists [1, 2], dentists [3], surgeons performing minimal access surgery [4–7] and nurses [8, 9] have been studied.

Although other minimal access surgery fields are increasingly being researched for ergonomic risk factors, the population of otolaryngologists has not been adequately screened for the same. The otolaryngologist's job profile encompasses key-hole surgeries, in the operation theatre and examining deep narrow cavities in the outpatient set-up. There is a limited field of vision and restricted freedom

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of movement. Both the outpatient department examination and surgical procedures necessitate sitting posture for prolonged duration leading to a predominantly sedentary working lifestyle. Due to continuous use of devices like head-light, otoscope, microscope, endoscope, they frequently adopt awkward neck, back and shoulder postures in the outpatient room.

A national survey from 325 ENT consultants in UK conducted by Babar-Craig et al. [10] revealed that 72% of the otolaryngologists were affected with back and neck pain. A similar survey done by Cavanagh et al. [11] in American Society of Pediatric Otolaryngology members showed that 62% of the respondents experienced pain or discomfort associated with their surgical practice. Only 31% of the respondents were aware of the ergonomic principles. These studies highlight the lack of awareness and need of adequate training to prevent WRMSDs in otolaryngologists. These two studies did not take into account the ergonomic challenges encountered by the otolaryngologists in outpatient room.

The present survey was conducted to find out the prevalence of WRMSDs in otolaryngologists in Mumbai and Navi Mumbai with a view to analyze the risk factors encountered not only in the operation room but also the outpatient room.

Methodology

For the survey, a questionnaire was formulated and 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 included the following information.

- Demographic (age, gender, height and weight, hand glove size) and surgical and outpatient workload (average number of operations, operating hours per week, outpatient consultation hours/week etc.).
- Musculoskeletal symptoms as per the modified version of the Standardised Nordic Questionnaire (based on Kuorinka et al. [12]) were recorded. The area of pain was marked on body chart and the otolaryngologists were asked to report severity of symptoms on numeric rating scale from 1 to 10, 1 indicating mild pain and 10 indicating severe pain/symptoms.
- For evaluation of ergonomic risk factors, the otolaryngologists were asked their interpretation of the potential (causal and preventive) factors of WRMSDs.

The prevalence of symptoms during outpatient consultation and surgery was asked separately in part A and B of the questionnaire respectively.

This study followed a participatory ergonomics approach which states that the involvement of participants in addressing solutions to problems encountered by them leads to a greater carry-over of benefits.

The survey was conducted in otolaryngologists practicing in both private and general hospitals as well as university hospitals. 150 questionnaires were distributed by hand delivery method. Before discarding any incomplete questionnaire one attempt was made for personal communication for the unfilled answers. The items in the questionnaire were statistically analyzed with SPSS software.

Results

73 questionnaires were returned after completion. The response rate was 48.6% (73/150). The mean age was 37.38 (± 10.79) years. 63.1% of the study participants were men and 36.9% were women. The average number of years in practice was 10.60 (± 9.1) years. 54.7% of the respondents were in the academic setting, 45.2% in private setup. The average number of surgeries was 4.86 (± 2.23) per week and surgery hours/week were 13.26 (± 12.32).

The total prevalence of WRMSDs in the otolaryngologists was 87.67%.

WRMSDs in Outpatient Setup

69.86% of the respondents complained of WRMSDs related to ergonomic flaws in their consultation chamber. Out of these, 81% had pain in multiple sites. The anatomical site wise prevalence of WRMSDs which the respondents attributed to outpatient practice is shown in Fig. 1 and the mean pain intensity (NRS) at various anatomical sites in affected population is depicted in Fig. 2.

Those suffering from neck pain attributed their pain to sustained posture (73.3%) awkward posture (60%) and inadequate breaks (36.6%) Those suffering from upper back pain attributed their pain to sustained posture (74%), awkward postures (66.7%) and inadequate breaks (48%) (Table 1).

Other factors like OPD equipment placement, temperature related, sustained grip and force application were reported less frequently as causal to development of WRMSDs.

Adequate breaks, using back rest, change in posture and time management were the preventive factors considered as important preventive factors by the participants (Table 2).

Fig. 1 Anatomical site prevalence of WRMSDs attributed to outpatient practice

Mean pain score on NRS

Fig. 2 Mean pain intensity (NRS) at various anatomical sites in affected population

Factors like well-designed furniture, safe reaching distance and ergonomically designed equipment were reported less frequently.

WRMSDs in OR

61.64% of the survey group reported that they suffered from musculoskeletal problems which they attributed to the ergonomics issues encountered during surgery. 35.5% had

single site pain and 64.4% of the participants had complaints in more than one area. The prevalence of WRMSDs in women was higher (66.6%) than men (58.6%) (Table 3).

Mann–Whitney statistical test was used for between group comparisons. $p < 0.05$ was considered significant. The above parameters were not statistically different in the two groups.

The anatomical site wise prevalence of WRMSDs which the respondents attributed to surgical practice is shown in Fig. 3 and the mean pain intensity (NRS) at various anatomical sites in affected population is depicted in Fig. 4.

In the surgical setup, those suffering from WRMSDs attributed their pain more commonly to sustained posture and awkward postures, OT table height, inadequate breaks and inadequate assistance (Table 4).

Other factors like force application, limited workspace, temperature related and inadequate illumination were reported less frequently as causal to development of WRMSDs (Table 5).

Ergonomically designed equipment, adopting neutral postures, using backrest, skilled assistance and time management were the important preventive factors.

Table 1 Anatomical site-wise prevalence of causal factors of WRMSDs during outpatient consultation as reported by study participants

Sr. no.	Factor contributing to pain	Neck (%)	Upper back (%)	Lower back (%)	Upper limb (%)
1	Sustained posture	73.3	74.07	44.44	27.7
2	Awkward posture	60	66.66	48.14	13.8
3	Repetitive movements	26.6	14.81	25.92	41.66
4	Instrument handling	–	–	–	36.11
5	OPD table height	20	18.51	18.51	2.7
6	Inadequate breaks	36.6	48.14	25.9	16.6
7	Limited workspace	10	–	14.81	13.8
8	Inadequate illumination	43.3	25.92	18.51	27.7
9	Inadequate assistance	–	18.51	11.1	2.7

Table 2 Anatomical site-wise prevalence of preventive factors of WRMSDs as reported by study participants

Sr. no.	Factors relieving pain	Neck (%)	Upper back (%)	Lower back (%)	Upper limb (%)
1	Adequate breaks	46.6	85.18	51.85	38.8
2	Using back rest	36.6	62.96	40.74	–
3	Skilled assistance	30	–	–	2.7
4	Change in posture	60	–	40.74	19.44
5	Customized workstation	–	–	14.81	11.1
6	Time management	18	70.37	40.74	52.77

Table 3 The following table depicts the demographic and workload characteristics of the participating surgeons with WRMSD due to surgery

Demographics	Surgeons with WRMSDs mean ($\pm$ SD)	Surgeons without WRMSDs mean ($\pm$ SD)	<i>p</i> value
Age in years	36 (10.41)	39.6 (11.21)	0.20
Height in cms	166.11 (8.43)	166.92 (9.22)	0.99
Weight in kgs	72.2 (15.11)	68.42 (11.77)	0.33
Glove size (median)	7	7	0.28
Working years	10.08 (9.45)	11.42 (8.66)	0.51
Working hours/week	56.47 (32.92)	47.82 (24.07)	0.25
Surgeries/week	4.79 (2.5)	4.96 (1.77)	0.31
Surgery hours/week	12.63 (11.48)	14.25 (13.69)	0.45
Participating in exercise	51.1%	64.28%	–

Fig. 3 Anatomical site prevalence of WRMSDs in surgical setup **Fig. 4** Mean pain intensity (NRS) at various anatomical sites in affected population

Discussion

The prevalence rate of work related musculoskeletal symptoms in otolaryngologists was 87.67% in this study which is higher than the 15–18% prevalence rate reported in the general Indian population [13, 14]. Our prevalence rate is comparable with that reported in dentists, nurses and sonologists who are considered as high risk groups in health care workers.

Outpatient Room Ergonomics

The commonly affected areas due to outpatient consultation were neck, upper and low back. The factors in the

Table 4 Anatomical site-wise prevalence of causal factors of WRMSDs as reported by study participants

Sr. no.	Factor contributing to pain	Neck (%)	Upper back (%)	Lower back (%)	Upper limb (%)
1	Sustained posture	50	64.70	50	2.94
2	Awkward posture	50	76.47	43.3	5.88
3	Repetitive movements	12.5	11.76	10	23.52
4	Vibration	4.16	–	–	20.58
5	Sustained grip	–	–	–	23.52
6	OT table height	20.8	23.52	–	2.94
7	OT equipment placement	12.5	–	–	2.94
8	Inadequate breaks	20.8	23.52	–	2.94
9	Inadequate assistance	12.5	23.52	–	8.82

Table 5 Anatomical site-wise prevalence of preventive factors of WRMSDs as reported by study participants

Sr. no.	Factor contributing to pain	Neck (%)	Upper back (%)	Lower back (%)	Upper Limb (%)
1	Ergonomically designed equipment	20.8	29.41	20	5.8
2	OT redesigning	–	–	–	20.58
3	Arm rest	–	–	–	17.64
4	Back rest	25	52.94	43.3	5.8
5	Intermittent change of posture	–	–	40	5.8
6	Adopting neutral postures	37.5	52.94	36.6	14.7
7	Safe reaching distance	–	–	20	5.8
8	Adequate breaks	16.6	23.52	–	8.8
9	Skilled assistance	12.5	17.64	13.3	8.8
10	Time management	20.8	17.64	13.3	14.7

outpatient department responsible for pain and symptoms of musculoskeletal disorders were cited by the respondents of our study as sustained posture, awkward postures, writing desk height, inadequate breaks, inadequate illumination, inadequate assistance and repetitive movements. The relieving factors for OPD related neck, upper and low back symptoms were reported as adequate breaks, periodic changes in posture, back rest, skilled assistance, time management and use of customized workstation.

In the outpatient setup, the reason for neck pain could be the adoption of forward head and trunk posture during the ear examination with otoscope. It is known that the load on the cervical spine is likely to increase in abnormal head alignment in sitting position. In the forward head posture, the head is positioned farther anterior to the C₇T₁ junction, increasing the load on C₇T₁ joint. Interventions to reduce forward head posture may be important in preventing disc degeneration, as well as in treating symptoms associated with cervical disc degeneration [15, 16] (Figs. 5, 6).

Use of a camera coupled to the endoscope or otoscope or a customized workstation may assist in adopting a neutral position while visualizing the ear, nose or larynx. The

monitors should be mounted in a manner that viewing angle is in the viewers' line of vision. 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 [17–19].

In the outpatient setup, the otolaryngologist frequently adopts an awkward posture of thoracolumbar spinal flexion and rotation as he alternately stoops forward on his chair to examine the patient and then turns around for writing notes. Sustained awkward seating posture (overly arched or slouched) can result in higher intradiscal pressure and may be injurious to spinal postural health [20]. Forward inclined postures while sitting have been described as risk factors for the presence of low back pain [21]. Prolonged sitting being another important risk factor should be avoided.

Operation Room Ergonomics

In their survey from 325 ENT consultants in UK, Babar-Craig et al. [10] reported a prevalence of 72% neck and back pain. Of those with pain, 53% attributed their symptoms directly to ENT surgery. Highest figures were

Fig. 5 Awkward postures in Outpatient room

Fig. 6 Excessive shoulder abduction during syringing

reported among otologists, related to microscope work and prolonged sitting. 60.27% of the respondents interviewed in our study, complained of musculoskeletal disorders due to their surgical practice.

In a survey conducted by Jonathan Cavanagh 62% of pediatric otolaryngologists reported pain or discomfort which they attributed to their surgical practice. Women were significantly more likely to report experiencing pain or discomfort that they associated with their surgical practice ($p = .033$). In our study too the percentage of women suffering from WRMSD was higher (66.6%) than men (58.6%).

Low back and neck were the most commonly affected regions due to surgical practice followed by upper back and wrist-hand pain. The factors in the OR responsible for pain and symptoms of musculoskeletal disorders were cited by the respondents of our study as sustained posture, awkward postures, inadequate breaks, OT table height, sustained grip, inadequate assistance and repetitive movements. The relieving factors for OR related neck, upper and low back

symptoms were reported as ergonomically designed equipment, adequate breaks, adopting neutral posture, back rest, skilled assistance, time management.

The back and neck pain can be attributed to their prolonged stoop sitting or stoop standing postures adopted while doing repetitive, precision surgical tasks using microscope or nasal endoscope. Also an unorganized work set-up and inadequate assistance will cause the surgeon to repeatedly reach out for instruments. Prolonged forward bent posture fatigues the extensor musculature, and eccentrically overloads them, leading to ischemia and strain, leading to myofascial pain in low back muscles [3, 22] (Fig. 7).

Prolonged awkward postures can lead to the development of pain, which would then interfere with the normal kinesthesia of the body region resulting in adoption of even more inappropriate postures.

The neck pain could be related to the inappropriate height and viewing angles of the monitors. Higher monitors not placed directly in line of vision lead to an awkward neck posture of extension coupled with rotation which is usually sustained for longer duration.

Endoscopic sinus surgery and mastoid and middle ear surgery requires the surgeons to hold their arms in an elevated or abducted position for a prolonged duration. As a result, there is increased demand on the shoulder stabilizers, which may predispose to supraspinatus or bicipital tendinitis.

Elbow, wrist and hand pain in the otolaryngologists may be due to uncomfortable instrument handles, repetitive upper limb movement, awkward wrist and forearm postures, cold temperatures in OR and vibrations associated

Fig. 7 Awkward posture during tonsillectomy surgery

with instruments like drills and suction handles. Epidemiological research associates the onset and severity of hand and wrist WRMSDs with repetitive cyclical loading of the upper extremity, performance of repetitive hand-intensive tasks, awkward or extreme wrist and forearm postures, cold temperatures, and vibration [23–26].

Analyzing WRMSD in otolaryngologists is challenging due to the confounding influence of age, general health, stress, fatigue, sleep disturbance, anxiety, emotional distress, cognitive dysfunction, poor quality of life and poor pain threshold. Nevertheless, in view of the high prevalence we recommend urgent ergonomic attention to the work setup of otolaryngologists. Otolaryngologists should revisit their workplace, in the presence of physical therapists. Physical therapists can screen visually for postural deviations [27] and provide education on good and bad work postures, biomechanics, ergonomic advice and interventions [28], and workplace exercises [29].

Ergonomics in Head–Neck Surgery

Head and neck surgery, though being an open surgery is nevertheless associated with prolonged standing, awkward body positions, and the occasional need to exert substantial forces on tissues, which are all associated with WRMSDs. [30–32] Often head and neck surgery requires a team approach and this puts constraints on the optimal table height, the posture of the surgeon and assistants, and their movements as they perform tasks in synchrony without obstructing each other's line of vision.

Kant et al. [30] studied the posture of physicians and nurses during surgery and found that surgeons and scrub nurses experience substantial stress to the musculoskeletal system owing to their frequent and prolonged static head-bent and back-bent postures. Buerger et al. [33] demonstrated that, during open surgeries, the surgeons adopt more back and neck bent postures.

It has long been recognized that sitting posture is a preferred position for light manipulative work [34] and suggestions have been made to allow surgeons to adopt a sitting position during at least some part of an operation, like suturing [35–37].

When an otolaryngologist performs head and neck surgery, he is often tempted to use the equipment at his disposal like a head light, a loupe or the operating microscope. Though these instruments make the surgery more meticulous, they also put an additional strain on the neck of the operating surgeon.

All these factors increase the risk of WRMSDs in otolaryngologists who also perform head and neck surgery. It may be noted that the respondents of our survey performed head and neck surgery occasionally.

Recommendations to Prevent WRMSD's Among Otolaryngologists

The lack of ergonomic guidelines awareness is a major problem that poses a tough position for ergonomics in both the operating room and outpatient set-up. Increased knowledge of ergonomics is essential to reduce WRMSD's.

To prevent and minimize WRMSD s in otolaryngologists, we recommend the following measures:

1. Use of height-adjustable and revolving chair with back rest while examining the patients.
2. Keeping the part to be examined (ear, nose, throat etc.) in line of vision, to maintain neutral neck and trunk postures.
3. Keeping the monitor in line of vision of the surgeon with the upper border of the monitor at the eye level.
4. Operating with neutral neck and trunk postures by adjusting the patient's head, height and position of the operating microscopes and OR table.
5. Ear suction should be performed with the patient in the supine position on an adjustable plinth.
6. Keeping the frequently used instruments, within elbow reach eliminating the need for bending or turning to pick instruments.
7. Resting the elbows in endoscopic and microscopic surgeries.
8. Use of an organized instrument trolley and skilled assistance.
9. Use of an endoscope holder.
10. Availing mini breaks between consultations with periodic standing, stretching and walking.
11. Maintaining ideal body weight and exercising regularly.

Physical activity in any form has reported to be helpful in decreasing MSD prevalence [38]. Reasons may be multifactorial like an increase in pain threshold, decrease in stress and anxiety levels seen with regular physical activity. Grotle et al. [39] have found obesity as a significant risk factor for musculoskeletal pain.

Better ergonomics in the OR will speed operations. Improved surgical comfort will finally translate into a favorable outcome for the patient. Thus, the final goal of ergonomics in otolaryngology would be an ideal workplace environment in the form of customized workstations in the consultation room and operation suites incorporating best practices with emphasis on both patient care and surgeon welfare.

Conclusion

In our study the prevalence of WRMSD in otolaryngologists was found to be 87.67%. The otolaryngologists' job profile puts them at high risk for WRMSDs. This survey

underscores the need for ergonomic consideration in workplace planning, layout and activities, in operation room as well as outpatient room for otolaryngology practice.

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Compliance with Ethical Standards

Conflict of interest Authors T.D., S.Y., Y.G.D, H.K.V. and G.G. declare that they have no conflict of interest.

Human and Animal Rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required. This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

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