

SPECIFIC FEATURES OF OCCUPATIONAL FLUOROSIS

E.Yu. Ornitson, M.V. Chashchin, E.V. Zibarev

State Institution, Northwestern Scientific Center of Hygiene and Public Health of the Ministry of Health of the Russian Federation. St. Petersburg

SUMMARY: Analysis of X-ray images of 397 patients suffering from fluorosis showed that 94.0% of cases exhibit degenerative-dystrophic impairments of the lumbar spine; 65.0% of cases – calcification of the anterior longitudinal ligament; and 91.0% of cases – impairments in the form of epicondylitis, periarthrosis, and deforming arthrosis. Impairment of the musculoskeletal system exhibited systemic, multiple, and symmetrical nature.

Keywords: *fluorosis, fluorine compounds, X-ray examination.*

The issue of the prevalence of chronic fluorine intoxication (CFI) arose most acutely in the period from 1968 to 1969 when 581 cases of this disease were registered in the course of a medical examination of 8,085 workers at seven aluminum manufacturing plants [2]. From 40 to 100 cases of occupational fluorosis are registered in Russia each year. Currently, CFI is still associated only with fluorosis of teeth and bones, always exhibited as osteosclerosis and, to a lesser extent, as calcification of connection sites of ligaments and tendons to bones, periosteal reactions, and metabolic-dystrophic impairment of large joints. Under this interpretation, CFI pathogenicity of fluorine compounds is reduced to their osteopathogenicity, specific mechanisms of which are described in detail in literature reviews [1, 3-5, 10]. Production modernization as well as technological and hygienic measures have led to the improvement of working conditions at plants which use fluorine compounds (facilities involved in the production of cryolite, marble, superphosphate, and aluminum), resulting in lower concentrations of fluorine in workplace air. As a result, occurrence of severe cases of fluorosis has decreased significantly. However, there has been a significant increase in the prevalence of an involutinal process occurring within the osseous tissue in the form of calcification of ligaments and tendons and deformation of the joints and spine [7].

Materials and methods.

In order to identify the specific features of the CFI course, we analyzed case histories of 397 patients suffering from fluorosis who have been under dynamic observation by specialists at the clinic for occupational diseases for more than 20 years. 63.6% of the patients had the first stage of the disease, 17.8% the second stage, and 3.7% the third stage. To identify the characteristic features of the X-ray patterns caused by various impact intensity levels of fluorine compounds on the body, the investigation was conducted by the case-control method. The study subjects were in two groups of workers, 15 people each, employed in the production of aluminum at two different plants using the same technology; the average age was 44.3 years and the average length of service was 18.8 years. The mean fluorine level in the urine of workers at the first plant was significantly higher ($p < 0.05$) (2.3 ± 0.430 mg/L) compared to the fluorine level in the urine of the tested individuals in the control group (1.2 ± 0.308 mg/L).

Results. Analysis of the X-ray patterns of the clinic patients showed that in the 1st stage of the disease the lumbosacral spine is affected in 94.0% of cases. The X-ray images showed an increase in density with coarsening of the osseous tissue structure of the vertebrae. Calcification of the anterior longitudinal ligament was seen in 65.0% of cases. 33.3 % of patients exhibited characteristic changes of the

long bones in the form of induration of the cortical bone substance. Pathology of skeletal bones at the 2nd and 3rd stages of fluorosis was characterized by widespread osteosclerosis, accompanied by an elevated hyperostosis index. All patients exhibited increased mineralization in the ligamentous apparatus. Impairments in the form of epicondylitis, periarthrosis, and deforming arthrosis of the elbow and shoulder joints were found in 91.0% of cases. Articular forms – mainly, the impairment of elbow and knee joints – prevailed somewhat over para-articular forms (55.5% and 45.5%, respectively). Impairment of the musculoskeletal system exhibited systemic, multiple, and symmetrical nature. Most frequently encountered were combined impairment of the elbow and knee joints and the spine in the form of massive hook-like growths along the edges of the joint surfaces and soft tissue calcification in the form of osteophytes and parasosseous lumps. This peculiar type of impairment of the articular apparatus has not been seen in occupations associated with physical exertion and exposure to vibration. At the same time, myofibrosis and tendovaginitis of the forearm, common among workers exposed to physical factors, were encountered in this group of patients significantly less frequently. Some of the clinical features of such diseases as deforming arthrosis of the elbow and knee joints had attracted our attention. Patients suffering from fluorosis did not exhibit locked joints typical of “floating cartilages,” suffered little loss of flexion and extension, and exhibited dulling of external epicondylitis symptoms caused by traction of the periosteum of the shoulder epicondylus. Therefore, in our opinion, the pathology of the

musculoskeletal system in the form of articular and para-articular impairments of the joints should be attributed to the CFI symptoms. Earlier experimental studies have shown that with an increased intake of fluorine compounds, their content increases in soft tissues and cartilage [6, 8, 9].

In the course of dynamic observation of patients suffering from fluorosis of the bones, it was found that a stable pattern of symptoms was determined in 62% of cases; in some cases, a decrease has been seen in the severity of osteosclerosis of the vertebral bodies of the lumbar spine and of the cylindrical bones (33.0% and 10.0% of the cases, respectively), and a deterioration of X-ray patterns has been observed in 5% of the cases. In some cases, a build-up of osteosclerosis and periosseous and endosseous overlays in the bones were observed for a period of up to 20 years after the termination of exposure to fluorine compounds. For the same period, 60% of patients showed progression of deforming spondylosis, arthrosis, epicondylitis, and periarthrosis.

Analysis of study results by the case-control method showed that workers of first group developed 1.6 times more degenerative dystrophic impairments of the cervical and lumbar spine than the workers of the control group. Bilateral joint impairments occurred more frequently in the main study group (see table).

Thus, in order to diagnose fluorosis early, attention should now be paid not only to the characteristic symptoms of express osteosclerosis but also to structural changes in the spondylotic tissue (metaphysis of long bones, spine, etc.).

The share of unilateral and bilateral impairments of joints in workers with different fluorine exposure levels, %

Nosological form	Workers with high exposure to fluorine		Operating control group	
	Unilateral impairment	Bilateral impairment	Unilateral impairment	Bilateral impairment
Osteoarthritis of the wrist	33.3	66.7	50.0	50.0
Epicondylitis of the humerus	25.0	75.0	66.7	33.3
Humeroscapular periarthrosis	42.9	57.1	57.1	42.9
Myofasciitis of the forearms	14.3	85.7	33.3	66.7
Arthrosis of the knee	25.0	75.0	40.0	60.0

¹ **Conclusions.** 1. *The principal radiographic morphology symptoms of developing fluorosis include: changes in the bone structure and induration of the osseous tissue, moderate hyperostosis, narrowing of the medullary space, and calcification of the ligamentous apparatus.* 2. *The earliest changes associated with occupational fluorosis are structural changes in the spongy tissue that occur due to thickening and induration of bone trabeculae.* 3. *Pathology*

of the musculoskeletal system in the form of articular and para-articular impairments is the result of the impact of fluorine compounds on the periosteum and articular cartilage. 4. *Long after termination of exposure to fluorine, radiographic symptoms of osteosclerosis of the vertebral bodies of the lumbar spine and of the cylindrical bones may in some cases be reduced, although complete restoration of normal bone structure was not found in any patients.*

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