Cervical occupational hazards in ophthalmic plastic surgery

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Purpose of review

To increase awareness of cervical musculoskeletal disorders (cMSD) in ophthalmic plastic surgeons (OPS) and review strategies for management and prevention.

Recent findings

There are objective data that show OPS spend the majority of their time operating in awkward, prolonged, static, asymmetric postures. These postures increase cervical load and cMSD. Loupes and headlamps further increase this cervical loading by 40%. Risk for cMSD is not limited to the operating room. Muscular demands in the anterior deltoid and cervical trapezius are increased in slit lamp biomicroscopy and indirect ophthalmoscopy. Furthermore, the majority of the office visit is spent keyboarding into the electronic medical record which is associated with cMSD. Habitual postural faults result from these cumulative exposures. These must be addressed to prevent further insult and debilitating injury. Successful management requires education in neutral posture, therapeutic exercise, environmental adjustments in the workplace and home, and supported neutral sleep posture.

Summary

The risks of cMSD in OPS are well established, and nearly 10% of cervical injury will end a career. Neck pain must not be ignored, and experienced professional help is critical. A long-term approach that incorporates exercise, manual therapy, and education is essential for management and prevention.

Keywords

ergonomics, loupe, musculoskeletal, oculoplastic surgery, ophthalmology

INTRODUCTION

Our purpose is to increase awareness and understanding of cervical musculoskeletal disorders (cMSD) in ophthalmic plastic surgeons (OPS), so that injury is recognized early, and strategies for management, improvement, and prevention can be implemented.

Ophthalmic plastic surgeons are at risk for cervical spine disorders [1,2▪▪,3–6]. Nearly one-tenth of these injuries end a career [1]. The other 90% interfere with the ability to work and overall quality of life. Signs of cMSD occur early in a career (mean age 35 years) [7]. Despite awareness of this occupational hazard, there are few objective studies of cMSD in OPS, most not in the ophthalmic literature. This article summarizes the risks and etiology of cervical injury in OPS based on published information. The anatomic aspects and physiology of cMSD are presented with recommendations for intervention.

TEXT

Risk for injury

Neck/shoulder pain, awkward posture, high volume surgery, high patient load, and lack of exercise are associated with cMSD [1,2▪▪,5,6]. It is well established that neck/shoulder pain indicates injury [8]. Over 80% of surgeons who use loupes have neck

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KEY POINTS

- Neck pain, awkward posture, high case/patient load, and lack of exercise are associated with cMSD.
- Complex operating room postures generate high cervical loading.
- Loupes and headlamps increase cervical loading 40%.
- Rehabilitation requires a functional, integrated whole-body approach.
- Exacerbations of cMSD require prompt intervention.

pain, and 72.5% of OPS have pain while operating, 58% localized to the neck [1,9]. Neck pain should not be ignored.

Awkward postures held for lengthy periods of time (static contraction and load), frequently repeated, in a setting of high cognitive load, lead to injury [10–13]. Ophthalmic plastic surgeons perform highly dexterous surgery on very small irregular surfaces, often looking into a deep hole in which visualization is difficult (e.g. dacryocystorhinostomy, deep orbital surgery). To improve visualization, 80% use loupes, and nearly 70% use headlamps [1]. Both of these increase cervical spine load and risk of cMSD [2••,3,4,14]. Moreover, demanding postures are not limited to the operating room. Slit lamp biomicroscopy and indirect ophthalmoscopy are also associated with high demand on the upper trapezius and deltoids [15]. Although practices vary, it is likely that most OPS spend the majority of their time working in awkward postures.

In general, high volume of surgery is strongly predictive of physical discomfort [16]. Specific to ophthalmology, seeing more than 100 patients per week and performing four or more surgeries per week increases neck, upper extremity, or lower back symptoms [6]. Ophthalmic plastic surgeons who have pain while operating report that it increases with the length of the procedure [1].

Regular physical exercise is negatively correlated with cMSD. In one study, OPS who exercised more than 5 h per week were less likely to modify operating room activities to accommodate pain or injury [1]. One survey study reported those who exercised less than 1 day per week were more likely to have neck/shoulder symptoms than those who exercised at least 3 days per week [5]. In general, neck/shoulder pain/dysfunction can be improved by specifically directed exercises, and resistance training may have a preventive role for cMSD [17–19]. Interestingly, body mass index does not correlate with cMSD [20].

Basic physiology of cervical pain and injury

Habitual postural faults are associated with chronic nontraumatic neck pain and disability [21,22]. Chronic nonneutral postures lead to muscular imbalances and joint stresses. For example, rounding of the thoracic spine with compensatory forward inclination of the head increases sheer stress on the cervical spine. Over time, this leads to shortened posterior neck extensors together with elongated and weak deep anterior neck flexors. The thoracic spine loses mobility, and the shoulders remain rounded forward. Coexisting abdominal weakness, exaggerated lumbar lordosis, and hip flexor tightness are common [21]. Moreover, the postures of OPS are three-dimensionally more complex, thereby complicating this pathophysiology [2••,3,4].

Etiology of cervical musculoskeletal disorders in ophthalmic plastic surgeons

Observational studies have suggested that the strenuous postures adopted by ophthalmologists are based in the flexion/extension plane [23]. The OPS postures adopted while operating are, however, more complex, with triplanar deviation from neutral (Fig. 1) [2••,3]. These generate higher forces on cervical joints compared with near neutral postures [2••,3].

In a field study by the authors, three-dimensional posture data were obtained from three OPS while performing eyelid and orbital operations (duration: 45–60 min eyelid, 60–90 min orbital). The total time during which data were recorded was 30.5 h for eyelid and 20 h for orbital operations [2••,3]. Eighty-five percentage of operating time was spent with the OPS in nonneutral posture, characterized by head-neck flexion more than 15° coupled with bending or rotation angles of more than 15°. About 26% of the time, the surgeons assumed extreme nonneutral and asymmetrical postures with high flexion (>45°), rotation (>45°), and bending (>30°) [2••,3]. Data analysis using a biomechanical cervical spine model revealed the following: first, an increase in bending from 15° to 30°, significantly increased cervical load in postures consisting of flexion between 15° and 30° and rotation between 15° and 45°; second, increasing flexion from 30° to 45°, and significantly increased cervical load in postures consisting of bending of 15° and rotation between 15° and 45° [2••,3].

In this same field study, surface electromyography (EMG) of the cervical trapezius and sternocleidomastoid was recorded. On average, significant fatigue of these muscles occurred at 45 min.

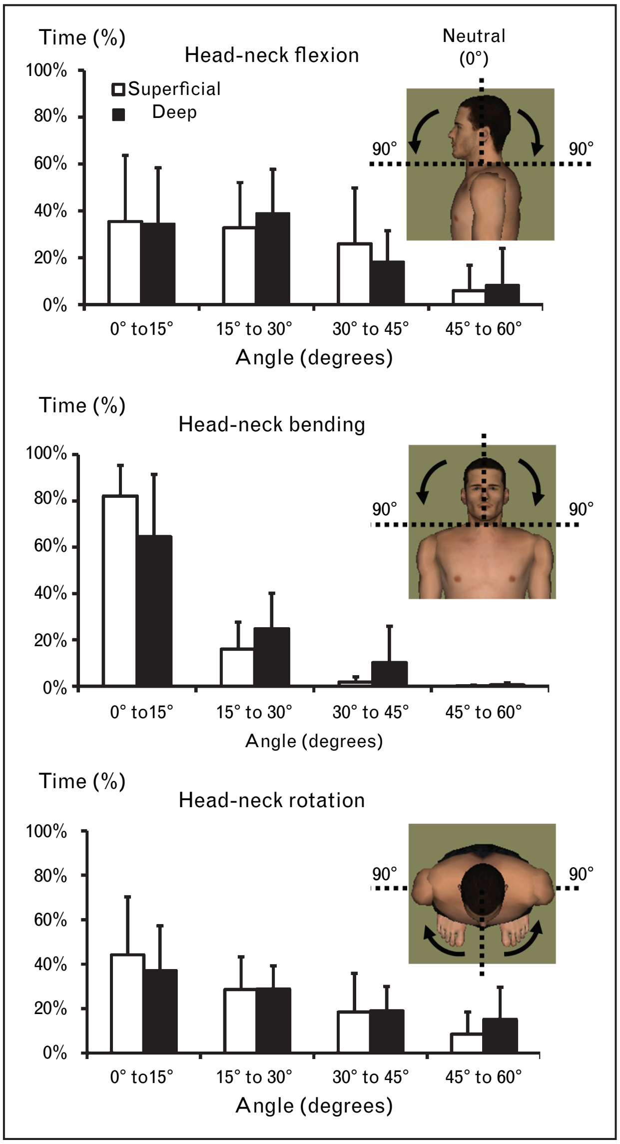

FIGURE 1. Summary of postural data (error bar represents one standard deviation).

The use of loupes and headlamps increased mean cervical loading by 40% overall, across all postures, at all cervical levels. The effect of these devices was more pronounced in postures consisting of flexion at least 45° and bending of 15–30° [2■■,3]. In these postures, greater muscle forces are required to support the weight of the head alone, and a further increase in force is required when wearing loupes and a headlamp.

Most OPS use loupes and headlamps. Loupes are mounted at a fixed angle and limit fields of depth and vision which consequently restricts head–neck motion. A surface EMG study of the cervical trapezius and sternocleidomastoid found that head–neck flexion decreased with an increase in loupe angle, but increased muscle activation occurred despite a reduction in flexion [14]. This may be because of a more erect head–neck posture and a consequent increase in tension in the neck musculature. The headlamp is mounted to the head, forcing a change of head position to illuminate the operative field, adding one more layer of restriction to head–neck motion.

Risks for cMSD also arise in the office setting. A continuous surface EMG study of 15 ophthalmologists (608 examinations) found that use of the indirect ophthalmoscope and the slit lamp biomicroscope are associated with increased muscular effort in the anterior deltoid and upper trapezius [15]. Although these examinations are relatively brief, neck and shoulder pain can result from cumulative exposure [24,25]. This study also found that keyboarding comprised the majority of an office visit. Computer use is linked to musculoskeletal symptoms involving the neck and arm [26].

The awkward postures adopted by OPS during surgery, together with loupe and headlamp use, the increased muscular activity required during slit lamp examinations and indirect ophthalmoscopy, and the keyboarding required by the electronic medical record constitute potential insults to the neuro-musculoskeletal system. Cumulatively, these exposures are the etiology of cMSD in OPS.

Acute intervention

OPS with neck, shoulder, and/or upper back pain should be evaluated by specialists with experience in cervical occupation-related disorders. A thorough neurological examination is imperative, with particular attention to nerve root impingement related to the complex, asymmetric postures. Range of motion, strength, posture, ergonomics, and functional limitations should be evaluated. Highly irritating symptoms, including muscle spasm, can be managed with relative rest, range of motion, and lower intensity manual therapies. Headache is frequent with cervical dysfunction, and manual techniques to relax the suboccipital muscle group and improve movement in the upper cervical segments (C1–C3) can be helpful. The use of a soft cervical collar may be beneficial. The use of NSAIDS evening topically may be beneficial [27]. Radicular symptoms because of nerve root irritation require special caution, and the prognosis is less favorable.

Once acute symptoms subside, cervical mobility is addressed. This is frequently excessive in women with long, lithe necks, and exercises to improve stability and neuromuscular control are recommended [28]. Cervical hypomobility is treated with joint mobilizations and stretching. Treatment should not be limited to the neck;

thoracic spinal movement has to be improved because this has been shown to lessen cervical pain and improve outcomes with respect to the cervical spine [29,30].

Early intervention may prevent the chronic, irreversible, postural changes that lead to disability. Prognosis is generally favorable when three to four of the following factors are present: first, age less than 54 years, second, dominant arm uninvolved, third, no increase in symptoms with cervical flexion, and fourth, participation in a comprehensive rehabilitation program [31].

Long-term management and prevention

Long-term treatment of cervical dysfunction because of postural faults includes: first, education in neutral posture, second, therapeutic exercise, third, environmental adjustments in the workplace and at home, and fourth, supported neutral sleep posture (Fig. 2).

Neutral posture

Ideal posture evenly distributes compressive loads across the spine with minimal muscular effort. In the seated position, this includes an anterior tilt of the pelvis, lumbar lordosis, neutral thoracic kyphosis, lower cervical lordosis, and upper cervical kyphosis [23]. The thighs should be parallel (or angled upward slightly) to the floor with feet resting flat on the floor. The trunk should be perpendicular to the floor. Shoulders and upper arms ought to be relaxed, close to the body, in line with the torso, and generally perpendicular to the floor (Fig. 3) (http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html). When using a keyboard, ideally the forearms are parallel to the ground with wrists and hands straight and supported. Reaching should be avoided (Fig. 3) (http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html). When standing, the legs, torso, and neck should be approximately in line, while maintaining the natural curves of the spine as described above (Fig. 3) (http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html). A basic method of finding neutral alignment is outlined in Fig. 4. A particular posture, even if ideal, should not be held statically for an extended period of time. If prolonged standing is required, alternate placement of a foot on an elevated surface is recommended (http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html). Alternating the seated and standing positions obviates the problems arising from prolonged static positions.

FIGURE 2. Neutral sleeping posture on side and back with neck (towel roll), arm (pillow), and leg (pillow) supported.

Exercise

The human body can be conceptualized as a set of interconnected polyarticular chains. Consequently, a change in one part of the body has remote effects. The ideal alignment of the head and neck allows the position of the head to be maintained with minimal muscular effort. This cannot be achieved if the pectoralis minor and hip flexor muscles are tight and the thoracic spine is immobile. Longstanding awkward postures affect the entire body and can be equally difficult to recognize and alleviate. Because of the asymmetric nature of the postures typical for OPS, expert professional assistance in designing and determining the proper form of exercises is highly recommended. Postural correction for forward head/rounded shoulders includes stretching of the cervical spine extensors, pectoralis minor, and in some

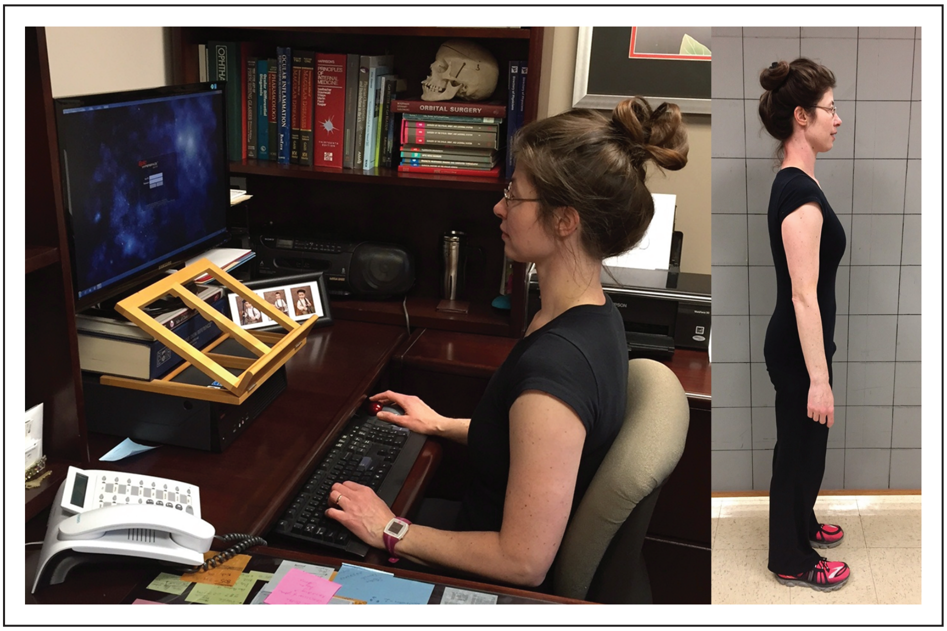

FIGURE 3. Neutral posture sitting and standing. The standing figure has slightly rounded shoulders with a mildly flat thoracic spine.

cases the low back and hip flexors. Strengthening of the anterior cervical deep flexors, thoracic extensors, scapular stabilizers, and abdominal muscles is essential. Standard exercises, such as pectoralis deck strengthening and crunches, are not advisable as these promote rounded shoulders and increase thoracic kyphosis; strengthening of the abdominals with avoidance of a rounded thoracic spine is required [32]. Successful rehabilitation is based on a foundation of therapeutic exercise complemented by specific interventions and patient education [33]. Manual therapy (e.g., massage, acupuncture) can be beneficial. But, patient recognition of aggravating and mitigating factors is imperative [33]. Exacerbations of cMSD are inevitable as long as one continues to practice ophthalmic plastic surgery, and when this arises prompt professional intervention is essential. Many forms of exercise and manual therapy satisfy the general principles of treatment. The key to long-term success is finding the most enjoyable modality, obviously individual specific. Although focused treatments are important, especially in the acute phase, a functional, integrated, whole-body approach is essential for long-term success.

Ergonomic (environmental) intervention

Loupe and headlamp use should be minimized. These devices need to be as light as possible, and the headlamp should have a multiarticulate joint for adjustment of the light position. Maximal decline loupe angle has been suggested empirically. The most ergonomic angle is, however, not known [14]. Rest and relief from static position, i.e., taking breaks, perhaps every 45 min, should be incorporated into long cases and between cases. All seated activities (e.g., surgery, office examinations, keyboarding) should be performed in chairs that provide proper support, including height adjustments that keep the thighs parallel (or knees slightly elevated) to the floor and feet resting flat on the floor. The chair must have an adjustable backrest that gives an inward curve to the lumbar spine and outward curve for the thoracic spine (Fig. 3). The chair should rotate readily for proper positioning in front of the computer or the patient (http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html). In the operating room, chairs with chest support can be useful as forward leaning often cannot be avoided. Patient placement should allow the physician to achieve the best possible ergonomic position. Time taken to raise or lower the bed/examination chair is well spent. An operating room table that minimizes reach (narrow headrest) and can be tilted for better access to the patient is highly desirable. As much as possible, the forearms should be supported. Patients can be asked to lean forward into the slit lamp, with forehead against the strap, while grasping the handlebars for stability.

Recently, modifications of the slit lamp biomicroscope and indirect ophthalmoscope have been shown to reduce upper trapezius and left anterior deltoid effort (EMG amplitude) 9–15% [34]. Slit

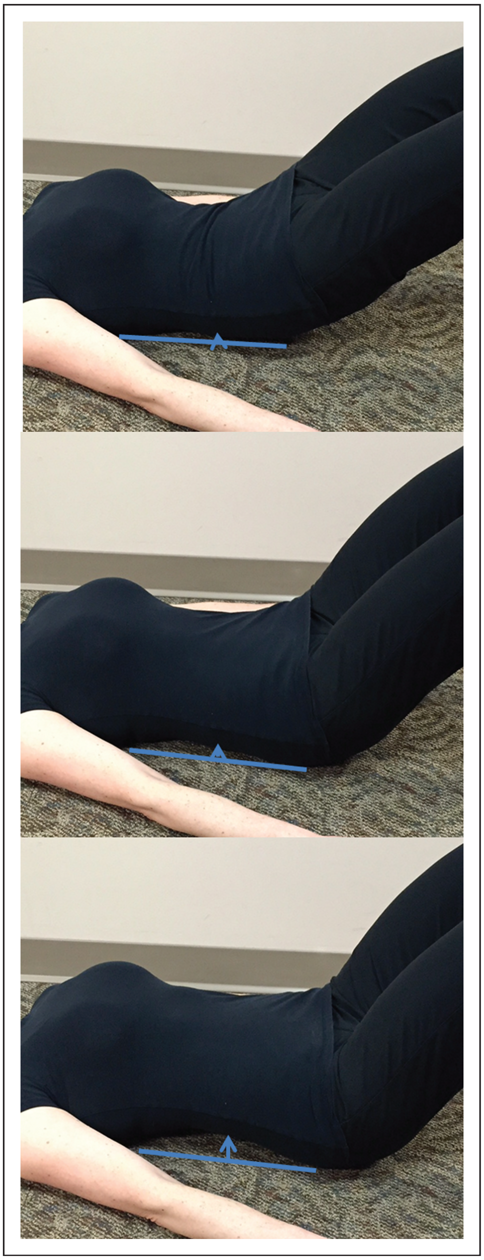

FIGURE 4. Pilates approach to finding neutral spine position. Laying in supine with feet flat on the floor, heels, toes, knees, and hips in line, relax the shoulders, neck, and jaw. Allow the lower ribs to drop into the floor. Inhale with the intent of expanding your back and side ribs, exhale and press the lumbar spine into the floor in a pelvic tilt position (top photo), allowing your abdomen to sink toward the spine. Inhale to release back to neutral (middle photo). Exhale and pull the lower spine up away from the floor, continuing to keep the abdomen pulled in toward the spine (bottom photo). Continue with this breathing and movement, making each repetition smaller until a neutral spine is reached (anterior iliac crest and pubic bone inline and parallel to the floor). Maintain the shoulders relaxed toward the hips without rigidity in the neck. The lines and arrows show the distance between the back and the floor.

lamp oculars with an incline tilt reduce neck flexion, a wider table improves arm support, and an elbow rest mitigates prolonged arm elevation when holding a lens. A balanced indirect ophthalmoscope eliminates the concentration of weight on the forehead. These modifications have been found subjectively to be more comfortable [34]. Further interventions to improve the ergonomics of the office are described in the American Academy of Ophthalmology Best Practices (http://one.aao.org/course/ergonomics-best-practices).

Keyboarding for entry of information into the electronic medical record comprises the majority of office visit time for ophthalmologists [15]. Computer use also consumes a significant amount of time at home. In addition to a neutral seated position, the Occupational Safety and Health Administration recommends the following: first, the torso face the computer screen at a distance of 18–24 inches; second, the top of the monitor be at or below eye level so that it can be seen, even with bi- or trifocals, without bending the head forward or backward; third, the center of the monitor be about 15° below eye level, fourth, the keyboard be at a height that keeps the forearms parallel to the floor; fifth, there are no sharp edges; sixth, the wrists should be supported; seventh, that the input device be to the right of the keyboard at a position that eliminates reaching; and eighth, that the keyboard and input device be stable (Fig. 3) (http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html).

CONCLUSION

The risks for cMSD in OPS are well established. They are built into every aspect of practice and persist while at home. Symptoms arise early in the course of a career, and must not be ignored. Experienced professional help is critical, and a long-term rehabilitation plan that incorporates exercise, manual therapy, and education is essential for both management and prevention. More studies are needed to define effective interventions.

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Conflicts of interest

There are no conflicts of interest.

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■■ of outstanding interest

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