

# Work-related musculoskeletal symptoms in otorhinolaryngology and their relationship with physical activity. A nationwide survey

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## Main Article

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### Abstract

**Objective.** The main objective of this study was to determine the prevalence of work-related musculoskeletal symptoms in otolaryngology and head and neck surgery specialists and trainees in Spain, and to measure the effect that physical exercise could have on muscular discomfort.

**Method.** A cross-sectional survey was administered between September and December 2017 to practising otolaryngologists.

**Results.** Four hundred and three ENT surgeons responded, with a median age of 44.9 years, and 89.8 per cent reported discomfort or physical symptoms that they attributed to surgical practice. More female surgeons reported musculoskeletal symptoms (92.8 per cent vs 87.1 per cent;  $p = 0.04$ ). When the level of physical activity was compared with the frequency of physical discomfort, no significant difference was found.

**Conclusion.** This study has shown a high prevalence of musculoskeletal disorders among ENT surgeons in Spain but has failed to demonstrate an important role of physical exercise in the prevention of musculoskeletal disorders.

## Introduction

The practice of otorhinolaryngology involves performing extremely precise and delicate procedures in the small and narrow spaces of the ears, nose or throat. Otorhinolaryngologists often have to maintain forced postures of the neck, back or shoulders when using otoscopes, endoscopes or microscopes and manipulating different instruments within these cavities. This entails a risk of developing musculoskeletal disorders.<sup>1</sup>

Musculoskeletal symptoms can lead to surgical fatigue syndrome, in which the surgeon's dexterity, judgment and performance may decline, with detrimental effects for both the patient and the surgeon.

There is growing concern about musculoskeletal disorders derived from surgical practice in the different surgical specialties and otolaryngology is not an exception, as evidenced by the growing number of publications on this issue in recent years. Surveys aimed at ENT professionals or those with a special dedication in a more specific field have shown a very high prevalence of musculoskeletal complaints that the respondents attribute to surgical practice.<sup>2–4</sup>

The first objective of this study was to determine the prevalence of work-related musculoskeletal symptoms in otolaryngology and head and neck surgery specialists and trainees in Spain and compare these results with those from other similar studies conducted so far. The second and more novel approach was to identify and measure the effect that physical exercise and the level of physical activity could have on the appearance of musculoskeletal disorders. A third aim was to establish potential associations between those musculoskeletal symptoms and demographic variables such as age, gender, body mass index, subspecialty and other variables related to workload. Finally, although work-related musculoskeletal disorders are pervasive, awareness of ergonomic principles aimed at preventing this type of discomfort is less common. The last objective of the study was to assess individual perception of the magnitude of this problem and the level of knowledge of the principles and recommendations in studies and research in the field of surgical ergonomics.

## Materials and methods

The study protocol was reviewed and approved by the hospital's ethics committee (Ethical Committee, Hospital Universitario Marqués de Valdecilla, Santander, Spain) and by the institutional review board.

### Target population and method

A survey adapted from Cavanagh *et al.*<sup>2</sup> was electronically distributed to the entire membership of the Sociedad Española de Otorrinolaringología (the official society of otolaryngologists in Spain).<sup>5</sup> The questionnaire was sent via e-mail (google forms) and was open from September to December 2017 for a total of 12 weeks. Repeat e-mails were sent to encourage participation. All survey responses were anonymous.

In addition to the questions included in the original questionnaire, the current survey addressed other issues such as: hours of surgery in the last week or last month; hours of sports or gymnastics in the last week or last month; current smoking status; and asked, in the respondent's perception, what percentage of fellow otolaryngology surgeons suffer musculoskeletal disorders attributable to the performance of surgical interventions.

Exclusion criteria were: previous musculoskeletal disorders (not related to surgical practice), general medical conditions or previous surgery preventing surgical practice in the last year.

### Survey structure

The survey was based on a questionnaire adapted from Cavanagh *et al.*<sup>2</sup> (in turn adapted from Park *et al.*).<sup>5</sup> This questionnaire included the following sections: (1) demographic information, which included age, gender, height and weight, handedness, years in practice, number of different types of procedures performed in a year, caseload, number of hours of exercise, and smoking habits; (2) physical symptoms; (3) ergonomics; and (4) individual perception of the magnitude of the problem.

Some questions included multiple choice answers, such as 'what is your type of practice? (public, private, both)'; other questions included check all that apply options such as 'if you answer yes, which of the following apply? (numbness, stiffness, fatigue, pain)'; and others allowed free-text answers to open-ended questions such as 'when do these symptoms or discomforts affect you most?'

### Statistical analysis

A descriptive analysis was performed with a calculation of the mean and median for continuous variables and percentages for categorical variables. Categorical variables are presented as the means of absolute and relative frequencies, and numerical variables are presented as the mean (standard deviation) or median (25th and 75th percentiles). Categorical variables were analysed with the chi-square test, and the numerical variables were analysed with the Mann-Whitney U test or the Kruskal-Wallis test. Analysis of variance and Fisher's exact test were used where appropriate. A *p*-value of less than 0.05 was considered statistically significant. The analysis was done with STATA® (version 14) statistical software.

### Results

The survey was sent to 2450 otolaryngology and head and neck surgery practitioners across Spain. Four hundred and seven surgeons (58 of whom were trainees) answered the survey giving a response rate of 16.6 per cent. There were 403 total completed surveys (excluding individual perception of the magnitude of the problem). Table 1 summarises the demographic information of the respondents, prevalence of

**Table 1.** Demographic information, prevalence of work-related musculoskeletal symptoms and their impact, and awareness of surgical ergonomics among Spanish otolaryngologists

Parameter	Value or description
Year	2017
Target population	Sociedad Española de Otorrinolaringología
Total population ( <i>n</i> )	2450
Inclusion criteria	ENT specialists and trainees
Total number of respondents ( <i>n</i> )	403
Response rate (%)	16.6
Age (mean (range; SD); years)	44.9 (25–70; 11.4)
Female (%)	48.5
Weight (mean (range; SD); kg)	72.3 (61–117; 10.7)
Body mass index (mean (range; SD); kg/m <sup>2</sup> )	24.55 (19.4–36.1; 3.2)
Years in practice (mean (range; SD); years)	17.08 (0–45; 11.1)
Current smoking (%)	8.9
Musculoskeletal disorder attributed to surgical practice (%)	89.9
Received therapy (%)	60.6
Limit their practice (%)	9.9
Unaware of ergonomic principles (%)	83.8

SD = standard deviation

work-related musculoskeletal symptoms and their impact, and awareness of surgical ergonomics among Spanish otolaryngologists. The mean age of respondents was 44.9 years. Most responders practised in an academic setting (55.4 per cent).

### Practice experience and musculoskeletal disorders

The average caseload was 9.82 (standard deviation (SD) = 5.4) hours per week and 28.9 (SD = 16.7) hours per month. Physicians completed a large number of minor microscopy cases: 247 ENT surgeons performed more than 25 cases a year and 114 ENT surgeons performed more than 50 cases a year. Among respondents, 62 rhinologists, 32 otologists, and 30 head and neck or skull base surgeons completed more than 50 cases of minor and major endoscopy, major microscopy and head and neck or skull base cases, respectively.

### Surgical practice and musculoskeletal disorders

A total of 89.8 per cent (362) of respondents reported discomfort or physical symptoms that they attributed to surgical practice (95 per cent confidence interval, 86 to 93 per cent). Of these, the most frequent symptom reported was pain (79.6 per cent; 288), followed by stiffness (51.5 per cent; 187), fatigue (49 per cent; 178) and numbness (40.5 per cent; 147). The most affected regions were (in descending order): the back (218), the neck (177), shoulder (68) and hands (59). The symptoms were localised in 46.5 per cent of respondents. In the rest, they radiated to other parts of the body. Other complaints described by the respondents were headache, eyestrain, tingling and heaviness in the legs. Table 2 presents the pain or discomfort characteristics that the otolaryngology and head and neck surgeons attributed to their surgical practice, and

**Table 2.** Summary of studies on the prevalence of work-related musculoskeletal disorders amongst ENT surgeons worldwide showing most frequently affected body parts

Study	Year	Target population	Total responders (n)	Response rate (%)	Female (%)	MSD (%)	Back (%)	Neck (%)	Shoulder (%)	Wrist and hand (%)
Mal & Costello <sup>6</sup>	2002	BAOHNS	367	64.6	NA	Nad	Nad	Nad	24	Nad
Babar-Craig H <i>et al.</i> <sup>7</sup>	2003	BAOHNS	325	58	NA	53	48	52.61	Nad	Nad
Little <i>et al.</i> <sup>4</sup>	2012	ARS	62	Unknown	23	77	29 (lumbar region)	46	63	54
Cavanagh <i>et al.</i> <sup>2</sup>	2012	ASPO	100	43.70	15	62	56.5	59.7	12.9	19.4
Wong <i>et al.</i> <sup>8</sup>	2014	AAO-HNS	476	9.20	17	83	48	52	21	11
Amin <i>et al.</i> <sup>9</sup>	2015	BRS	82	22.20	12	74	71	60	45	17
Rimmer <i>et al.</i> <sup>10</sup>	2016	ERS	250	11.2	21.20	76.5	59.8	60.3	50.8	11.7
Vijendren <i>et al.</i> <sup>3</sup>	2016	ENT-UK	323	24	NA	47.40	27.9	29.7	NA	8.9
Dabholkar <i>et al.</i> <sup>1</sup>	2017	Mumbai	73	48.60	36.9	69.86	36.98 (upper back) & 32.87 (lower back)	41	16.43	23.28
Bolduc-Bégin <i>et al.</i> <sup>11</sup>	2017	CSO-HNS	137	23	21	74	72 (dorsal region) & 78 (lumbar region)	88	33 (left side) & 38 (right side)	wrist (left: 19; right: 26); hand (38) & fingers (42)
Ho TT <i>et al.</i> <sup>12</sup>	2017	AFPRS, SUO	377	12.5	27.3	63.9	NA	63–82*	45–68*	NA
Present study	2018	SEORL	407	16.6	48.5	89.9	60.2	48.9	18.8	16.3

\*lowest and highest prevalence of symptoms by procedure type (six subgroups according to type of surgical procedure). MSD = musculoskeletal disorders; BAOHNS = British Association of Otorhinolaryngology-Head and Neck Surgery; NA = not available; Nad = not addressed; ARS = American Rhinologic Society; ASPO = American Society of Pediatric Otolaryngology; AAO-HNS = American Academy of Otolaryngology-Head and Neck Surgery; BRS = British Rhinological Society; ERS = European Rhinological Society; ENT-UK = British Association of Otorhinolaryngology-Head and Neck Surgery; CSO-HNS = Canadian Society of Otolaryngology-Head and Neck Surgery; AFPRS = American Academy of Facial Plastic and Reconstructive Surgery; SUO = Society of University Otolaryngologists; SEORL = Sociedad Española de Otorrinolaringología

**Table 3.** Comparison of main data for the three physician groups

Parameter	Male (n)	Female (n)	Total (n)	Average physical activity*	Average caseload†
No symptoms reported	27	14	41	3.05/8.68	9.28/26.23
Pain or discomfort and no therapy	72	63	135	2.59/9.33	9.39/28.53
Pain or discomfort and had received therapy	110	117	227	2.78/9.42	10.17/29.57
Total	209	194	403	2.74/9.32	9.82/28.89

\*accumulated hours in the last week/last month ( $p=0.65/p=0.85$ ); †accumulated hours of surgical activity in the last week/last month ( $p=0.32$ ;  $p=0.49$ )

these are compared with other published results of similar studies.

Most respondents reported that the discomfort was most frequent during a surgical intervention and in the hours immediately after it, followed by long surgical procedures and out-patient clinical work. Of respondents, 60.6 per cent received some type of treatment for this reason (pharmacotherapy, physiotherapy, and osteopathy or chiropractic treatment), and 93.6 per cent experienced improvement with treatment. However, the problem was solved in only 45.9 per cent of cases, and 10 surgeons required surgery. The problem limited clinical practice in 9.9 per cent of cases. The most difficult reported procedures to perform in these circumstances were septoplasty and functional endoscopic sinus surgery. Finally, the discomfort represented a current problem for 29.4 per cent.

#### Subspecialty and musculoskeletal disorders

There was no significant difference when the frequency of physical discomfort or the need of treatment was compared with the different subspecialties.

#### Physical activity and musculoskeletal symptoms

The average physical activity (exercising, stretching, sports and gymnastics) was 2.7 (SD = 2.9) and 9.3 (SD = 7.8) hours per week and hours per month, respectively. When the level of physical activity was compared with the frequency of physical discomfort, no significant difference was found.

#### Individual perception of the problem

This question was answered by 379 respondents. Seven participants did not answer the question correctly, and the rest left this box blank. The average perception of those who answered the question correctly was 59 per cent (SD = 25 per cent) or given as the mode was 50 per cent.

#### ENT practice and awareness of ergonomics

Of the respondents, 83.8 per cent did not know the recommendations from the field of surgical ergonomics. The majority of those who had some knowledge (16.2 per cent) obtained it on the internet (alternative sources were courses, lectures and by word of mouth). Of these, most had applied it to their surgical practice with very positive and satisfactory results. Finally, 94.2 per cent reported that they would appreciate more information regarding surgical ergonomics.

#### Musculoskeletal disorders and need for medical treatment

Demographic information, workload and physical activity were compared with the prevalence of musculoskeletal

symptoms and with the need for medical treatment. This analysis showed that years of experience, workload and the majority of demographic variables were not related to a higher frequency of musculoskeletal disorders or need for treatment. The only significant variable associated with a higher rate of musculoskeletal symptoms was sex, with muscle disorders being more frequent in women ( $p=0.04$ ). Table 3 compares the data for the three groups of physicians: (1) those who reported pain or discomfort and had received medical therapy; (2) those who reported pain or discomfort and had not received medical therapy; and (3) those who did not report any pain or discomfort related to their surgical practice.

#### Discussion

Four hundred and three ENT surgeons responded to our survey, and 89.8 per cent (362) reported discomfort or physical symptoms that they attributed to the surgical practice. The response rate of 16.6 per cent was acceptable and comparable to other similar studies (Table 2).<sup>1-4,6-12</sup> Online or postal surveys typically have low response rates, with a median around 20 per cent for similar surveys.<sup>10</sup>

It should be noted that the gender distribution in this study was even, compared with a male predominance in previous studies. This may be because the number of female doctors specialising in ENT has increased in recent decades, and female ENT surgeons currently represent about 45 per cent of the ENT population in Spain. In this study, women had a higher prevalence of musculoskeletal disorders than men, which is consistent with previous studies and probably explained not only by differences in the perception of complaints, pain or discomfort but also by a possible ergonomic disadvantage in the operating room.<sup>2</sup> Female surgeons responding to the survey were significantly shorter than men (on average 1.63 cm vs 1.77 cm, respectively;  $p < 0.0005$ ), and this should be considered when equipping an operating room (for instance, some operating tables are not low enough). The mean age of respondents was 44.9 years, significantly lower than the mean age for back and neck pain in the general population.<sup>13</sup>

Musculoskeletal disorders were reported by 89.9 per cent of respondents in the present study, which is slightly higher than in other studies (Table 2). The most affected body regions were similar to those reported for ENT surgeons. Looking at other studies, shoulder complaints ranged between 12.9 per cent (Cavanagh *et al.*) and 63 per cent (Little *et al.*).<sup>2,4</sup> In our study shoulder complaints were reported by 18.8 per cent, which is a similar figure to that of Mal *et al.*, who specifically addressed shoulder impingement syndrome in British otolaryngologists.<sup>6</sup>

Ho *et al.* surveyed symptom prevalence by type of surgery and found that the neck and shoulder were the most affected areas, with shoulder complaints ranging from 45.2 to 62.8 per cent depending on the procedure (microdirect laryngoscopy and bronchoscopy being the most problematic).<sup>12</sup> Some studies

have assessed symptom frequency for a specific area (back and neck;<sup>7</sup> shoulder<sup>6</sup>) or surgical procedure (microlaryngeal surgery,<sup>8</sup> endoscopic sinus surgery<sup>4,9,10</sup>). For microlaryngeal surgery, the rate of reported shoulder symptoms was only 21 per cent.<sup>8</sup> By contrast, for musculoskeletal disorders related to endoscopic sinus surgery, the rates were 63 per cent,<sup>4</sup> 50.8 per cent<sup>9</sup> and 45 per cent,<sup>10</sup> which are higher rates than in other surveys aimed at all ENT surgeon populations.

When we analysed the areas affected in surgeons with a focus on a specific type of surgery (defined as those who performed 50 or more procedures of a particular subspecialty a year), we found no significant differences compared with the rest of the respondents. However, it should be noted that only 62 (15.3 per cent), 32 (7.9 per cent) and 30 (7.4 per cent) ENT surgeons met the criterion for major microscopy, minor and major endoscopy, and head and neck and skull base surgery, respectively. In any case, there was no difference with the largest general ENT physician group. Sitting and standing position during surgery was not evaluated and was beyond the aim of this study, although it could be related to the ratio of upper vs lower limb musculoskeletal disorders.

Endoscopic sinus surgery and otological and laryngological procedures expose otolaryngology and head and neck surgery specialists to neck, shoulder and back strains.<sup>14</sup> Otorhinolaryngologists have been found to spend 54 per cent of their operating time with the head bent forward, to one side or twisted.<sup>7</sup> Although a higher musculoskeletal disorder prevalence might be expected with increasing age and cumulative surgical load, this has not been demonstrated, which could be explained by the healthy worker effect.<sup>2</sup> However, Bolduc-Bégin *et al.* found that respondents who worked more than 16 hours per week in clinic had a higher prevalence of global musculoskeletal disorders.<sup>11</sup>

Out-patient clinical work is not often considered, but many factors might contribute to musculoskeletal disorders such as sustained or awkward postures, inappropriate writing desk setup, work break frequency, illumination, and assistance. In the present study, out-patient clinical work was the third most cited factor related to musculoskeletal discomfort after surgical practice and long surgical procedures. The prevalence of reported musculoskeletal disorders was similar for otolaryngology residents and practising otolaryngologists and consistent with published findings.<sup>15</sup>

An effort should be made to establish preventive measures and teach ergonomic skills early in training. Some corrective measures have been suggested by ENT surgeons themselves: adequate work breaks, skilled assistance, change in posture, customised workstations, use of a back rest and time management.<sup>1</sup> Other more specific recommendations come from the fields of ergonomics, minimally invasive surgery, laparoscopic surgery and, most recently, studies on ergonomic aspects of microlaryngoscopy and endoscopic sinus surgery.<sup>16–20</sup>

Satham *et al.* demonstrated that lack of arm support during microlaryngeal surgery leads to a 4-fold increase in compressive forces on vertebral disc space. The position that involves least risk for the surgeon is one in which the arms and feet are well supported, and the neck minimally flexed from 0° to 10° with respect to the vertical plane.<sup>18</sup> Ramakrishnan *et al.* reviewed the ergonomic recommendations for endoscopic sinus and skull base surgery based on scientific evidence. These recommendations cover aspects such as appropriate monitor placement, proper instrument maintenance, adjustable operating tables, correct use of pedals and upper body position.<sup>17</sup>

The increasing preoccupation with ergonomics in current surgical training is reflected in the growing number of

publications on the issue. Although otolaryngology and head and neck surgery practitioners in Spain have a high perception of the magnitude of the problem of musculoskeletal disorders, knowledge of surgical ergonomics is low meaning there is an urgent need for thorough ergonomics education and training. Surgeons who are aware of the implications of ergonomics are more likely to take them into account during surgery. In the present study, most of those who had some knowledge (16.2 per cent) applied it to their surgical practice with very positive and satisfactory results.

This study failed to demonstrate a relationship between factors such as age, surgical experience or workload and the development of musculoskeletal disorders. This is consistent with other surveys published in recent years that point to many potential offenders without clearly confirming their role in work-related musculoskeletal disorders. This could be explained by multifactorial aetiology, where diverse factors such as general health, physical activity, fitness, lifestyle and work style factors (e.g. postures involved in office procedures or computer work), risk-related behaviours, and cumulative exposure to risk factors may contribute to the development of symptoms.<sup>8</sup>

This study has several limitations. First, there is a possibility of selection bias as physicians with an interest in ergonomics or those who have experienced musculoskeletal symptoms could have been more likely to respond to the survey. However, if we consider that those who did not respond have no musculoskeletal disorders, the number of otorhinolaryngologists in Spain with musculoskeletal disorders derived from surgical practice is still 14.5 per cent. Secondly, the multifactorial aetiology of musculoskeletal disorders constitutes a confounding factor even though the respondents reported the musculoskeletal symptoms directly related with their surgical practice. The final limitation is the small sample size, although it is larger than most of the reviewed surveys, some of which are international in scope.

We did not find a positive relationship between regular physical exercise and the absence of musculoskeletal disorders. This may be due in part to the high prevalence of musculoskeletal disorders among those who responded to the survey. If we collected data related to the practice of exercise and the presence of musculoskeletal disorders as a secondary variable, we might obtain a different result. Another possible reason is the non-specific nature of the exercise, meaning it does not act as a protective factor and may even aggravate certain symptoms or work-related musculoskeletal disorders. We believe that the best way for physical exercise to be beneficial would be through a series of physical exercises aimed at strengthening the most compromised muscle groups and would be personalised, thereby taking into account the individual's surgical and medical activity, physical condition, and any possible previous injuries or affected muscle groups. It has been shown that performing any type of physical activity prevents the appearance of musculoskeletal disorders,<sup>1</sup> although exercises that strengthen the muscles that are most in demand during normal activity are probably the most beneficial.

We must take advantage of the knowledge and experience of rehabilitation doctors and physiotherapists who can advise on the adoption of correct postures at work, ergonomic aspects and exercises appropriate to workload.

Poor ergonomics might lead to chronic pain and fatigue. This is a significant concern not only for the surgeon's quality of life but also for healthcare delivery. Applying ergonomic knowledge may result in less illness, better surgical outcomes, high productivity and injury-free careers for surgeons. We

encourage the cited articles to be read in order to spread knowledge of the ergonomics recommendations for endoscopic sinus and skull base surgery, and microlaryngeal surgery. Future studies should address the possible impact of specific surgical ergonomic changes on the intensity and prevalence of musculoskeletal disorders among otolaryngology and head and neck surgery practitioners.

- There is a high prevalence of musculoskeletal disorders among ENT surgeons in Spain, which is similar to other European and American countries
- Muscular discomfort or physical symptoms attributed to surgical practice start very early in training
- This study has failed to demonstrate an important role of physical exercise in the prevention of musculoskeletal disorders
- The most beneficial effects of exercise would be through personalised exercises to strengthen the most compromised muscle groups in each surgeon based on their surgical and medical activity
- There is an urgent need for more thorough ergonomics education and training among otolaryngologists

## Conclusion

Musculoskeletal disorders are very prevalent among ENT surgeons in Spain. Although the perception of the magnitude of the problem of musculoskeletal disorders among these professionals is high, the knowledge of surgical ergonomics is very low. Accordingly, there is an urgent need for more thorough ergonomics education and training. This study has failed to demonstrate an important role of physical exercise in the prevention of musculoskeletal disorders. The reasons are unclear but might be related to the non-specific nature of the exercise.

**Competing interests.** None declared

## References

- 1 Dabholkar T, Yardi S, Dabholkar YG, Velankar HK, Ghuge G. A survey of work-related musculoskeletal disorders among otolaryngologists. *Indian J Otolaryngol Head Neck Surg* 2017;**69**:230–8
- 2 Cavanagh J, Brake M, Kearns D, Hong P. Work environment discomfort and injury: an ergonomic survey study of the American Society of Pediatric Otolaryngology members. *Am J Otolaryngol* 2012;**33**:441–6
- 3 Vijendren A, Yung M, Sanchez J, Duffield K. Occupational musculoskeletal pain amongst ENT surgeons - are we looking at the tip of an iceberg? *J Laryngol Otol* 2016;**130**:490–6
- 4 Little RM, Deal AM, Zanation AM, McKinney K, Senior BA, Ebert Jr CS. Occupational hazards of endoscopic surgery. *Int Forum Allergy Rhinol* 2012;**2**:212–16
- 5 Park A, Lee G, Seagull FJ, Meenaghan N, Dexter D. Patients benefit while surgeons suffer: an impending epidemic. *J Am Coll Surg* 2010;**210**:306–13
- 6 Mal RK, Costello CH. Is shoulder impingement syndrome a problem in otolaryngologists? *Clin Otolaryngol Allied Sci* 2002;**27**:44–7
- 7 Babar-Craig H, Banfield G, Knight J. Prevalence of back and neck pain amongst ENT consultants: national survey. *J Laryngol Otol* 2003;**117**:979–82
- 8 Wong A, Baker N, Smith L, Rosen CA. Prevalence and risk factors for musculoskeletal problems associated with microlaryngeal surgery: a national survey. *Laryngoscope* 2014;**124**:1854–61
- 9 Amin M, Rimmer J, Swift A, White P, Lund VJ. FESS, fingers and other things--you are not alone! *Rhinology* 2015;**53**:116–21
- 10 Rimmer J, Amin M, Fokkens WJ, Lund VJ. Endoscopic sinus surgery and musculoskeletal symptoms. *Rhinology* 2016;**54**:105–10
- 11 Bolduc-Bégin J, Prince F, Christopoulos A, Ayad T. Work-related musculoskeletal symptoms amongst Otolaryngologists and Head and Neck surgeons in Canada. *Eur Arch Otorhinolaryngol* 2018;**275**:261–7
- 12 Ho TT, Hamill CS, Sykes KJ, Kraft SM. Work-related musculoskeletal symptoms among otolaryngologists by subspecialty: a national survey. *Laryngoscope* 2018;**128**:632–40
- 13 Manchikanti L, Singh V, Datta S, Cohen SP, Hirsch JA; American Society of Interventional Pain Physicians. Comprehensive review of epidemiology, scope, and impact of spinal pain. *Pain Physician* 2009;**12**:E35–70
- 14 Wunderlich M, Jacob R, Stelzig Y, Rütger T, Leyk D. Analysis of spinal stress during surgery in otolaryngology [in German]. *HNO* 2010;**58**:791–8
- 15 Wong K, Grundfast KM, Levi JR. Assessing work-related musculoskeletal symptoms among otolaryngology residents. *Am J Otolaryngol* 2017;**38**:213–17
- 16 Matern U, Konecny S. Safety, hazards and ergonomics in the operating room. *Surg Endosc* 2007;**21**:1965–9
- 17 Ramakrishnan VR, Montero PN. Ergonomic considerations in endoscopic sinus surgery: lessons learned from laparoscopic surgeons. *Am J Rhinol Allergy* 2013;**27**:245–50
- 18 Statham MM, Sukits AL, Redfern MS, Smith LJ, Sok JC, Rosen CA. Ergonomic analysis of microlaryngoscopy. *Laryngoscope* 2010;**120**:297–305
- 19 Schmitz PM, Gollnick I, Modemann S, Rothe A, Niegsch R, Strauss G. An improved instrument table for use in functional endoscopic sinus surgery. *Med Sci Monit Basic Res* 2015;**21**:131–4
- 20 Ayad T, Péloquin L, Prince F. Ergonomics in endoscopic sinus surgery: systematic review of the literature. *J Otolaryngol* 2005;**34**:333–40