Work-Related Musculoskeletal Disorders in Dental Students: A Cross-Sectional, Pilot Study from a UK University Teaching Hospital

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Abstract

Purpose: Musculoskeletal disorders can be acute or chronic conditions of the musculoskeletal system and are prevalent within the dental profession. Dentistry is a high-risk profession for musculoskeletal disorders due to the use of repetitive hand movements and the adoption of prolonged static procedures. These have been identified as a prevalent cause of early retirement and have been shown to develop during dental training and education. The reported high rates of musculoskeletal disorders in dental and dental hygiene therapy students is a significant cause for concern.

Methods: Following university ethical approval, a questionnaire was designed, piloted and distributed to dental students in the third and fourth Bachelor of Dentistry (BDS) cohort. Questions investigated the prevalence of back/neck pain along with other clinical factors identified as risk factors for musculoskeletal disorders, including use of indirect vision, work-place adaptations and four-handed dentistry.

Results: A total of 102 questionnaires were returned from a potential 148 students a response rate of 68.9%. 76.5% (n = 78) of students questioned reported experiencing pain in the neck or back following a clinical session. Of those who experienced pain, 67.9% experienced pain at least once a month or more. 21.6% of students were unsure of the correct height to place their patients to optimise their posture during treatment, and a further 57.8% were only slightly aware. Furthermore, 89.2% of students felt that they did not have adequate nursing support to maintain good posture; 50% had not experienced four-handed dentistry with a nurse; and 7.9% very confident to use their mirror for indirect vision.

Conclusions: The prevalence of neck/back pain within this study is similar to those reported internationally within the literature. High prevalence rates within dental students is a concerning finding that may have significant implications for individuals and the profession. The strongest evidence within the literature supports resistance training and stretching exercise programmes for prevention of musculoskeletal disorders. Students should be educated of the risks, and these preventative strategies should be encouraged within dental education programmes. Greater interventional studies are required.

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Keywords
Musculoskeletal disorders (MSD), Work-related musculoskeletal disorders (WRMDs), Posture, Dentistry, Dental students

Introduction

Musculoskeletal disorders (MSDs) are injuries to the musculoskeletal system (bones, ligaments, muscles,
tors for MSD in dentistry, which include: Prolonged static procedures (PSPs); repetitive movements (RMs); sub-optimal lighting and poor positioning. Specific specialties or procedures within dentistry were also suggested as risk factors, with hygiene/therapists more likely to undertake RMs, and those practicing four-handed dentistry likely to occupy PSPs for longer. Poor positioning and PSPs can potentially result in muscle imbalance and ischaemia, with inadequate rest between sustained muscle activity considered as a mechanism for pain development, joint hypo-mobility and joint degeneration. This proposed mechanism for MSD development is covered elsewhere [14].

**Prevention**

A number of publications have discussed the importance of prevention in avoiding and reducing risk of MSD, with some suggestions for this listed in Table 2 [1,14-16]. It has been suggested that age, [6,11,17] gender [18,19] and patient treatment time [6] can affect the prevalence rate of WRMDs. Studies have shown that MSD can develop early in clinical careers [20] and older practitioners have been shown to be less likely to suffer from MSD [6,11]. However, this finding may reflect the fact that those who suffer with significant MSD have often left the profession. For this reason, it is possible that current prevalence data under-represents MSD within the profession and greater incidence studies are required. Whilst work remains a potential risk factor for MSD, well-designed work has been encouraged for those that are suffering from MSDs [4].

A range of recent research has focused their investigations on the prevalence of WRMDs in dental and dental hygiene/therapy students. A review of the literature by Gupta, et al. highlighted that students in dental education were exposed to MSDs and that greater preventive measures are required within dental programmes [21]. Ng, et al. reported prevalence of MSDs in at least one body area to be 85% in oral health and dentistry students in Australia [22]. This was mirrored in anoth-
er questionnaire based study from Columbia which recorded ‘muscular pain’ of 80% in dental students [23]. Ng, et al. also reported the highest level of ‘poor posture’ in final year dental students, which suggests that poor postural techniques are in fact learnt behaviours that develop during dental education. Morse, et al. summarised the prevalence rates of MSDs across the dental professions in 2009 [20]. It is clear from this research that students are at risk of MSDs and this raises pertinent questions regarding the role of dental education in developing and reducing the risk of MSDs. With this in mind, a pilot study was undertaken at a UK University dental teaching hospital to investigate MSDs in dental students. The aim was to assess prevalence of MSDs amongst this cohort, including their awareness of correct clinician posture, patient position and use of indirect vision, which have all been discussed as possible risk factors for MSD [20].

**Methodology**

This cross-sectional, questionnaire based study was completed at a UK dental school. A short questionnaire was devised by the authors and piloted locally on hospital dental core trainees. Participants were recruited from two cohorts of dental students attending mandatory courses within the operative skills suite (phantom head suite). This included students from years 3/4 of the five year Bachelor of Dental Surgery (BDS) degree or from years 2/3 of a four year postgraduate BDS degree. Ethical approval was gained from the University Ethics Committee. All students in attendance during the data collection were given the opportunity to opt into the study. No exclusion criteria were outlined. The questionnaire collected basic demographic data (gender/year of study). Further questions were designed to investigate key factors identified in maintaining good posture (chair adjustments/patient & clinician positioning), good clinical practice (indirect vision/four-handed dentistry) and prevalence of MSDs.

**Results**

A total of 102 questionnaires were returned from a potential 148 students a response rate of 68.9%. 65 students were from 4th year (63.7%) and 37 students from 3rd year (36.3%). Results were combined to give cumulative totals across the study as no differences were identified between groups. Participant demographics are reported in Table 3. 76.5% (n = 78) of students questioned reported experiencing pain in the neck or back following a clinical session (Table 4). Of those who experienced pain, 67.9% experienced pain at least once a month or more (Table 5).

Figure 1 shows the participant responses to a series of questions regarding posture, chair adjustments and patient positioning that may be associated with WRMD. Of note, 21.6% of students were not sure of the correct height to place their patient to optimise their posture during treatment, and a further 57.8% were only slightly aware. Table 6 shows the participants responses to questions regarding nurse support, four-handed dentistry and indirect vision. 89.2% felt that they did not have adequate nursing support to maintain good posture; 50% had not experienced four-handed dentistry.

| Year of Study and Gender | Total       | Male       | Female     |
|--------------------------|-------------|------------|------------|
| 3rd                      | 37 (36.3%)  | 9 (24.3%)  | 28 (75.7%) |
| 4th                      | 65 (63.7%)  | 22 (33.8%) | 43 (66.2%) |
| Total                    | 102 (100%)  | 31 (30.4%) | 71 (69.6%) |

| Have you ever experienced neck/back pain at the end of a clinical session or day? | Percentage (%) |
|-----------------------------------------------------------------------------|----------------|
| Yes                                                                        | 76.5%          |
| No                                                                         | 22.5%          |
| No response                                                               | 1%             |
| Total                                                                     | 100%           |

| Pain frequency of those reporting neck/back pain following clinic (n = 78) | Percentage (%) |
|--------------------------------------------------------------------------|----------------|
| At least once per week                                                   | 19.2%          |
| Less than once per week, but at least once a month                       | 48.7%          |
| Less than once per month                                                 | 30.8%          |
| No response                                                              | 1.3%           |
| Total                                                                     | 100%           |

| Do you routinely adjust your seat at the start of each session to provide the best support for you? | Yes/Very | Sometimes/Usually | No | No Response |
|-----------------------------------------------------------------------------------------------|----------|-------------------|----|-------------|
|                                                                                               | 26.5%    | 49.0%             | 24.5% | 0.0%         |
| Do you feel that you have adequate nursing support in order to maintain your posture?       | 9.8%     | N/A               | 89.2% | 1.0%         |
| Have you had experience of four-handed dentistry with a dental nurse?                      | 49.0%    | N/A               | 50.0% | 1.0%         |
| Do you feel confident in using your mirror for indirect vision?                             | 7.9%     | 57.8%             | 29.4% | 4.9%         |
concentration and focus on a particular task [26] and as a result, students appear to be less likely to consider working posture and could be at greater risk of WRMD [20]. Furthermore, it is not clear the level of training dental students receive regarding the risks of poor posture and the development of good clinical practice. Four handed dentistry, good lighting, magnification and appropriate chair and patient positioning are but a few of the recommended modifications to improve clinical practice.

This pilot study suggests that back and neck pain is prevalent amongst dental students with 76.5% having experienced neck or back pain of which 67.9% experienced pain at least once per month. Whilst no causative links can be demonstrated with this study design, it is of some concern that 21.6% of respondents were not aware of the correct position in which to place their patient for treatment and only 26.5% of students routinely adjusted their chair at the start of clinical sessions to optimise their posture. Furthermore, 29.4% of participants were not confident in using indirect vision and 50% of participants felt they had no experience of four-handed dentistry with a nurse. These factors have been discussed as exacerbating factors for the development of WRMD.

### Discussion

It is widely acknowledged that clinical dentistry requires good manual dexterity and fine motor control to perform a wide array of procedures and tasks. Procedures are frequently lengthy and performed in a seated position with repetitive movements of the hands and wrists. The reported high rates of WRMDs in dentistry should be of great concern to the profession with WRMD a prevalent source of early retirement [12] and lost productivity [24]. Whilst a number of potential lifestyle factors would influence the development of WRMD, the practice of dentistry frequently involves prolonged static procedures and repetitive movements and as such makes dentists and DCPs at increased risk of WRMD.

Of great concern is the potential development of MSDs in dental students. As trainees, who are developing their clinical skills, in order to demonstrate competency in technically difficult tasks, [25], they are likely to take longer than qualified practitioners to complete similar dental procedures. In addition, they require more concentration and focus on a particular task [26] and as a result, students appear to be less likely to consider working posture and could be at greater risk of WRMD [20]. Furthermore, it is not clear the level of training dental students receive regarding the risks of poor posture and the development of good clinical practice. Four handed dentistry, good lighting, magnification and appropriate chair and patient positioning are but a few of the recommended modifications to improve clinical practice.

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### Figure 1: A table to show the frequency of participant responses to a series of clinical skill-related questions associated with WRMD.
of a worker’s workstation had mixed findings and not enough evidence was available to inform current practice. It is therefore important that the two interventions with the strongest evidence-base should form the basis of dental education into the prevention of MSDs; resistance training and stretching exercise programmes. Educating students about the risks of developing MSDs is imperative, alongside encouraging students to take responsibility for their own health by adopting proactive preventative strategies. A MSDs student fact sheet may be beneficial for clinical university programmes.

It is clear from the findings of this study and the literature discussed within this article that dentistry is a high risk profession for MSDs. Of great concern, is the high prevalence reported amongst students studying dentistry and dental hygiene/therapy. Greater focus and education on the risk of MSDs within the undergraduate programme may encourage students to adopt greater postural habits and pursue beneficial lifestyle choices. Small group workshops on resistance training or stretching programmes are being considered locally to help guide students to adopt these strategies, as well as greater focus on posture and patient positioning during clinical sessions. Utilisation of student fact sheets or digital applications may further support decision making in this respect.

The literature spanning several decades remains dominated by prevalence studies and there appears to be sparse research into the effectiveness of workplace interventions in the prevention of WRMDs in dentistry. Further well-designed intervention studies should be performed to investigate strategies that will help inform dentists and dental care professionals how best to avoid MSDs and prolong their practicing careers. Future research within this field should adopt the Nordic musculoskeletal questionnaire (NMQ) [34] or a modified NMQ [29] to enable more accurate and repeatable comparisons across cohorts. Future comparisons across dental specialities may also assist with workforce planning and risk stratification.

Conclusion

This cross-sectional study highlights that MSDs are prevalent amongst a cohort of dental students within a U.K. dental school. Dentistry frequently relies upon excellent manual dexterity and fine motor control to complete a range of clinical treatments. Procedures often involve prolonged static positions and repetitive movements which have been suggested as possible causes for muscle pain and musculoskeletal disorders. A number of management strategies and workplace interventions have been discussed including resistance training, stretching programmes and workplace modifications such as adjustment of patient position and chair height, which should be adopted and taught by educational institutions.
References

1. Graham C (2002) Ergonomics in dentistry, Part 1. Dent Today 21: 98-103.
2. Keyserling WM (2000) Workplace risk factors and occupational musculoskeletal disorders, Part 1: A review of biomechanical and psychophysical research on risk factors associated with low-back pain. AIHA J 61: 39-50.
3. da Costa BR, Vieira ER (2010) Risk factors for work-related musculoskeletal disorders: A systematic review of recent longitudinal studies. Am J Ind Med 53: 285-323.
4. Madan I, Grime PR (2015) The management of musculoskeletal disorders in the workplace. Best Pract Res Clin Rheumatol 29: 345-355.
5. Alexopoulos EC, Stathi IC, Charizani F (2004) Prevalence of musculoskeletal disorders in dentists. BMC Musculoskeletal Disord 5: 16.
6. Finsen L, Christensen H, Bakke M (1998) Musculoskeletal disorders among dentists and variation in dental work. Appl Ergon 29: 119-125.
7. Akesson I, Johnsson B, Rylander L, Moritz U, Skerfving S (1999) Musculoskeletal disorders among female dental personnel-clinical examination and a 5-year follow-up study of symptoms. Int Arch Occup Environ Health 72: 395-403.
8. Anton D, Rosecrance J, Merlino L, Cook T (2002) Prevalence of musculoskeletal symptoms and carpal tunnel syndrome among dental hygienists. Am J Ind Med 42: 248-257.
9. Tirgar A, Javanshir K, Talebian A, Amini F, Parhiz A (2015) Musculoskeletal disorders among a group of Iranian general dental practitioners. J Back Musculoskeletal Rehabil 28: 755-759.
10. Hayes M, Cockrell D, Smith DR (2009) A systematic review of musculoskeletal disorders among dental professionals. Int J Dent Hyg 7: 159-165.
11. Leggat PA, Smith DR (2006) Musculoskeletal disorders self-reported by dentists in Queensland, Australia. Aust Dent J 51: 324-327.
12. Burke FJ, Main JR, Freeman R (1997) The practice of dentistry: An assessment of reasons for premature retirement. Br Dent J 182: 250-254.
13. Davis KG, Kotowski SE (2015) Prevalence of musculoskeletal disorders for nurses in hospitals, long-term care facilities, and home health care: A comprehensive review. Hum Factors 57: 754-792.
14. Valachi B, Valachi K (2003) Preventing musculoskeletal disorders in clinical dentistry: Strategies to address the mechanisms leading to musculoskeletal disorders. J Am Dent Assoc 134: 1604-1612.
15. James T, Gilmour ASM (2010) Magnifying loupes in modern dental practice: An update. Dent Update 37: 633-636.
16. Yamalik N (2007) Musculoskeletal disorders (MSDs) and dental practice Part 2. Risk factors for dentistry, magnitude of the problem, prevention, and dental ergonomics. Int Dent J 57: 45-54.
17. Alghadir A, Zafar H, Iqbal ZA (2015) Work-related musculoskeletal disorders among dental professionals in Saudi Arabia. J Phys Ther Sci 27: 1107-1112.
18. Chowanadisai S, Kukiattrakoon B, Yapong B, Kedjarune U, Leggat PA (2000) Occupational health problems of dentists in southern Thailand. Int Dent J 50: 36-40.
19. Marshall ED, Duncombe LM, Robinson RQ, Kilbreath SL (1997) Musculoskeletal symptoms in New South Wales dentists. Aust Dent J 42: 240-246.
20. Morse T, Bruneau H, Dussetschleger J (2010) Musculoskeletal disorders of the neck and shoulder in the dental professions. Work 35: 419-429.
21. Gupta A, Ankola AV, Hebbal M (2013) Dental ergonomics to combat musculoskeletal disorders: A review. Int J Occup Saf Ergon 19: 561-571.
22. Ng A, Hayes MJ, Polster A (2016) Musculoskeletal disorders and working posture among dental and oral health students. Healthcare (Basel) 4: 13.
23. Diaz-Caballero AJ, Gomez-Palencia IP, Diaz-Cardenas S (2010) Ergonomic factors that cause the presence of pain muscle in students of dentistry. Med Oral Patol Oral Cir Bucale 15: e906-e911.
24. Van Eerd D, Munhall C, Irvin E, Rempel D, Brewer S, et al. (2016) Effectiveness of workplace interventions in the prevention of upper extremity musculoskeletal disorders and symptoms: An update of the evidence. Occup Environ Med 73: 62-70.
25. Moore U, Durham J (2011) Invited commentary: Issues with assessing competence in undergraduate dental education. Eur J Dent Educ 15: 53-57.
26. Chambers DW, Geissberger M (1997) Toward a competency analysis of operative dentistry technique skills. J Dent Educ 61: 795-803.
27. Garcia PPNS, Campos JADB (2013) Risk of musculoskeletal disorders in upper limbs in dental students: Concordance of different methods for estimation of body angle. Indian J Dent Res 24: 562-566.
28. Szymanska J (2002) Disorders of the musculoskeletal system among dentists from the aspect of ergonomics and prophylaxis. Ann Agric Environ Med 9: 169-173.
29. Vijay S, Ide M (2016) Musculoskeletal neck and back pain in undergraduate dental students at a UK dental school - A cross-sectional study. Br Dent J 221: 241-245.
30. De Carvalho MV, Soriano EP, de Franca Caldas A Jr, Campeao RIC, de Miranda HF, et al. (2009) Work-related musculoskeletal disorders among Brazilian dental students. J Dent Educ 73: 624-630.
31. Khan SA, Chew KY (2013) Effect of working characteristics and taught ergonomics on the prevalence of musculoskeletal disorders amongst dental students. BMC Musculoskeletal Disord 14: 118.
32. Thornton LJ, Barr AE, Stuart-Buttle C, Gaughan JP, Wilson ER, et al. (2008) Perceived musculoskeletal symptoms among dental students in the clinic work environment. Ergonomics 51: 573-586.
33. Peros K, Vodanovic M, Mestrovic S, Rosin-Grget K, Valic M (2011) Physical fitness course in the dental curriculum and taught ergonomics on the prevalence of musculoskeletal disorders amongst dental students. BMC Musculoskeletal Disord 15: e906-e911.
34. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sorensen F, et al. (1987) Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon 18: 233-237.