The Relationship Between Surgical Loupes Usage, Workplace Ergonomics, and Musculoskeletal Disorders Among Saudi Ophthalmologists

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Research Article

Keywords:

Posted Date: March 8th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1322145/v1

Abstract

Objective: Evaluate the knowledge, attitudes, and practices of surgical loupes among ophthalmologists and determine the relationship between this tool and musculoskeletal disorders.

Methods: An anonymous, internet-based survey via Google forms was distributed among ophthalmologists (trainees and consultants) working in Saudi Arabia between December 2020 and January 2021.

Results: 93 surveys were completed, and 82% reported pain with operating during the past 12 months. Neck pain was reported in 87%, shoulder pain 81%, and lower back pain 73%. 68% chose to rest without seeking professional care. 47% of participants exercise regularly. 69% attributed the pain to “bending or twisting your neck.” 55% of surgeons owned loupes, only a third used loupes regularly. 40% indicated limited field of vision as the main limitation. Chi-Squared analysis showed that musculoskeletal (MSK) pain is a risk among all ophthalmic surgeons. It was more prevalent among surgeons with longer experience. Higher rates of pain noted with increased surgical volume and prolonged operating time. Additionally, more frequent loupe use was associated with an increased prevalence of pain. None were found to be statistically significant. Finally, the activity level was significantly associated with a lower prevalence of pain (P = 0.028).

Conclusion: We established that the majority of participants experienced occupational MSK pain. Most participants owned loupes. Only a third used loupes regularly. This is most likely due to prolonged operating time, static positioning, and neck flexion, producing the “head forward” posture. Young ophthalmologists should be encouraged to apply ergonomic principles to safeguard against future MSK injuries.

Introduction

The use of magnification devices has contributed to the evolution of microsurgery. [1] Since their introduction in the 1960s, surgical success rates have increased.[1,2] They have become an essential part of several surgical fields, including ophthalmology.[1,2] Optical magnification is achieved using either loupes or operating microscopes.[3] Loupes are easier to use, less expensive, and offer better portability than surgical microscopes making them more favorable.[2,3] Other benefits include a more detailed view of operative anatomy, translating into superior clinical work and enabling the performance of procedures otherwise impossible with the naked eye.[3]

Improved intraoperative magnification can have ergonomic benefits due to a more comfortable working distance.[4]Though, improper or prolonged use of these devices can have the opposite effect, with studies reporting the association of neck pain and occupation-related musculoskeletal disorders (MSDs) with surgical loupes.[5,6]

A strong correlation has been established between static loads, awkward postures, excessive static contractions, and increased mental stress with cervical MSDs. [5,7] Ophthalmic surgeons encounter all of these factors while using surgical loupes, operating in prolonged non-neutral head-neck postures with the stressful nature of surgery.[5,7]

There are only a few articles regarding surgical loupes use among ophthalmologists and their relation to musculoskeletal (MSK) pain, none in the middle east. This study aims to assess surgical loupes usage, workplace ergonomics, and MSK pain among ophthalmic surgeons. Thus, increasing awareness of MSDs to ensure early recognition of injury and implement strategies to prevent, manage and promote safer use.

Methods

An internet-based survey **(Appendix 1)** was conducted via Google Forms between December 2020 and January 2021. The survey questions were adapted from literature and modified to assess usage and opinions on surgical loupes, knowledge of workplace ergonomics, and prevalence of MSK pain among ophthalmic surgeons in Saudi Arabia. The study

participants included ophthalmologists from different hospitals. The survey link was distributed via email or direct invitation through text messages. A consent form appeared at the beginning of the survey. The institutional review board of King Fahd Hospital of the University approved this study (IRB-2021-11-191). This study is compliant with the tenets of the Declaration of Helsinki.

The demographics included age, gender, nationality, subspecialty, years in practice, and practice setting. Loupe ownership was established. Loupe owners were asked about the magnification, working distance, type, brand, frequency and context of use, and the time of purchase. Participants who did not own a loupe were asked to provide clarifying reasons. Nextparticipants shared their perceptions of the limitations and benefits of loupe use, attitudes regarding the benefits of loupes during training and their effect on surgical outcomes, and whether loupe purchase should be required during residency.

The last section focused on musculoskeletal pain; participants were asked if they experienced MSK pain attributed to work in the clinic or in the operating room in the past 12 months. They were asked to pinpoint perceived contributary factors. They were required to identify the specific body site affected. For each location, they rated the pain severity and duration. Participants were also asked about how they deal with the pain. Treatment categories ranged from “rest” and “alternative medical practices” to “prescription medicine” and “surgery.” Finally, data on the amount of physical activity performed per week was collected.

Statistical Analysis

The collected data were entered using Microsoft Excel software (Microsoft Corporation, Redmond, WA.) and analyzed using STATA software (StataCorp LLC, College Station, TX). Graphs were created in Excel. Pearson’s chi-square test or Fisher-Freeman-Halton exact tests were used as appropriate to examine the associations between categoricalvariables (specialty, years in practice, length of individual cases, hours of surgery per week, weekly exercise), loupe usage, and pain experience. Significance was determined as: $*P < 0.05$, $*P < 0.01$, $*P < 0.001$.

Results

Ninety-three ophthalmologists participated in the survey **(Table 1)**. Of these, 57 were female (61%). Most participants were ophthalmology residents (n = 47 [51%]), other participants included pediatric ophthalmologists (n = 16 [17%]), oculoplastic surgeons (n = 15 [16%]), and other ophthalmologists (n = 15 [16%]). The majority of ophthalmology residents were from the Dammam training program (n = 30 [64%]). The most common practice setting reported was in a teaching hospital (n = 60 [39%]) followed closely by an eye specialist hospital (n = 54 [35%]). Forty-eight participants revealed multiple settings of practice. Two-thirds of participants had five years or less experience in ophthalmology.

Loupe Ownership and Use

About half of the participants (n = 51 [55%]) owned loupes **(Table 2)**. Those who did not own one, 15 cited they did not need it in their practice or had insufficient training and/or opportunities to try. Ten were not interested, ten said they were expensive, and the remaining sevenstated discomfort. 69% (n = 35) of loupe owners purchased it during residency. The majority (n = 58 [63%]) did not specify the brand of the loupe used, the two brands used by participants were Designs for Vision (n = 12 [13%]) and Zeiss (n = 12 [13%]), 2.5x was the most common magnification (n = 36 [39%]), and the front-lens-mounted loupe was most commonly used (n = 30 [32%]). Only 10 (11%) participants always used their loupes, whereas 63 (68%) rarely or never used them. Approximately two-thirds of those who rarely or never used loupes did not own one.Loupes were used mostly for lacrimal procedures (n = 70 [75%]), including dacryocystorhinostomy, jones tube placement, and other lacrimal surgery, followed by strabismus surgery (n = 48 [52%]). The least frequently reported use was for chalazionexcision (n = 12 [13%]) **(Table 3)**.

With regards to loupe use, 83% of participants (n = 77) reported limitations, with limited field of vision being the most common (n = 37 [40%]). Other limitationswere, neck pain (n = 31 [33%])and lack of comfort (n = 31 [33%]). Others revealed headache (n = 27 [29%]), adjustment period (n = 24 [26%]), and limited depth of vision (n = 22 [24%]). The key benefits mentioned were magnification (n = 82 [88%]) and identification of anatomical structures (n = 65 [70%]). About a third of participants believed loupes improved quality of patient care (n = 24 [26%]). Whereas only a few believed they increased comfort (n = 18 [19%]) and provided better ergonomics (n = 12 [13%]).

Lastly, regarding the perceived advantages of loupes in practice and training,most participants considered loupes would be beneficial for surgical training during residency (n = 58 [62%]); 10 were against (11%), and 25 were neutral (27%). Fewer participants thought loupes improve the outcomes of surgery (n = 55 [59%]); 10 were against this (11%), while 28 were neutral (30%). Less than half believed that purchase of loupes during residency should be mandatory (n = 36 [39%]), with an almost equal number that thought it should not be required (n = 35 [38%]); 22 were neutral (24%). There was no correlation between the frequency or duration (in years) of loupe use and whether they believed loupes should be incorporated into residency surgical training (P= 0.114 and P= 0.776, respectively). However, those with a shorter experience of loupe use believed they were beneficial for training. Additionally, most participants believe residents should purchase theirloupes (P = 0.269), those who use them less frequently (less than 50% of their surgical cases) tend to have aninconclusive opinion in this regard. More participants with shorter experience believed that residents should not be required to purchase their loupes (P = 0.015). Furthermore, regardless of their frequency of loupe use and length of experience, participants believed loupe use improves surgical outcomes (P = 0.602 and P= 1.000).

Pain Severity and Location

Musculoskeletal pain attributed to work in the operating room in the last 12 months was reported by 82% (n = 76). In contrast, 78% (n = 73) experienced MSK pain in the previous 12 months related to work in the clinic. Neck pain was reported by 87% of participants; 47% described the pain as “moderate,” 31% as “mild” pain, and 9% as “severe” pain. Followed by shoulder pain in 81%. The pain was described as “moderate” by 35% of participants, 32% reported “mild” pain, and 13% reported “severe” pain. Lower back pain closely followed and was reported by 73% of participants; 35% rated the pain as “moderate,” 34% as “mild,” and 3% as “severe.” Upper back pain, hand or wrist and elbow pain had the lowest reporting rates at 59%, 30%, and 14% respectively**(Figs. 1,2)**.

Pain Coping Mechanisms

Rest was the most common strategy of dealing with pain, reported by 68% of participants. Massage therapy was the second coping modality mentioned by 43%, followed by paracetamol and hot or cold packs, at 32% and 31%, respectively. Acupuncture and occupational therapy were reported by only 2% and 1%, respectively. None mentioned prescription opioids or surgical intervention as a coping modality.

Most participants, 59% (55 of 93), did not seek professional help for work-related MSK pain. Care was sought most commonly by a “massage therapist” as mentioned by 30% (28 of 93), followed by “personal trainer” 14% (13 of 93), “physiotherapist” 12% (11 of 93), and “orthopedic surgeon” 12% (11 of 93). “Acupuncture specialist” 3% (3 of 93), “chiropractor” 2% (2 of 93), “family physician” 1% (1 of 93), “neurologist” 1% (1 of 93), “neurosurgeon” 1% (1 of 93), and “rheumatologist” 1% (1 of 93) were rarely sought.

Perceptions on the cause of Work-Related MSK Pain?

Varying causes were described as an association with work-related MSK pain, “bending or twisting your neck” being the most common 69% (64 of 93). Other reported factors were “working in the same position for a long duration” 56% (52 of 93), “reaching or working over your head or away from your body” 40% (37 of 93), “working long or unusual hours” 39% (36 of 93), “working in cramped or awkward positions” 35% (33 of 93), and “insufficient breaks during the day” 33% (31 of

93). Less reported factors were “performing the same task repeatedly” or “continuing to work when injured or sick” 16% (15 of 93).

As for the specific tasks identified as contributing to work-related MSK pain, “height difference to the assistant surgeon” 54% (50 of 93) and “length of the surgical case” 53% (49 of 93) were the most likely factors. “Surgery with loupes” 30% (28 of 93), “indirect ophthalmoscopy” 30% (28 of 93), “slit-lamp examination” 27% (25 of 93), “surgery without loupes or microscope” 18% (17 of 93), and “surgery with a microscope” 15% (14 of 93) were less commonly reported.

Risk Factors for Increased MSK Pain amongLoupe Users

The Chi-square and Fisher's exact testswere used to identify factors associated with increased work-related MSK pain**(Table 4)**. There appeared to be no difference across the different ophthalmic subspecialties and the occurrence of pain ($P = 0.348$). Therefore, MSK pain remains a risk amongst all ophthalmologists. Increased prevalence of pain was associated with more frequent use of loupes ($P = 0.735$), longer experience ($P = 0.156$), increased surgical volume ($P = 0.766$), and prolonged operating time of individual cases ($P = 0.551$), although this was not statistically significant. Loupe ownership did not affect pain experience ($P = 0.624$), nor did the type of loupe ($P = 0.252$), meaning that the development of work-related MSK pain is a risk regardless. The level of activity (days of exercise per week) was found to be associated with a lower prevalence of pain. This was statistically significant and should thus be encouraged ($P = 0.028$). Finally, knowledge of workplace ergonomics alone did not appear to be protective as there was no difference between aware and unaware participants ($P = 0.103$). These findings portray that work-related MSK pain is a genuine issue and that knowledge alone is not enough. Ophthalmologists must be equipped with the correct tools to avoid occupational hazards.

Discussion

Microsurgical techniques transformed modern ophthalmic surgery.[3] Operating microscopes were used widely initially until the introduction of good-quality loupe magnification with evidence supporting comparable outcomes when using either loupes or operating microscopes.[3] Loupes are user-friendly, portable, and less expensive.[3] In addition, closer access to the surgical field is possible with loupes.[2] Despite their widespread use clinically, few papers have been published regarding patterns of use in practice and training in ophthalmic surgery, along with the perceived benefits and limitations of use.[8] This study is the first to evaluate ophthalmic surgeons’ opinions on loupes, document their preferences, usage patterns, and their relation to the prevalence of work-related musculoskeletal disorders in Saudi Arabia.

This study established that about 55% of surgeons owned loupes, patterns of use varying depending on the subspecialty. Only a third of surgeons used loupes regularly. The main limitations were attributed to the limited field of vision, lack of comfort, and neck pain, including others. The prevalence of loupe usage in this study was lower than previously shown in literature (87% and 80.9%).[7,8]However, participants in previous studies were oculoplastic surgeons and did not include trainees. [7,8]

Regarding the importance of loupes in surgical training, 62% agreed that loupes would be beneficial and required in training. There was a lack of consensus on whether residents should purchase loupes, with only 38% agreeing that it should be mandatory. More participants with shorter experience believed residents should not be required to purchase their loupes. Perhaps they could recall the financial difficulties residents face. Although the participants who owned loupes, 69% had purchased their loupe during residency training. Residency programs could offer to cover the cost of loupes in support of their trainees. Furthermore, the survey was distributed evenly among training program residents, Dammam residents were more interested in participating in the study. It could be because they are encouraged to buy and use loupes starting from their first year of residency by the oculoplastic attendings; this was not the case with other residency programs.

Approximately two-thirds (59%) of respondents thought loupe usage enhanced surgical outcomes. Therefore, the infrequent loupe usage could be related to the perceived limitations. The most common perceived limitation was the limited field of vision. Richards et al. showed that for every 30% increase in magnification, there was corresponding decrease by 2.5 cm in the depth and width of a user's visual field.[8,9] Lack of comfort and neck pain were the second most common limitations. Yet, a similar number of participants reported the opposite, indicating comfort and better ergonomics or posture as benefits (19% and 13%, respectively).

Whether or not loupes improve ergonomics remains a debate in literature. In dentistry, loupe use has been associated with reducing risks of musculoskeletal discomfort. A lower incidence of lower back pain was seen in the context loupe use that allowed for appropriate delineation angles resulting in optimal working postures. Therefore, surgical magnification without proper positioning may not have the same effect.[4] These findings are supported by a systemic review, which concluded that the use of ergonomic saddle seats and magnification loupes improve working posture among dental care professionals. Additionally, the use of loupes appears to reduce shoulder, arm, and hand pain; the effect on neck pain is limited.[8,10] This finding was replicated in a study by Aboalshamat et al., which demonstrated significantly lowered levels of musculoskeletal discomfort with the use of dental loupes (<0.05).[11] Conversely, Burton et al. reported that static positioning associated with loupe use could cause dentists to experience back or neck pain.[8]

Our study showed that 82% of participants experienced musculoskeletal pain attributed to work in the operating room. The prevalence of pain was higher in participants who used loupes more frequently; however, this was not statistically significant. In contrast, 78% reported MSK pain related to work in the clinic. These rates are high and should be taken seriously, especially since 10% of musculoskeletal disorders have been reported to be career-ending among oculoplastic surgeons.[5,7,8]Another study reported 7% of plastic surgeons had to modify their practice, which is a direct consequence of MSD morbidity.[12] Literature showed varying prevalence rates of MSK pain ranging from 46% to 90% across different surgical specialties.[6-8,13-14]

Diaconita et al. surveyed ophthalmologists and found that 46% experienced "neck pain" in the previous 12 months, 36% had "lower back pain," while 28% had "shoulder pain."[15] These results are not similar to ours, which showed that 87% of ophthalmologists recalled suffering "neck pain" in the last 12 months, 81% experienced "shoulder pain," and 73% "low back pain." Like Diaconita et al., we noted lower rates reported for upper back, hand or wrist, and elbow pain by participants.[15] Most participants chose to rest or self-medicate and did not seek professional help. It is important to note that none of the participants resorted to prescription opioids or surgical intervention. In contrast, Godwin et al. found that 4% of surgeons with neck pain required discectomy.[12]This could indicate that our physicians try to work through the pain, which could have more serious long-term sequelae. This is a critical issue to address, as injury rates among healthcare workers are estimated to be almost twice that of other service industries.[16]Alternatively, this could be related to a reporting bias with participants sharing coping mechanisms and treatments they underwent only in the past 12 months.

Our survey was based on the work of Diaconita et al. and Wei et al. Each tackled the topic from a different angle, one focusing on the prevalence of work-related MSK pain among ophthalmologists, the latter on patterns of loupe usage among oculoplastic surgeons.[8,15] We aimed to determine the contribution of loupe usage to the prevalence of work-related MSDs. Although we established that ophthalmic surgeons with longer experience in the field, increased surgical volume, and prolonged operating times and loupe users had a higher prevalence of MSK pain, none of these associations were statistically significant. The results do not conclusively show that the high rate of MSK pain among ophthalmic surgeons is due to loupe use. Conducting the study with a higher number of participants could yield more significant results.Previous studies have studied this hypothesis across different surgical specialties with varying results **(Table 5)**.[6,7,11,12,17-19]

Conversely, amount of exercise was associated with a lower prevalence of pain. Four or more days of exercise per week significantly reduced the likelihood of experiencing work-related MSK pain. Previous studies confirm these findings. One study established that exercise can improve neck-shoulder pain and function, targeting neck-shoulder muscle groups being very effective.[20]Other studies found resistance-based exercises to play a role in the prevention of neck-shoulder symptoms.[20-22]Sivak-Callcott et al. established that five hours of weekly exercise reduces the probability of modifying surgical practice among oculoplastic surgeons.[7]

Regarding workplace ergonomics, only 30% of participants were aware of the concept. This study showed that knowledge alone did not appear to be protective. Therefore, ophthalmic practitioners must be educated and encouraged to apply ergonomic principles to safeguard against injuries.[16] Ergonomic improvements at the workplace aim to create a safer, healthy work environment.[16]Other benefits may arise. For example, productivity increases by 10-15%, with ergonomic improvements.[16] The institute can note decreased levels of job stress, absenteeism, and mistakes (including medical errors).[16]

There are limitations to this study. First, a low number of participants, almost half of them below 30 years, so response and selection bias may have influenced the findings.The cross-sectional nature is another limitation.The questionnaire could have included more details regarding the long-term morbidity of MSDs by recording sequelae of the pain episode, past medical and surgical history, impact on work, and changes to work patterns. An ergonomic assessment would have helped evaluate the postural impact of wearing loupes while operating. A previous study demonstrated that oculoplastic surgeons wearing loupes adopted non-neutral posture 85% of their operating time, either bending or rotation >15°, along with flexion of >15°. Approximately 26% of their time in extreme postures with bending (>30°), rotation (>45°), and high flexion (>45°).[5,7] Other reports found significant risk factors contributing to MSDs in the ophthalmic field include excessive static loading or exertion and repetition. [12,16]In addition tothemental stress associated with operating.[16] Most participants (32%) reported using front-lens-mounted loupes.While none of the available loupe systems provide neutral head posture, well-designed loupes should support a working posture of <25° of head flexion and <15° of head extension.[16]

Conclusion

In summary, the goal of this study was to identify the prevalence of musculoskeletal pain among Saudi ophthalmic surgeons who use loupes so that necessary actions can be taken at the physician, department, hospital, and industry level to tackle this rising concern. Our survey established that work-related musculoskeletal pain remains a risk amongst all ophthalmologists. Although most participants owned loupes, a direct relationship could not be established between loupe use and pain prevalence. Further research is required to identify the exact pathophysiology of pain or injury associated with ophthalmic surgery, specifically among loupe users. At the ergonomic level,developing new loupe designs that minimize awkward body positions and reduce cervical load; creating specific exercise programs to strengthen neck-shoulder and lower back muscles; stressing the importance of body-positive positions and active, healthy living among ophthalmic surgeons, especially those at the beginning of their career, to prevent future musculoskeletal injuries.

Declarations

Funding: The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Competing Interests: The authors have no relevant financial or non-financial interests to disclose.

Author Contributions: All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by AyshaAlOqab, WalaaAlTurkistany, and Hala M Nassim Ali. The first draft of the manuscript

was written by Aysha AlOqab and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Consent to Participate: Informed consent was obtained from all participants. This article does not contain any personal information that could lead to the identification of the participants.

Ethics Approval: This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of King Fahd Hospital of the University approved this study (23.05.2021/IRB-2021-11-191).

Acknowledgements: None.

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Tables

Table 1 Characteristics of the study participants (n=93)

Characteristics	N	%
Age (Years)		
23-29	43	46.24
30-39	35	37.63
40 and above	15	16.14
Gender		
Female	57	61.29
Male	36	38.71
Nationality		
Saudi	81	87.1
Other	12	12.9
Specialty		
Ophthalmology Resident	47	50.54
Pediatric Ophthalmologist	16	17.20
Oculoplastic Surgeon	15	16.13
Other	15	16.13
Training Program (Residents)		
Dammam	30	63.83
Riyadh	6	12.77
Jeddah	5	10.64
Abha	2	2.13
Other	4	8.52
Level of Training		
Residency Year 1	3	6.38
Residency Year 2	12	25.53
Residency Year 3	12	25.53
Residency Year 4	20	42.55
Practice Setting		
Teaching Hospital	60	38.96
Eye Specialist Hospital	54	35.06
General Hospital	31	20.13
Private Practice	9	5.84
Years in Practice		
<5	59	63.44
5-10	17	18.28

11 and more	17	18.28

Table 2 Loupe specifications and usage patterns (n=93)

Specifications	N	%
Loupe familiarity		
Yes	87	93.55
No	6	6.45
Loupe ownership		
Yes	51	54.84
No	42	45.16
Time of purchase		
Residency Year 1	11	21.57
Residency Year 2	12	23.53
Residency Year 3	9	17.65
Residency Year 4	3	5.88
Fellowship	11	21.57
Upon Practicing	5	9.80
Magnification		
2.5	36	38.71
3.5	19	20.43
4.5	3	3.23
Don’t know	35	37.63
Type		
Front-lens-mounted	30	32.26
Head-mounted	24	25.80
Through-the-lens	13	13.98
No preference	26	27.96
Brand		
Designs for Vision	12	12.90
Zeiss	12	12.90
Keeler	10	10.75
Hiene	1	1.08
Other	58	62.37
Frequency of usage		
Always	10	10.75
Often	14	15.05
Sometimes	6	6.45
Rarely	40	43.01

Never	23	24.73

Table 3 Loupe usage across various operations (n=93)

Operations of Usage	N	%
Lacrimal surgery	70	75.27
Strabismus surgery	48	51.61
Orbital tumor removal/biopsy	24	25.81
Enucleation/evisceration/exenteration	24	25.81
Blepharoplasty	21	22.58
Eyelid tumor removal/biopsy	21	22.58
Orbital decompression surgery	20	21.51
Ectropion/entropion repair	18	19.35
Ptosis repair	17	18.28
Injectables (Botox/fillers)	16	17.20
Orbital fracture repair	14	15.05
Chalazion excision	12	12.90
Other	1	1.08
None	9	9.68

Table 4 Risk factors for musculoskeletal pain among participants

Characteristics	Total (n=93)	Yes (n=76) [%]
Age (Years)		
23-29	43	31 [40.79]
30-39	35	30 [39.47]
40 and above	15	15 [19.74]
Gender		
Female	57	47 [61.84]
Male	36	29 [38.16]
Specialty		
Ophthalmology Resident	47	37 [48.68]
Pediatric Ophthalmologist	16	14 [18.42]
Oculoplastic Surgeon	15	15 [19.74]
Comprehensive Ophthalmologist	15	10 [13.16]
Years in Practice		
<5	59	46 [60.53]
5-10	17	13 [17.10]
11 and more	17	17 [22.37]
Surgical Volume (hours/week)		
> 6	16	14 [18.42]
4-6	30	27 [35.53]
1-3	13	8 [10.52]
< 1	34	27 [35.53]
Length of Individual Case (hours)		
≥ 3	2	2 [2.63]
2	7	7 [9.21]
1	46	39 [51.32]
< 1	38	28 [36.84]
Frequency of Loupe Usage		
Always	10	10 [13.16]
Often	14	14 [18.42]
Sometimes	6	4 [5.26]
Rarely	40	33 [43.42]
Never	23	15 [19.74]
Loupe Ownership		
Yes	51	45 [59.21]

No	42	31 [40.79]
Type of Loupe		
Front-lens-mounted	30	27 [35.53]
Head-mounted	24	21 [27.63]
Through-the-lens	13	12 [15.79]
No preference	26	16 [21.05]
Activity Level (days/week)		
Four to seven	15	12 [15.79]
Two to three	29	21 [27.63]
One	22	20 [26.32]
None	27	23 [30.26]
Knowledge of Workplace Ergonomics		
Yes	38	30 [39.47]
No	55	46 [60.53]

Table 5 Summary of previous publications and the risk factors of MSDs in the surgical work force among loupe users

Article	MSD	Respondents	Response Rate	Prevalence of Pain	Loupe Use	Surgical Intervention	Significant Risk Associations
Sivak-Callcott et. al (2011)[7]	Neck, back, and shoulder	Oculoplastic surgeons	21.5 – 28.2% 130 respondents	72.5%	80.9%	7.6% spinal surgery	1. Operating 2. < 5 hours of exercise per week
Farook et. al (2012)[17]	Neck and back	Dental trainers and trainees	153 respondents	47% dental trainers (loupe users and nonusers) 22-27% dental trainees (loupe users and nonusers)	31% (62% were dental trainers)	–	–
Godwin et. al (2017)[12]	Cervical	Consultant plastic surgeons	81% 342/424 (329 usable responses)	32% (106/329)	99% (325/329)	6% steroid infiltration 4% discectomy	1. Duration of loupe use (hours worn) 2. Older age
Howarth et. al (2018)[18]	Neck, back, and shoulder	Microsurgeons	16.7% 117/700	50% acute pain 40% chronic pain	53% [MSD for surgery with loupes had a median pain level of 4/10 (10 worst pain)]	5% surgery	–
Howarth et. al (2019)[6]	Neck and back	Craniofacial and maxillofacial surgeons	23.8% 95/400	55% acute pain	[MSD for surgery with loupes had a median pain level of 4/10 (10 worst pain)]	–	1. Operating 3 days per week 2. Operating > 10 hours
Meisha et. al (2019)[19]	General	Dentists	65% 239 /360	70%	23.9%	–	1. Wearing dental loupes 2. Proper chair positioning 3. Sufficient light at the workplace

							4. Having the instruments within hand's reach 5. Performing stretching exercises after clinical practice *(Decrease the odds of MSD)*
Aboalshamat et. al (2020)[11]	General	Dental practitioners	80% 400/500	8% loupe user vs 19% nonusers *(Pain in the last 7 days)*	12.3%	–	1. Loupe use was associated with *lower levels of MSD*

Figures

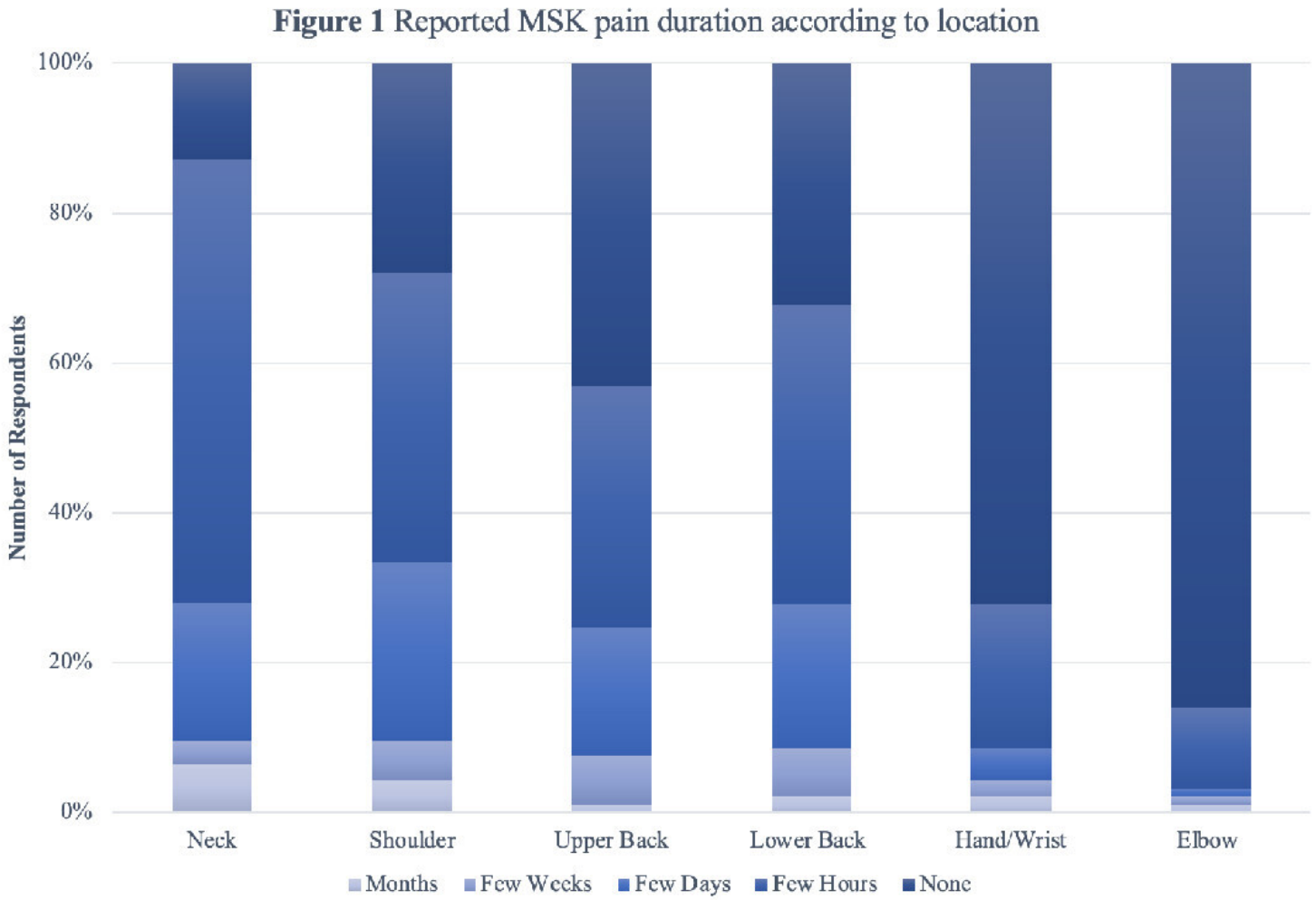

Figure 1

See image above for figure legend.

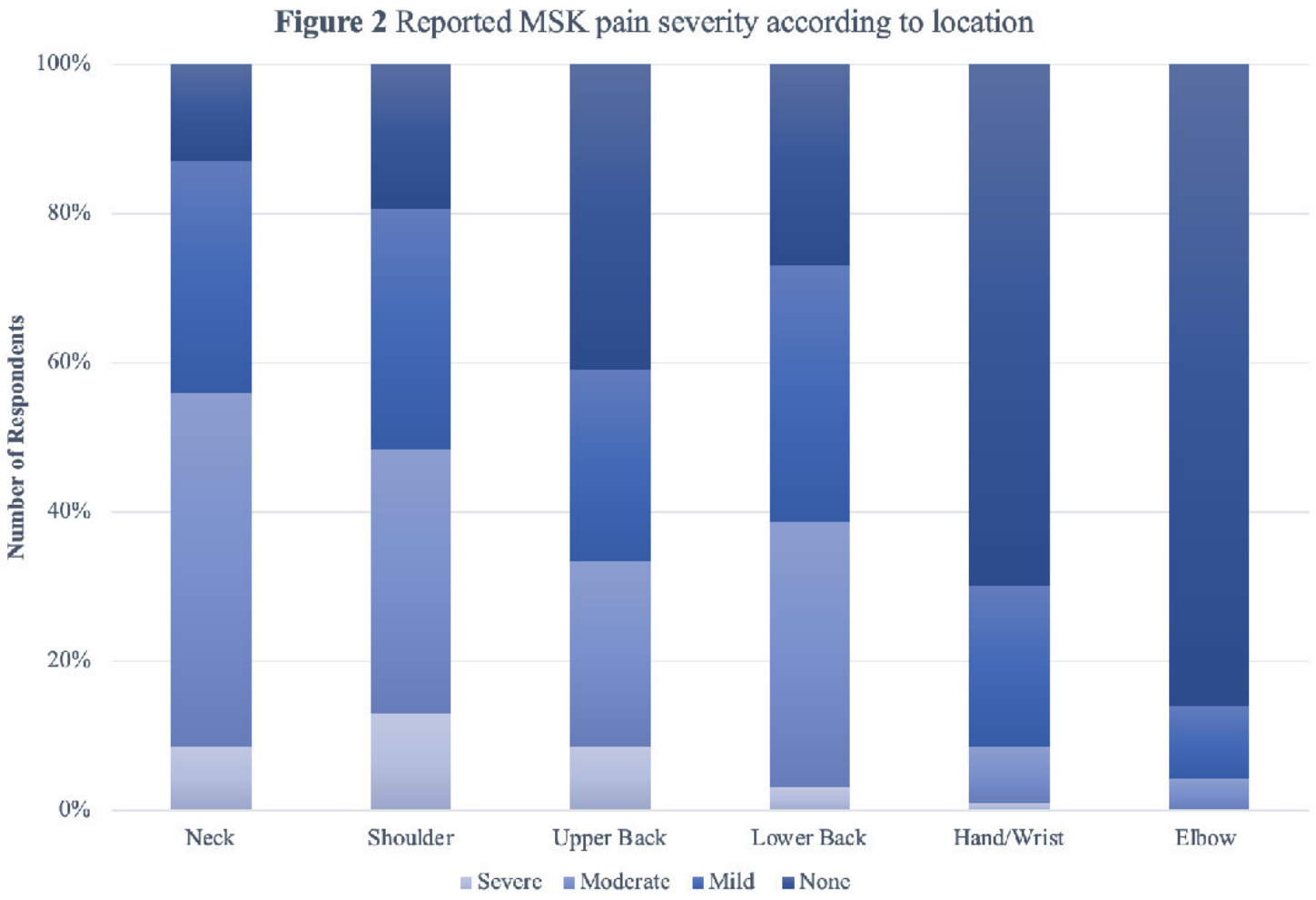

Figure 2

See image above for figure legend.

Supplementary Files

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- Appendix1.docx