

Degenerative changes of vertebrae, intervertebral discs, and narrowing of the intervertebral foramens of the cervical spine in physical workers with neck pain

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Abstract

Disorders of the skeletal system in humans are a serious problem. The aim of the study was to determine occurrence of degenerative changes of vertebrae, degeneration of intervertebral discs, osteophytes of vertebral body margins, and narrowing of intervertebral foramens on several motion segments of cervical spine in physical workers suffering from neck pain (NP). All patients were subjected to computed tomography examination and following three-dimensional shaded surface display reconstructions of the C3–C7 segments. The relationships between intervertebral discs degenerative changes, osteophytes of vertebral body margins, and intervertebral foramens narrowing of cervical spine were determined. The occurrence of degeneration of intervertebral discs and osteophytes of vertebral body margins was stated in 97 and 56 motion segments of the cervical spine, respectively. The occurrence of narrowing of intervertebral foramens on the right and left side of the cervical spine was stated in 84 and 78 motion segments, respectively. Statistically significant relationships were found between the investigated degenerative changes within single motion segment. In conclusion, positive relationships were found between the occurrence of degeneration of intervertebral discs, osteophytes of anterior vertebral body margins, and narrowing of intervertebral foramens of the cervical spine in physical workers suffering from NP.

Key words

cervical spine, computed tomography, disorders of skeletal system, intervertebral discs, neck pain, osteophytes

INTRODUCTION

Nowadays, disorders of skeletal system and locomotory functions in humans are a serious medical, social and economic problem. Taking into consideration these issues, the year 2000 was proclaimed the beginning of the Bone and Joint Decade by the World Health Organization. The objective of the Bone and Joint Decade 2000-2010 was significant improvement of the quality of life in people suffering from musculoskeletal and locomotor disorders [1]. Neck pain (NP), similar to low back pain (LBP), is an important cause of health and economic problems and is becoming a more frequent cause of disability [2,3]. Dissemination of work with personal computers significantly increases the number of patients suffering from chronic NP, mainly within the professionally-active population.

The most frequent degenerative changes of the spine are localized within the lower cervical and lumbar spine and influence all elements of the motion segment, such as intervertebral discs, vertebral body margins, intervertebral joints, ligaments and muscles [4-6]. Numerous studies have evaluated the importance of environmental factors that may lead to an increased risk of NP, with and long-term office work in a sitting position, lack of or very low locomotor activity and stress being the most prevalent [7]. However, the data

on morphological changes of the cervical spine in patients with NP in response to disadvantageous environmental factors are strongly limited. Thus, the aim of our study was to determine the occurrence of degenerative changes of the bony structure, intervertebral discs degenerations, and intervertebral foramens narrowing within several motion segments of the cervical spine in physical workers suffering from NP. Additionally, the relationships between several pathological changes of the cervical spine were evaluated.

MATERIALS AND METHODS

The study was performed on 60 patients with chronic neck pain – 33 women and 27 men, between the ages of 31-75 (mean 49.5 ±7.5). The patients were subjected to computed tomography (CT) examination of the cervical spine and subsequent three-dimensional (3D) SSD reconstructions of the C3–C7 segments. In total, 240 motion segments were evaluated. The evaluation of the presence of degenerative changes of the intervertebral discs (Figure 1), as well as osteophytes of the vertebral body margins (Figure 2) and intervertebral foramens narrowing (Figure 3) of the cervical spine, was performed separately for each motion segment. The obtained results were subjected to statistical analysis with the use of the Chi-square test as a non-parametric test. The database was prepared using Microsoft Office Excel 2003 software, and statistical analysis performed with the use of the Statistica PL version 6.0 software (StatSoft, Poland). The relationships between intervertebral discs degenerative

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Figure 1. Computed tomography evaluation of the presence of degenerative changes of intervertebral discs. White arrow indicates intervertebral disc herniation

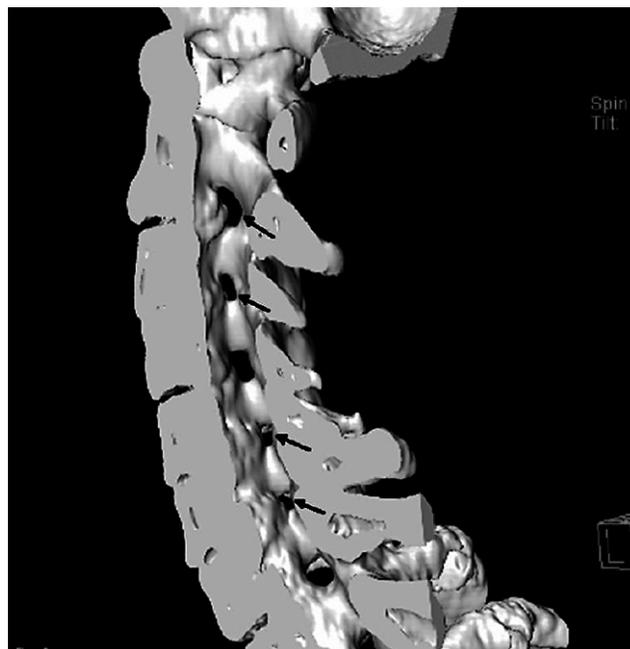


Figure 3. Three-dimension computed tomography intercanal reconstruction of bony structures of the cervical spine. Black arrows indicate narrowing of the intervertebral foramens



Figure 2. Three-dimension computed tomography reconstruction of bony structures of the cervical spine. Black arrows indicate osteophytes of the vertebral body margins

changes, osteophytes of the vertebral body margins, and intervertebral foramens narrowing of the cervical spine were determined. The level of statistical significance was set at $p < 0.05$.

RESULTS

Degenerative changes of the intervertebral discs of the cervical spine were stated in 97 motion segments – 40.04% of the investigated segments. The presence of osteophytes of

the anterior margins of the vertebral body were identified in 56 motion segments, while 52 motion segments were affected by osteophytes of the lateral margins of the vertebral body – 23.33% and 21.67%, respectively. While hypertrophic changes and osteophytes of margins of the uncovertebral joints of the cervical vertebrae were found in 28 motion segments (11.67%), the intracanal osteophytes of the posterior vertebral body margins were found in 75 motion segments (31.25%). The narrowing of right intervertebral foramens was stated in 84 motion segments (35%), while the narrowing of left intervertebral foramens were diagnosed in 78 segments (32.5%). Statistically significant relationships were found between several changes diagnosed within single motion segments. The occurrence of degenerative changes of the intervertebral discs was related to the presence of osteophytes of the anterior margins of the vertebral body of cervical spine segments ($\chi^2=3.92$; $p=0.04$). However, no relationships were found between degenerative changes of the intervertebral discs and osteophytes of the lateral margins of the vertebral body, nor between degenerative changes of the intervertebral discs and degeneration of the uncovertebral joints. The degenerative changes of the intervertebral discs were not significantly related to osteophytes of the posterior margins of the vertebral body.

A significant relationship was found between the degenerative changes of the intervertebral discs and narrowing of right intervertebral foramens of the cervical spine segments ($\chi^2=7.68$; $p=0.006$). A similar tendency was observed when the relationship between the degenerative changes of the intervertebral discs and narrowing of the left intervertebral foramens was investigated ($\chi^2=3.31$; $p=0.069$).

DISCUSSION

Five highly probable risk factors for neck pain associated with work conditions have been distinguished: time factors,

exposure level, repetitiveness (frequency), and psychological work environment. Individual factors were age and gender. Time factors consist of length of employment and number of working hours per day, while repetitiveness can be revealed by the interval pattern and changes in posture. Exposure level includes nature of the job and design of the workstation [8]. There is a significant positive association between prolonged sitting while working and neck pain, implying that there is an increased risk of neck pain for people who are working almost all day in a sitting position (more than 95% of the working time) [7]. Root pain is commonly linked to nerve compression [5]. For some authors, the link between spinal degeneration and patient symptoms remains controversial despite numerous studies investigating these relationships [9]. Some of the studies indicate that pathological changes of the cervical spine in young adults are similar to those observed in both patients suffering from NP and patients without NP symptoms. Intervertebral disc herniation was the only finding observed with the use of magnetic resonance imaging (MRI) that was significantly associated with neck pain [10].

In our studies, the degenerative changes of the intervertebral discs were found in 97 motion segments of the cervical spine - 40.04% of the investigated spine segments. Occlusion of the intervertebral foramen with the soft tissues is obviously related to the root pain symptoms [11]. Similar relationships were reported with bone-related narrowing of intervertebral foramina [12]. In the current study, the narrowing of the intervertebral foramina affected 33.8% of all the investigated motion segments of the cervical spine in patients with NP. Moreover, a significant relationship between degenerative changes of the intervertebral discs and narrowing of the right and left intervertebral foramina was stated. These data indicate that degenerative changes of the intervertebral discs and narrowing of the intervertebral foramina may induce clinical symptoms. Among the potential sources of intervertebral canal and intervertebral foramina are listed: stenosis and compression of the spinal cord and nerve roots, central or lateral herniation of the nucleus pulposus, osteophytes of the posterior and posterior-lateral margins of the vertebral bodies, osteophytes of the facet joints, thickening and calcification of the posterior longitudinal ligament and ligamentum flavum, and lordosis reduction and subluxation [13]. Cervical myelopathy results from spinal cord dysfunction and the degenerative changes located within one or more spine segments are considered as its causative factors [14]. Cervical myelopathy and radiculopathy are often induced by osteophytes of the margins of the posterior vertebral bodies. The segmental stiffness at the degenerated level increases with the severity of degeneration. Intervertebral disc bulge and annulus stress and strain decreased at the degenerated level. The strain energy distribution and stress in the vertebral cortex increased adjacent to the degenerated disc. Specifically, the anterior region of the cortex responded with a higher increase in these responses. The increased strain energy density and stress in the vertebral cortex over time may induce the remodeling process according to Wolff's law, leading to the formation of osteophytes [15]. Due to the significant relationship between degenerative changes of the intervertebral discs and osteophytes located on the anterior margins of the vertebral bodies of cervical spine observed in the current study, it is concluded that the osteophytes of the anterior vertebral body margins are induced as the consequence of overloading and excessive movement of the

motion segments with degenerated intervertebral discs. The degenerative changes of the cervical spine are commonly located within a few segments, and contain sequences of the pathological changes, such as degeneration of the intervertebral disc, osteophytes of the margins of the vertebral bodies, facet joint degeneration, as well as thickening of the ligaments and segmental instability [16].

CONCLUSIONS

This study shows that positive relationships were found between degenerative changes of the intervertebral discs and osteophytes of the margins of the anterior vertebral bodies, as well as between degenerative changes of the intervertebral discs and narrowing of the intervertebral foramina in physical workers. A positive relationship between degenerative changes of the intervertebral discs and narrowing of the intervertebral foramina of the cervical spine indicates that patients with narrowing of the intervertebral foramina are susceptible to neck pain when degenerative changes of intervertebral discs occur.

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