

Is there an Increased Incidence of Cervical Degenerative Disease in Surgeons who use Loupes and a Headlight?

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Abstract

Background context: The ergonomic effects of headgear on spine surgeons are poorly understood. Assessment of cervical degenerative disease resulting from prolonged use of loupes and/or headlights was performed via data drawn from spine surgeons.

Methods: A questionnaire was distributed to 54 fellowship trained spine surgeons. Part one assessed the current level of neck pain compared to prior to residency. The amount of exposure to headgear usage was determined using this formula for headgear hours: Headgear Hours=Years in practice * Number of months per year of headgear usage * Number of cases per month * Number of hours per case. Part two assessed whether a specific diagnosis or treatment associated with neck symptoms was rendered or received. The respondents were placed into two groups for comparison: Group A (non- or infrequent users of headgear), Group B (frequent users).

Results: 28 of the 41 (68%) surgeons in Group B experienced worsening of their neck symptoms since the start of their residency versus 5 of the 13 (38%) in Group A ($p=0.027$). Only 1 surgeon from group A was diagnosed with a degenerative cervical disorder compared to 14 from Group B.

Conclusions: Neck pain among spine surgeons is not uncommon. Poor ergonomics during surgery combined with frequent headgear use may contribute to increased neck pain and cervical degenerative disease.

Keywords: Neck pain; Ergonomics; Loupes; Headlights; Headgear; Cervical spondylosis; Cervical degenerative disease; Surgeons

Introduction

Ergonomic awareness is important for surgeons as equipment used to optimize intraoperative visualization often distributes substantial musculoskeletal forces on the axial skeletons of surgeons. Up to 70% of surgeons who perform endoscopic surgery experience neck, shoulder, or back pain associated with improper table height or monitor positioning [1]. In one study, 67% of the evaluated operating rooms for endoscopic surgery had poor ergonomic conditions [2]. Similarly, epidemiologic studies have reported a 70% prevalence of neck pain among dentists who use loupe magnification [3,4].

In addition to loupes for magnification used by dentists, many spine surgeons use powerful headlights to illuminate the operative field. Headgear use during surgery requires spine surgeons to hold their heads in a fixed, flexed position for prolonged periods of time. Biomechanical studies show that this position increases disc pressures within the cervical spine which may, in turn, lead to degenerative neck disease [5].

Some studies suggest that the proper selection and use of loupes reduces the amount of eye and neck strain in dentists by improving working posture [6,7]. These recommendations may be beneficial in reducing the same symptoms in spine surgeons. To our knowledge, there is no published study that evaluates the correlation between the use of headgear (loupes and headlights) with the development of degenerative neck disorders in spine surgeons.

Materials and Methods

Subjects

Questionnaires (Figure 1) were distributed to fellowship trained spine surgeons from March 2006 to December 2007. A total of 200 questionnaires were handed out at two spine conferences: the 2006 Cervical Spine Research Society meeting in Palm Beach, Florida and the 2007 Texas Spine Society Meeting in Austin, Texas. 30 additional

questionnaires were distributed at the 2007 American Academy of Orthopaedic Surgeons meeting in San Diego, California. Another 5 were distributed to spine surgeons at the investigating institution. Permission was obtained at each meeting to distribute the questionnaires and an announcement was made at the start of each meeting that conference participants were invited to fill out a survey as a part of a research study. Participation was voluntary. All subjects were chosen randomly by handing out questionnaires within the main meeting hall and at the doorway during breaks between sessions. Additional surveys were made available at the registration desk. Surveys were returned directly to the lead investigator or left in a collection box at the registration desk. Surveys distributed to the surgeons at the investigating institution were given to and collected from each surgeon personally by one of the co-authors.

Surveys were distributed randomly without regard to appearance, race, gender, age, or personal relationship. Participation was strictly voluntary - this was emphasized with an announcement at each meeting and to each surgeon who was handed a survey. 54 surveys were returned out of 235 surveys distributed (23%).

Demographic data was collected: age, gender, specialty (orthopaedic surgery or neurosurgery), years in practice, family history of cervical spondylosis, tobacco use.

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INTRODUCTION

This questionnaire is part of a study on the prevalence of degenerative neck problems in spine surgeons. It is designed to test the correlation of the use of headgear (loupes and/or headlights) with neck symptoms.

STUDY HYPOTHESIS

THE RISK OF DEVELOPING CERVICAL SPONDYLOSIS INCREASES WITH THE USE OF HEADGEAR (LOUPES AND/OR HEADLIGHT)

DEMOGRAPHIC INFORMATION

AGE: _____
 GENDER: M _____ F _____
 SPECIALTY: ORTHOPAEDICS _____ NEUROSURGERY _____
 YEARS IN PRACTICE: _____
 FAMILY HISTORY OF SPONDYLOSIS: YES NO
 SMOKER: YES NO FORMER SMOKER: YES NO
 Email address (optional): _____

PART ONE: NECK PAIN AND RISK FACTOR ASSESSMENT

Instructions: There are two sections below. If appropriate answer the follow-up questions on severity and frequency of your pain and use of headgear. Refer to the key below for specific definitions of pain severity, pain frequency, and frequency of headgear usage.

^aSeverity of Pain:
 1-Minimal Pain
 10-Worst pain ever

^bFrequency of Pain or Headgear Exposure:
 1 Seldom= Few times
 2 Regular= 1-3 times per month
 3 Frequent= 4 or more times per month

Headgear = headlamps, headlights, loupes, etc.

- I. PRIOR TO RESIDENCY/FELLOWSHIP
 A. DID YOU EXPERIENCE ANY EPISODES OF NECK PAIN:
 YES NO (IF NO MOVE TO SECTION II)
 1. SEVERITY OF PAIN^a:
 1 2 3 4 5 6 7 8 9 10
 2. FREQUENCY OF PAIN^b:
 1 2 3
- II. DURING OR AFTER RESIDENCY/FELLOWSHIP
 A. HAVE YOU EVER EXPERIENCED ANY EPISODES OF NECK PAIN:
 YES NO (IF NO MOVE TO PART B)
 1. SEVERITY OF PAIN^a:
 1 2 3 4 5 6 7 8 9 10
 2. FREQUENCY OF PAIN^b:
 1 2 3
 3. AFTER HOW MANY YEARS OF SURGERY DID THE SYMPTOMS DEVELOP: _____
- B. HAVE YOU EVER USED ANY HEADGEAR DURING SURGERY:
 YES NO (IF NO MOVE TO PART TWO OF SURVEY)
 1. FREQUENCY OF USAGE^b:
 1 2 3
 2. DID YOU LIMIT HEADGEAR USAGE TO PREVENT PAIN:
 YES NO
 C. IF YOUR HEADGEAR USAGE FROM QUESTION B WAS REGULAR (2) or FREQUENT (3):
 1. HOW MANY MOS./YR. DID YOU USE HEADGEAR:
 1 2 3 4 5 6 7 8 9 10 11 12
 2. FOR HOW MANY CASES PER MONTH: _____
 3. AVG. DURATION OF EACH USE (HOURS): _____
 4. DID YOU LIMIT HEADGEAR USAGE TO PREVENT PAIN:
 YES NO

PART TWO: DIAGNOSIS AND TREATMENT ASSESSMENT

Instructions: Please answer the following questions on whether a diagnosis has been made regarding your neck pain either by you or another physician. Then answer whether an intervention was given for your neck pain either by you or another physician. CIRCLE ALL ANSWERS THAT APPLY.

- I. WHICH OF THE FOLLOWING MEDICAL DIAGNOSIS HAVE BEEN MADE REGARDING YOUR NECK SYMPTOMS:
 A. CERVICAL HERNIATED DISC
 B. CERVICAL DEGENERATIVE DISC DISEASE
 C. CERVICAL RADICULOPATHY
 D. CERVICAL MYELOPATHY
 E. OTHER: _____
 F. NONE
- II. METHOD OF DIAGNOSIS:
 A. HISTORY AND PHYSICAL
 B. IMAGING: XRAY, MRI, CT, ETC.
 C. OTHER: _____
- III. TREATMENT RECEIVED
 A. NONOPERATIVE
 1. REST/ACTIVITY MODIFICATION
 2. THERAPEUTIC MODALITIES: MASSAGE, COMPRESSES, ETC.
 3. ORAL MEDS:
 a. NSAIDS
 b. STEROIDS
 c. MUSCLE RELAXERS
 d. NARCOTICS
 4. PHYSICAL THERAPY
 5. OTHER: _____
 6. NONE
 B. OPERATIVE
 1. ESI(s)
 2. LAMINOTOMY
 3. LAMINOPLASTY
 4. ACDF
 5. OTHER: _____
 6. NONE

Figure 1: Survey questionnaire. Part 1 is a screening questionnaire. Part 2 gathers diagnostic and treatment information.

The remainder of the questionnaire consisted of two parts. Part one was titled "Neck Pain and Risk factor Assessment". In this section, the amount of headgear usage and the development of neck symptoms were determined. Part two was titled "Diagnosis and Treatment Assessment". Only surgeons with neck symptoms were instructed to fill out this section. Information was collected regarding whether a formal diagnosis was made and/or treatments rendered. Information collected from the questionnaire was then analyzed for the results below.

The questionnaire collected data regarding neck symptoms by first asking about symptoms experienced prior to headgear exposure during residency. The surgeons were asked to indicate their pre-exposure level of neck pain on a visual analog scale from 0 to 10. They then indicated the frequency of these neck symptoms by the scale below. They answered the same questions regarding their current level of pain and frequency of pain. The surgeons were then asked to indicate the number of years prior to development of symptoms and whether they limit their use of headgear due to pain.

Infrequent pain (less than once per month on average)

Regular pain (1-3 times per month on average)

Frequent pain (4 or more times per month on average)

Next, headgear exposure was assessed by asking the surgeons to quantify their exposure to headgear by choosing one of three categories below.

1) Seldom use of headgear (less than once per month on average)

2) Regular use of headgear (1-3 times per month on average)

Frequent use of headgear (4 or more times per month on average)

An exact amount of headgear exposure was determined by collecting the number of months per year headgear was worn, number of cases per month, and average duration of each case (in hours). In part two of the questionnaire the surgeons were asked to indicate which, if any, diagnoses and/or treatments have been given for their neck symptoms. The diagnoses and treatments are listed below.

Diagnoses

Cervical herniated disc

Cervical degenerative disc disease

Cervical radiculopathy

Cervical myelopathy

Other

Treatments

Nonoperative:

- Rest/activity modification
- Therapeutic Modalities: Massage, Compresses, etc.

- Oral meds: Non-steroidal anti-inflammatory drugs (NSAIDs), Steroids, Muscle relaxers, Narcotics
- Physical therapy (PT)
- Other

Operative:

- Epidural Steroid Injection (ESI)
- Laminotomy
- Laminoplasty
- Anterior cervical discectomy and fusion (ACDF)
- Other

Statistical analysis

Data were analyzed using tests of proportions and logistic regression (Stata Ver 10, Stata Corp, College Station, TX) with statistical significance defined by $P < 0.05$.

Results

54 surgeons responded to the survey and all were male. The median age was 48 years (range: 31 to 72 years old), and the median number of years in practice was 16 (range: 1 to 49). Twelve respondents were neurosurgeons and 42 were orthopaedic spine surgeons.

Respondents were placed in one of two groups for analysis (Table 1). Thirteen surgeons were in Group A, which consisted of surgeons who used headgear 3 times or less per month. The average number of headgear-hours for Group A was 1826. Group B consisted of 41 surgeons who used headgear frequently, which was defined as 4 or more times per month. The average number of headgear-hours for Group B was 10424.

Within Group A, 5 of the 13 surgeons (38%) experienced an increase in the severity of symptoms from the start of their training. The average increase in the severity of their symptoms was 4 points on the visual analog scale. Four (31%) surgeons experienced an increase in the frequency of their symptoms. The average increase in frequency was 1.5 on the scale from 1-3, as defined in the questionnaire. One (8%) respondent in this group had been officially diagnosed with a degenerative neck problem (radiculopathy) and 4 (31%) have been treated for neck pain in the past.

Within Group B, 28 of the 41 surgeons (68.3%) experienced an increase in the severity of their symptoms since the start of their training. This proportion was significantly greater than in Group A ($P = 0.027$). The average increase in the severity of their symptoms was 4.1 points on the visual analog scale. Twenty-five (61%) surgeons experienced an increase in the frequency of symptoms ($p = 0.04$). The average increase in frequency was 1.5 on the scale ranging from 1-3 as defined in the questionnaire. 14 (34%) respondents in this group have been officially diagnosed with a degenerative neck disorder and

Groups	Number of Surgeons	Avg. headgear-hrs	Number with an increase in severity of symptoms after headgear usage	Avg. increase in severity of symptoms on VAS	Number with an increase in frequency of symptoms after headgear usage	Avg. increase in frequency of symptoms: scale 1-3	Number of Surgeons receiving treatment
A – use headgear ≤ 3 x/month	13	1826	5 (38%)	4	3 (23%)	1.5	4 (31%)
B – use headgear > 3 x/month	41	10424	28 (68.3%)	4.1	25 (61%)	1.5	24 (58.5%)
			$P = 0.027$		$P = 0.04$		

Table 1: Respondent analysis. Statistical significance at $P < 0.05$.

24 (58.5%) have been treated for neck pain in the past. Two patients in Group B had surgery for their pain. Each patient received an anterior cervical discectomy and fusion, and one of these two surgeons is unable to operate due to disability resulting from his cervical spondylosis.

Logistic regression analysis was performed by creating a variable “painworse” that was set to one for all respondents who had an increase in pain severity. This showed that frequent headgear users are 3.8 times more likely to have a worsening of symptoms ($P=0.05$). Whether the respondent smoked ($P=0.63$) or their age ($P=0.73$) were not significant in logistic regression analysis.

Discussion

Surgeons in Group B had significantly more exposure to headgear than surgeons in Group A (10,424 headgear-hours and 1826 headgear-hours respectively). This is associated with an increase in the severity and frequency of their neck related symptoms. It also correlated with an increase in the number of surgeons receiving treatment in each group. Two surgeons in Group B received surgery for their pain and one is now disabled and unable to operate. In Group A, no surgeons received any invasive treatments (injections or surgery), and no surgeons required any narcotic pain medicine to manage their symptoms. Based on this data, increased usage of loupes and headlights correlates with the development of more severe and frequent symptoms as well as an increased need for more aggressive treatment modalities.

Use of headgear among surgeons is common. The convenience of extra magnification and illumination is helpful but can place significant musculoskeletal stress on the surgeon. Exposure to risk factors such as awkward postures, repetitive motions, and forceful exertion can lead to work-related musculoskeletal disorders and are potentially career-ending [8]. Surgeons in our survey who wore headgear frequently (4+ times per month) had almost 6 times the number of headgear hours compared to those who wore headgear infrequently (3 times or less per month).

Perhaps moderate use of headgear, use only during difficult cases, or replacement with an operating microscope might decrease exposure in a meaningful fashion. Limiting headgear usage may lessen the severity and frequency of symptoms. What remains unclear is exactly how much usage causes neck pain. Further investigation to assess the amount of headgear use that predisposes surgeons to neck pain is warranted.

No previous studies evaluating neck pain in spine surgeons who use headgear are available for comparison. However, neck pain among Swedish helicopter pilots has been evaluated using a similar questionnaire and methodology. In this study, usage of night-vision goggles showed a significant trend towards the development of symptoms [9].

Other studies support the theory that when the head is held in a fixed, flexed position, increased stresses are generated that may produce symptoms of neck pain [1,5,9]. Younger patients with chronic non-traumatic neck pain, and without age-related spondylotic changes, were shown to have a more forward head posture in standing than matched pain-free participants in one study [10].

A separate study involving 284 laparoscopic surgeons evaluated the relationship of video monitor height during surgery with the development of neck symptoms. 70% of surgeons in this study agreed that bad monitor positioning led to the development of neck symptoms [1]. Further, cervical biomechanical studies demonstrate that, in a neutral, lordotic spine, axial loads are dispersed through an instantaneous axis of rotation (IAR) centered within the vertebral bodies without any torsion or moment arms applied to cervical discs

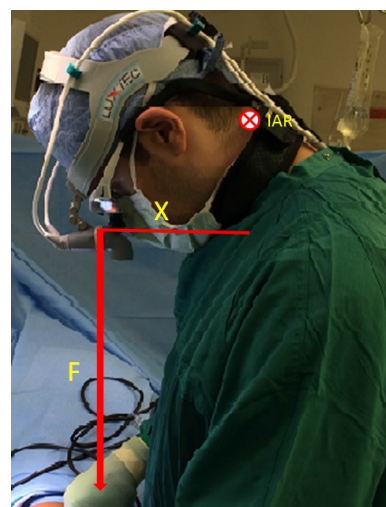


Figure 2: In a fixed, flexed posture, a substantial moment can be generated by each component of the head gear. The moment is determined by the weight of each component times the moment arm (X = distance to IAR). This moment arm will be dependent on the head position. The net moment is determined by the sum of moments for each component of the head gear. The net moment can generate large non-physiologic stress on cervical discs that can result in symptomatic degenerative changes.

[11]. However, in a fixed, flexed posture, a substantial moment arm can be generated at a distance (X) anterior to the IAR with large resulting torsional stress placed on cervical intervertebral discs (Figure 2).

The addition of headgear will alter the biomechanics depending on the location of the center-of-mass of the headgear with respect to the cervical discs. The distance of the center-of-mass from the disc plus the actual mass of the headgear will determine the additional moment arm and moments applied to the discs. With increased moments on the disc, concomitant increases in intradiscal pressures are generated that can accelerate degenerative changes. A frequently flexed, fixed position loaded with headgear places non-physiologic torsional stresses above the adaptive capacity of the cervical spine that will, ultimately, be poorly tolerated. One solution is to redesign the headgear to be light-weight with a center of mass close to the disc when the surgeon's head is in the most frequently used position.

Yet another possible cause of neck symptoms in spine surgeons is the use of inappropriate loupes. Common ergonomic factors to consider when selecting loupes include: comfort (light weight frames with comfortable nose pads), working distance (which must match the surgeon's working distance), depth of field, and field of view [6,7]. Perhaps the two most important factors are declination angle and frame design. Declination angle is the angle between the neutral line of sight and the actual line of sight chosen by the surgeon. Loupes with improper working distances and/or large declination angles, generally greater than 25 degrees, create poor working postures that can cause chronic neck and upper back pain.

These symptoms can often be avoided or eliminated with the use of properly fitted loupes that are designed to help keep the neck in a neutral position with good ergonomic posture [6]. A balance must be maintained in order to prevent extreme eye and neck strain. Tipping the head forward and downward reduces the amount of strain on eye musculature, but tipping the head too far to see through the loupes increases the risk of head, neck and shoulder strain. The selected optical system should not cause the surgeon to compromise optimal working position, but rather adapts to the needs of the surgeon [6,7].

Illumination headlights may also affect eye and neck strain. Headband mounted lights tend to be heavy and become easily misaligned with the surgeon's loupes and line of vision, causing a poorly lit surgical field. Lights that clip directly on the telescopes keep the illumination in line with the line of sight and are generally lighter in weight. For this reason, loupes should also allow easy incorporation of headlights [7,8].

With education and awareness, surgeons can significantly decrease the possibility of developing neck pain and cervical disc degeneration requiring treatment. Surgeons should avoid over-use of headgear in cases that may not require headgear or substitute with the use of an operating microscope. They should identify improper or poorly fitted headgear and avoid their use. Finally, surgeons can benefit from an ergonomic understanding of the operating room and how they visualize and perform surgical procedures.

Some limitations of this study include sample size, which should be judged in light of the difficulty associated with obtaining information of this sort from an elusive cohort of subjects such as spine surgeons. Another limitation of the current study is the cross-sectional nature of the data collection and attendant recall biases that may be present. The authors suggest that the results and conclusions of this study are by no means conclusive but is a rather informative bundle of data that, when analyzed collectively with other similar studies, may provide provider stronger conclusions.

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Akaanksh Shetty, Nick Boutriss, MD – pictured in Figure 2.

Key Points

- Frequent use of headgear correlates with an increase in the severity and frequency of neck pain and associated cervical degeneration.
- A fixed and flexed posture in the cervical spine may be the main contributing factor for neck pain in surgeons who frequently use headgear.

- Improved ergonomics and the proper use, selection and fitting of loupes and headlights may help reduce neck strain and discomfort.

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