

Original Research Article

Do occupational factors increase the radiological degree of cervical disc degeneration?

Daltaban IS.¹, Ak H.², Turksoy V.A.³, Yaycioglu S.⁴, Çetintepe P.S.⁵

¹Assistant. prof. Yozgat Bozok University School of Medicine Department of Neurosurgery Yozgat/Turkey.

²Associate Prof. Yozgat Bozok University School of Medicine Department of Neurosurgery Yozgat/Turkey.

³Assistant. prof. Yozgat Bozok University Faculty of Medicine / Internal Medical Sciences / Department of Public Health Yozgat/Turkey.

⁴Assistant. prof. Menderes University School of Medicine Department of Neurosurgery Aydın/TURKEY.

⁵Assistant. prof. Occupational Medicine Sub-speciality Fellow Department of Internal Medicine Hacettepe University, Ankara/ Turkey.

*Corresponding Author

İskender Samet DALTABAN

Abstract: Background: The aim of this study was to find out the relationship between occupational characteristics of patients and magnetic resonance imaging (MRI) stages of cervical disc hernia. Methods: The medical files of patients who applied with cervical disc degeneration were collected. Age in years, gender, comorbid diseases, occupation, years spent in occupation and degree of degeneration in cervical MRI were gathered from patients' medical files. Patients were divided into groups according to their occupations which were housewives, construction workers, teachers, and healthcare professionals. Based on the working years, patients were divided into four groups as follows: 0-5 years, 5-10 years, 10-15 years, and over 15 years. The degree of cervical disc degeneration on MRI was staged as bulging (group 1), protrusion (group 2), extrusion and sequestration (group 3). Results: A total of 500 patients with various cervical disc hernia participated in the study. Bulging and protrusion were seen frequently over 45 years of age, followed by extrusion & sequestration in 35-45 years of age ($p=0.001$). Bulging and extrusion & sequestration were statistically significantly higher in construction workers than other occupational groups, whereas protrusion were most frequently observed in healthcare workers ($p<0.001$). Any extrusion & sequestration case was not observed in least experienced workers ($p<0.001$). Conclusion: MRI cervical disc hernia grades differed significantly between occupational groups and exhibited an increase in the radiological degree of cervical disc degeneration with a correlation between years spent at work up to 10 years.

Keywords: Cervical disc degeneration; Occupation; Radiological degree.

INTRODUCTION

Cervical disc hernia is a disease that can cause pain and various neurological deficits by applying pressure on medulla spinalis or nerve root (Hammer, C. *et al.*, 2016). In the pathogenesis, genetic and environmental factors are thought to be essential (Hammer, C. *et al.*, 2016; Roberts, S., & Butler, R. C. 2005). Palmer *et al.* have conducted a case-control study on twin patients which exhibited that environmental factors are more important in triggering degeneration of cervical disc hernia (Palmer, P.E. *et al.*, 1984). The risk factors for cervical disc hernia can be listed as follows sudden trauma or chronic repetitive traumas of the neck, increased age, prolonged sitting or vehicle use leading to postural disturbance, physical stress and mechanical overload in occupations and activities, smoking, vascular diseases, diabetes mellitus, chronic

inflammatory diseases (Hammer, C. *et al.*, 2016; Roberts, S., & Butler, R. C. 2005). In addition, some jobs requiring the use of vibration-causing tools causing whole body vibration and some sports branches such as diving sports have been identified as risk factors for cervical disc herniation (Williams, F. M. K., & Sambrook, P. N. 2011).

The impact of occupational factors on the spine has been investigated by focusing on risk factors such as heavy manual lifting at work (Andersson, G.B. 1998; Lorusso, A., *et al.*, 2007). Studies in literature are mostly concentrated on the lumbar region and the number of studies related to the cervical region is very limited (Ariëns, G. A., *et al.*, 2001; Zejda, J. E., & Stasiow, B. A. R. T. Ł. O. M. I. E. J. 2003). Although it is thought that physical workload, whole body vibration

Quick Response Code



Journal homepage:

<http://www.easpublisher.com/easims/>

Article History

Received: 15.02.2019

Accepted: 25.02.2019

Published: 10.03.2019

Copyright © 2019: This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

exposure, psychosomatic and psychological factors play a role as predictive factors for cervical complaint indication or treatment, occupational risk factors for the radiological changes of the cervical spine are not fully known (Krause, N., *et al.*, 1997; Leclerc, A., *et al.*, 1999).

Magnetic resonance imaging (MRI) is the gold standard method for identification and follow-up of the cervical disc hernia (Hammer, C. *et al.*, 2016). The widely accepted version of (MRI) grading of the cervical disc hernia is classified by severity of disease as follows bulging, protrusion, extrusion and sequestration, respectively (Costello, R. F., & Beall, D. P. 2007). In the stage called bulging, annulus fibrosus is sustained while disc is enlarging beyond the normal range. Focal disc dilatation is seen due to rupture of the inner layers of the annulus fibrosus, with the posterior longitudinal ligament being intact during the protrusion phase. In extrusion phase, all layers of annulus fibrosus are torn and the nucleus pulposus extruded under the posterior longitudinal ligament. In the sequestration phase, the extruded nucleus ruptures the posterior longitudinal ligament and is released in the spinal canal (Costello, R. F., & Beall, D. P. 2007; Francis, H., *et al.*, 2013).

The aims of this study were 1) to describe the distribution of MRI findings and occupational features in patients with symptomatic cervical disc degeneration 2) to find out the relationship between occupational characteristics of patients and MRI stages of cervical disc hernia.

METHODS

The medical files of patients who applied to the Neurosurgery Outpatient Clinic of Bozok University Hospital between December 2016 and January 2017 with cervical disc degeneration according to MRI were collected. Occupational history data was derived from the individuals' medical files as follows: age in years, gender, comorbid diseases, occupation, years spent in occupation and degree of degeneration in cervical MRI. The age range for the study was maintained between 25 and 65 years old. Patients were divided into groups according to their occupations which were housewives, construction workers, teachers and healthcare professionals. Based on the working years, patients

were divided into four groups as follows: 0-5 years, 5-10 years, 10-15 years and over 15 years. The MRI findings were reported by an experienced radiologist. The degree of cervical disc degeneration on MRI from sequential sagittal view was staged as bulging (group 1), protrusion (group 2), extrusion and sequestration (group 3).

Patients diagnosed with diabetes mellitus, chronic liver disease, hypertension, obesity, trophoblastic diseases, osteoporosis, ankylosing spondylitis, hyperlipidaemia and patients with severe trauma history were not included in the study. Patients under the age 25 and over 65 were excluded from the study as well. This study was approved by Bozok University Faculty of Medicine ethics committee for non-invasive clinical research (31.02.2017 dated, 26 numbered).

Responses to the questionnaire questions were coded and filled into a database file. Statistical analysis was carried out with SPSS 23 software. Descriptive statistics were used to analyse the occurrence of various demographic and radiological features. The association between the degree of degeneration in cervical spine and occupational features were evaluated by using chi-square test. For p values, which are smaller than 0.05 were interpreted as a significant difference.

RESULTS

A total of 500 patients with various cervical disc hernia participated in the study. The demographic and clinical characteristics of the group are summarized in Table-1. The leading age group is the 35-45 years old group with 44.6%, followed by over 45 age group with 43.8%. As shown in Table 1, 37% of the patients were female and 63% of the patients were male. According to the distribution of occupations, 17.8% were housewives, 19.8% were teachers, 24.8% were healthcare workers and 37.6% were construction workers. According to years spent in current occupation, the most frequent group was the workers who spent more than 15 years with 39.6%, followed by 25.8% of those having working life ranging from 10 to 15 years. In the distribution of radiological stages, bulging was the most common finding with 78.6%, followed by extrusion & sequestration with 14.0%, and protrusion with 7.4%.

Table 1: Distribution of sociodemographic features and cervical MRI findings

		n	%
Age	25-35	58	11.6
	35-45	223	44.6
	>45	219	43.8
Sex	Female	185	37
	Male	315	63
Occupation	Housewife	89	17.8
	Teacher	99	19.8
	Health care worker	124	24.8
	Construction worker	188	37.6
Years in occupation	0-5	71	14.2
	5-10	102	20.4
	10-15	129	25.8
	>15	198	39.6
Degree of degeneration	Bulging	393	78.6
	Protrusion	37	7.4
	Extrusion & sequestration	70	14

In Table 2, the relationship between the degree of cervical disc degeneration in MRI and sociodemographic/occupational characteristics of the patients were examined. Bulging and protrusion were seen frequently over 45 years of age, followed by extrusion & sequestration in 35-45 years of age ($p=0.001$). The significant difference was not found between gender and radiological stages of patients ($p=0.9$). Bulging and extrusion & sequestration were statistically significantly higher in construction workers than other occupational groups, whereas protrusion were most frequently observed in healthcare workers ($p<0.001$). In housewives bulging was the most observed cervical spine finding with 19.6%, followed

by extrusion & sequestration with 14.2%. In teacher group, extrusion & sequestration was the leading finding with 32.9%, followed by protrusion with 24.3%. Half of the healthcare professional had a MRI finding of protrusion and quarter of them had bulging in cervical spine. While bulging (38.4%) and protrusion (54.1%) were seen most frequently in workers spent more than 15 years in occupation, extrusion & sequestration (44.3%) was significantly more pronounced in those having 10 to 15 years of work experience ($p<0.001$). Moreover, any extrusion & sequestration case was not observed in least experienced workers ($p<0.001$).

Table 2. Relation between degeneration degree of cervical disc in MRI and occupational features of patients

Degree of Degeneration				
	Bulging	Protrusion	Extrusion & Sequestration	p- value
Age (%)				0.001
25-35	13.0	18.9	0	
35-45	43.2	27.0	61.4	
>45	43.8	54.1	38.6	
Sex (%)				0.9
Female	37.2	35.1	37.1	
Male	62.8	64.9	62.9	
Occupation (%)				<0.001
Housewife	19.6	5.4	14.2	
Teacher	17.1	24.3	32.9	
Healthcare worker	24.9	51.4	10.0	
Construction worker	38.4	18.9	42.9	
Years in occupation (%)				<0.001
0-5	16.3	18.9	0.0	
5-10	20.9	21.6	17.1	
10-15	24.4	5.4	44.3	
>15	38.4	54.1	38.6	

DISCUSSION

The aim of the study is to reveal the relationship between occupational characteristics and MRI staging of symptomatic patients with cervical disc hernia. In patient aged ranging from 35 to 45, more than half had extrusion & sequestration in the cervical spine MRI ($p=0.001$). In addition, extrusion & sequestration in MRI of cervical disc was not observed in any person aged under 35. Although detection of advanced stages of cervical disc degeneration is not usual in people younger than 35 years old, the ages range from 35 to 45 are more likely to have an advanced cervical disc pathology in concordance with literature (Hammer, C. *et al.*, 2016; Nouri, A., *et al.*, 2015). In our study, unexpectedly, the rate of protrusion (54.1%) exceeding extrusion & sequestration (38.6%) in patients over 45 years old may be a statistical error due to the imbalance of the numbers of patients in the MRI subgroups.

In housewives, extrusion & sequestration (14.2%), which is a finding of advanced cervical discopathy, is the second most common finding after bulging (19.6%). Even though housewives do not appear to be actively engaged, they do repetitive movements such as housekeeping, kitchen work, shopping and carrying goods, and work that involves heavy lifting and risks for musculoskeletal system (Dhone, S., & Khare, T. 2017). Surveys conducted on housewives showed that the musculoskeletal complaints included all joints and muscle groups. In cross-sectional studies, 35% to 50% of housewives were found to have neck pain (Dhone, S., & Khare, T. 2017; Fazli, B., *et al.*, 2016).

Advance stages of MRI in cervical disc hernia, in other name extrusion & sequestration, were observed more significantly in construction workers (42.9%) and teachers (32.9%) than the other occupational groups ($p<0.001$). The appearance of advanced cervical disc pathologies in construction workers may be explained by increased physical activity, work requiring body vibration and weight lifting (Fazli, B., *et al.*, 2016; Jensen, M. V. *et al.*, 1996). In studies conducted on long road drivers (Jensen, M. V. *et al.*, 1996) and port workers (Waśkiewicz, J. 1996) who exposed to ergonomic risks, the clinical degree of cervical disc hernia was positively correlated with intensive physical activity. As in the case of the teacher group, the underlying cause of musculoskeletal problems in office workers is often attributed to false posture and ergonomic misfit (Solis-Soto, M. T., *et al.*, 2017). Despite many studies of aetiology of neck pain in occupational groups (Ariëns, G. A., *et al.*, 2001), any study evaluating the association between degree of MRI cervical discopathy and occupational characteristics was not found in the literature.

Musculoskeletal system problems are one of the major occupational exposures in health care workers. Risk factors for occupational musculoskeletal disorders in health care workers are mainly caused by long time standing, repetitive movements and static posture at work (Gutierrez-Diez, M. C., *et al.*, 2018; Yan, P., *et al.*, 2017). Dental practitioners working in static postures reported severe upper extremity-related illnesses and symptoms such as neck and arm pain (Huisstede, B. M., *et al.*, 2006; Lindfors, P., *et al.*, 2006). A definitive study in Italy showed that the frequency of low back pain was up to 86% in nurses (Lorusso, A., *et al.*, 2007; Shelerud, R. 1998). In the cross-sectional study performed on nurses by Tinubu *et al.* the percentage of neck pain complaints was up to 28% (Tinubu, B. M., *et al.*, 2010). Similarly, in the study performed on physiotherapists, complaints related to the neck region were reported to be observed close to 50% (Cromie, J. E., Robertson, *et al.*, 2000). In our study, the protrusion (51.4%) was seen more frequently in health care workers than other occupational group ($p<0.001$). Protrusion is included in early stage cervical hernia classification and can be improved by conservative treatment (Nakashima, H., *et al.*, 2015). The importance of periodic examination for early diagnosis should be underlined in this occupational group.

Despite extrusion & sequestration was found more frequently in MRI of cervical disc hernia in patients working more than 10 years, not observed in patients spent less than 5 years at work ($p<0.001$). The increased frequency of advanced cervical MRI findings in those having more than 10 years of working life is consistent with the cumulative nature of cervical disc degeneration (Hammer, C., *et al.*, 2016). Previous studies have shown a positive correlation between cervical/waist pain and years of physical work (Krause, N., *et al.*, 1997). In our study, protrusion (54.1%) was observed in employees who worked more than 15 years, followed by extrusion & sequestration (38.6%) ($p<0.001$). This conflicting picture may be due to personal factors such as other environmental and genetic factors that are effective in prognosis of cervical disc herniation (Hammer, C., *et al.*, 2016; Roberts, S., & Butler, R. C. 2005). In a study conducted by Zejda *et al.*, in coal miners, the significant difference was not found between the years spent in industry and degree of cervical disc degeneration detected in x-ray (Zejda, J. E., & Stasiow, B. A. R. T. Ł. O. M. I. E. J. 2003).

The strengths of our study can be listed as being the first study to investigate the relationship between multiple occupational groups and the MRI findings of patients which is the gold standard in evaluating the cervical disc hernia and sufficient numbers. The shortcomings of our study include the likelihood of selection bias, which may be due to nature of the retrospective study, and the fact that factors

predisposing to disc herniation such as smoking and physical activity of patients are not included in the study.

In conclusion, our study showed that the MRI cervical disc hernia grades differed significantly between occupational groups and exhibited an increase in the radiological degree of cervical disc degeneration with a correlation between years spent at work up to 10 years.

REFERENCES

1. Hammer, C., Heller, J., & Kepler, C. (2016, June). Epidemiology and pathophysiology of cervical disc herniation. In *Seminars in Spine Surgery* (Vol. 28, No. 2, pp. 64-67). WB Saunders.
2. Sakellariadis, N. (2006). The influence of diabetes mellitus on lumbar intervertebral disc herniation. *Surgical neurology*, 66(2), 152-154.
3. Roberts, S., & Butler, R. C. (2005). Inflammatory mediators as potential therapeutic targets in the spine. *Current Drug Targets-Inflammation & Allergy*, 4(2), 257-266.
4. Palmer, P.E., Stadalnick, R., Arnon, S. (1984). The genetic factor in cervical spondylosis. *Skeletal Radiol.* 11(3), 178-82.
5. Williams, F. M. K., & Sambrook, P. N. (2011). Neck and back pain and intervertebral disc degeneration: role of occupational factors. *Best practice & research Clinical rheumatology*, 25(1), 69-79.
6. Andersson, G.B. (1998). Epidemiology of low back pain *Acta Orthop Scand Suppl*, 28(1), 28-31.
7. Ariëns, G. A., van Mechelen, W., Bongers, P. M., Bouter, L. M., & van der Wal, G. (2001). Psychosocial risk factors for neck pain: a systematic review. *American journal of industrial medicine*, 39(2), 180-193.
8. Viikari-Juntura, E., Martikainen, R., Luukkonen, R., Mutanen, P., Takala, E. P., & Riihimäki, H. (2001). Longitudinal study on work related and individual risk factors affecting radiating neck pain. *Occupational and environmental medicine*, 58(5), 345-352.
9. Zejda, J. E., & Stasiow, B. A. R. T. Ł. O. M. I. E. J. (2003). Cervical spine degenerative changes (narrowed intervertebral disc spaces and osteophytes) in coal miners. *International journal of occupational medicine and environmental health*, 16(1), 49-53.
10. Krause, N., Ragland, D. R., Greiner, B. A., Fisher, J. M., Holman, B. L., & Selvin, S. (1997). Physical workload and ergonomic factors associated with prevalence of back and neck pain in urban transit operators. *Spine*, 22(18), 2117-2126.
11. Leclerc, A., Niedhammer, I., Landre, M. F., Ozguler, A., Eto, P., & Pietri-Taleb, F. (1999). One-year predictive factors for various aspects of neck disorders. *Spine*, 24(14), 1455.
12. Hammer, C., Heller, J., & Kepler, C. (2016, June). Epidemiology and pathophysiology of cervical disc herniation. In *Seminars in Spine Surgery* (Vol. 28, No. 2, pp. 64-67). WB Saunders.
13. Costello, R. F., & Beall, D. P. (2007). Nomenclature and standard reporting terminology of intervertebral disk herniation. *Magnetic resonance imaging clinics of North America*, 15(2), 167-174.
14. Francis, H., Shen, M.D .D.S.D. (2013). Textbook of the Cervical Spine. Elsevier Saunders.
15. Nouri, A., Tetreault, L., Singh, A., Karadimas, S. K., & Fehlings, M. G. (2015). Degenerative cervical myelopathy: epidemiology, genetics, and pathogenesis. *Spine*, 40(12), E675-E693.
16. Dhone, S., & Khare, T. (2017). Evaluation of Musculoskeletal Disorders among the House Wives in Nagpur City, Maharashtra. *International Journal of Research and Innovation in Social Science*, 1(1):39-40
17. Fazli, B., Ansari, H., Noorani, M., Jafari, S. M., Sharifpoor, Z., & Ansari, S. (2016). The prevalence of musculoskeletal disorders and its predictors among Iranians' Housewives. *International journal of epidemiologic research*, 3(1), 53-62.
18. Echarri, J. J., & Forriol, F. (2005). Influence of the type of load on the cervical spine: a study on Congolese bearers. *The Spine Journal*, 5(3), 291-296.
19. Jensen, M. V., Tüchsen, F., & Ørhede, E. (1996). Prolapsed cervical intervertebral disc in male professional drivers in Denmark, 1981-1990: a longitudinal study of hospitalizations. *Spine*, 21(20), 2352-2355.
20. Waśkiewicz, J. (1996). The effect of heavy work on the musculoskeletal system of dockers. *Bulletin of the Institute of Maritime and Tropical Medicine in Gdynia*, 47(1-4), 25-32.
21. Solis-Soto, M. T., Schön, A., Solis-Soto, A., Parra, M., & Radon, K. (2017). Prevalence of musculoskeletal disorders among school teachers from urban and rural areas in Chuquisaca, Bolivia: a cross-sectional study. *BMC musculoskeletal disorders*, 18(1), 425.
22. Gutierrez-Diez, M. C., Benito-Gonzalez, M. A., Sancibrian, R., Gandarillas-Gonzalez, M. A., Redondo-Figuero, C., & Manuel-Palazuelos, J. C. (2018). A study of the prevalence of musculoskeletal disorders in surgeons performing minimally invasive surgery. *International Journal of Occupational Safety and Ergonomics*, 24(1), 111-117.
23. Taib, M. F. M., Bahn, S., Yun, M. H., & Taib, M. S. M. (2017). The effects of physical and psychosocial factors and ergonomic conditions on the prevalence of musculoskeletal disorders among dentists in Malaysia. *Work*, 57(2), 297-308.
24. Yan, P., Li, F., Zhang, L., Yang, Y., Huang, A., Wang, Y., & Yao, H. (2017). Prevalence of work-related musculoskeletal disorders in the nurses working in hospitals of Xinjiang Uygur

- Autonomous region. *Pain Research and Management*, 2017.
25. Huisstede, B. M., Bierma-Zeinstra, S. M., Koes, B. W., & Verhaar, J. A. (2006). Incidence and prevalence of upper-extremity musculoskeletal disorders. A systematic appraisal of the literature. *BMC musculoskeletal disorders*, 7(1), 7.
 26. Lindfors, P., Von Thiele, U., & Lundberg, U. (2006). Work characteristics and upper extremity disorders in female dental health workers. *Journal of occupational health*, 48(3), 192-197.
 27. Lorusso, A., Bruno, S., & L'abbate, N. (2007). A review of low back pain and musculoskeletal disorders among Italian nursing personnel. *Industrial health*, 45(5), 637-644.
 28. Shelerud, R. (1998). Epidemiology of occupational low back pain. *Occupational medicine (Philadelphia, Pa.)*, 13(1), 1-22.
 29. Tinubu, B. M., Mbada, C. E., Oyeyemi, A. L., & Fabunmi, A. A. (2010). Work-related musculoskeletal disorders among nurses in Ibadan, South-west Nigeria: a cross-sectional survey. *BMC Musculoskeletal disorders*, 11(1), 12.
 30. Cromie, J. E., Robertson, V. J., & Best, M. O. (2000). Work-related musculoskeletal disorders in physical therapists: prevalence, severity, risks, and responses. *Physical therapy*, 80(4), 336-351.
 31. Nakashima, H., Yukawa, Y., Suda, K., Yamagata, M., Ueta, T., & Kato, F. (2015). Cervical disc protrusion correlates with the severity of cervical disc degeneration. *Spine*, 40(13), E774-E779.