

Changes of Sclerotic Skeletal Fluorosis After Changing to Drink Low-Fluorine Water for the Long Term

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[Abstract] Objective: To probe into the changing regularity of sclerotic skeletal fluorosis after patients changed to drink low-fluorine water for the long term. **Methods:** Study subjects were patients with sclerotic skeletal fluorosis who changed to drink low-fluorine water 16–25 years ago, and their sclerotic skeletal fluorosis had been proven by bone X-ray at the beginning of or prior to this change; their anteroposterior X-ray films of the pelvis, right forearm and right lower limb were taken for comparison and analysis. **Results:** The bone substances of all subjects improved remarkably after they changed to drink low-fluorine water for the long term, and 21.47% of them resumed a normal state. The morphology of bone trabecula was not improved for 18.75%–85.75% of cases, and dense bone trabecula became osteoporotic for most cases. The ossification of peri-osseous soft tissues worsened for 73.33% of cases and the degenerative changes of bone joints worsened for 80%. **Conclusion:** The bone substances of sclerotic skeletal fluorosis can improve remarkably after patients change to drink low-fluorine water for the long term, and so a portion of patients may resume the normal state. Two consequential effects of sclerotic skeletal fluorosis are osteoporosis and exacerbation of ossification of peri-osseous soft tissues.

[Key words] Low-fluorine water; sclerotic skeletal fluorosis; changing regularity

Skeletal fluorosis is the chief clinical manifestation of endemic fluorosis, and changes in skeletal fluorosis after stopping exposure to fluorine serve as an important index for assessing the effect of fluorosis prevention and control. Grandjean [1] reported on the changes of osteosclerosis related to industrial skeletal fluorosis after stopping exposure to fluorine, and considered that this osteosclerosis had reversibility. DAI Guo-jun [2] reported observations on endemic skeletal fluorosis for the first time, and pointed out that osteoporosis related to skeletal fluorosis improved remarkably after patients changed to drink low-fluorine water for 5 years, but no osseous change of sclerotic skeletal fluorosis was revealed, and the ossification of peri-osseous soft tissues and the degenerative changes of bone joint worsened. Afterwards, HUANG Chang-qing [3], ZHOU Yan-xing [4], MENG Xian-cai [5] and CHEN De-lang [6] reported in succession that osseous changes related to sclerotic skeletal fluorosis may also be reversed after changing to drink low-fluorine water for 4–10 years

We conducted this study in order to probe into the changing regularity of sclerotic skeletal fluorosis after changing to drink low-fluorine water for the long term.

1 Materials and Methods

1.1 Selection of observation points: Observation points were selected in Shuangwobu, Ongniud Banner and Shenjiawobu, Aohan Banner, Inner Mongolia. In Shuangwobu, the content of fluorine in drinking water was 1.5–5.0 mg/L before changing the drinking water, and it was 1.1–1.2 mg/L in 1974 and 1.0 mg/L in 1982. In Shenjiawobu, the content of fluorine in drinking water was 6.0 mg/L before changing drinking water, and it was 1.0 mg/L in 1983 when the drinking water was changed. From then on, the content of fluorine in drinking water did not change remarkably as was proven by annual re-examination.

1.2 Subjects under observation: Cases from Shuangwobu were diagnosed with sclerotic skeletal fluorosis by x-ray in 1973, and reexamination in 1979 did not reveal noticeable improvement of bone substances. Cases from Shenjiawobu were diagnosed with sclerotic skeletal fluorosis in 1982. All cases from these two regions were reexamined in 1999, i.e.; it had been 16–25 years since changing the drinking water.

1.3 Methods: 23 cases with sclerotic skeletal fluorosis and 8 normal cases were observed. The number of male cases and female cases in

different groups was balanced, and they were aged between 45 and 60 years old. The positions for the radiography included anteroposterior films of the pelvis, right forearm and right calf, and the radiographic conditions were the same as before. The X-rays were judged by two principal observers based on the diagnostic criteria for skeletal fluorosis.

2 Results

2.1 Osseous changes: For eight cases with normal X-ray manifestation of bones, no abnormality was revealed in the patients' bone substances after they changed to drink low-fluorine water for the long term. Of 23 cases with skeletal fluorosis, five cases had normal bone substance, and the other 18 cases had also improved remarkably (for 9 cases, moderate-serious skeletal fluorosis had become mild, and for another 9 cases the mild fluorosis had become extremely mild).

2.2 Changes of bone trabecula morphology: Patients' bone trabecula was improved noticeably after they changed to drink low-fluorine water for the long term; for example, bone trabecular fusion disappeared, and thickening and granular changes of bone trabecula were also improved for most cases; however, the abnormal bone trabecula did not become normal for 18.75–31.25% of the patients, and the osseous texture was still disordered for 85.71% of patients. The dense bone trabecula reduced, and in most patients became osteoporotic (table 1).

Bone trabecula morphology	Before changing drinking water (n)	After changing drinking water (n)	No change (%)
Large fusion	3	0	0
Small fusion	3	0	0
Thickened	22	7	31.18
Granules (large)	16	3	18.75
Granules (small)	16	5	31.25
Disordered arrangement	21	18	85.71
Dense	22	0	
Osteoporotic	1	14	

2.3 Changes of ossification of peri-osseous soft tissues: Not one case with skeletal fluorosis showed improvement of the ossification of peri-osseous soft tissues after changing drinking water for the long term; instead, 15 cases (73.33%) showed exacerbation. Of the eight normal cases, not one case manifested ossification of peri-osseous soft tissues.

2.4 Changes of degenerative changes of bone joints: For the 15 cases with degenerative changes of bone joints before changing drinking water, 12 experienced exacerbation after changing drinking water for the long term, accounting for 80%. The 8 normal cases did not experience any change.

3 Discussion

Both industrial fluorosis and endemic sclerotic skeletal fluorosis may be improved after stopping exposure to fluorine for several years, which is called bone trabecula reversibility. Osteosclerosis may still worsen within 3–5 years after stopping exposure to fluorine, and in general, no remarkable improvement may be revealed, or any improvement would be very mild and hardly be detected, as was pointed out by Grandjean [1]. Most often the noticeable improvement of osteosclerosis would occur 4–5 years after stopping exposure to fluorine. Complete recovery may occur to only a minority of cases or cases with skeletal fluorosis at the early stage, no matter how long exposure to fluorine had been stopped, and most cases may only experience alleviation of osteosclerosis. Sclerotic skeletal fluorosis would recover extremely slowly; based on our observation, this recovery would take at least 25 years, and severe cases may only experience an alleviation that is insufficient to easily resume the normal levels necessary for physiological functions.

Our current observation revealed that bone trabecula became increasingly osteoporotic for at least half of the cases after changing to drink

low-fluorine water. Soriano [7] reported that several cases of periostitis deformans occurred from drinking wine containing high levels of fluoride in Spain in the 1950s, first manifesting as osteosclerosis and then changing to osteoporosis, which was similar to our observations. The occurrence of osteoporosis is not accidental, and it may be attributed to the intensified osteogenesis under the stimulating action of residual fluorides on osteoblasts, as was explained by DAI Guo-jun et al [2] for the worsened ossification of peri-osseous soft tissues after stopping exposure to fluorine. This is a manifestation of intensified osteoclastic activity under the stimulating action of residual fluorides on osteoclasts. Most scholars agree that osteosclerosis and osteoporosis may be concurrently found in the X-rays of the same patient with skeletal fluorosis, and this kind of skeletal fluorosis is called mixed-type; this is a manifestation of disorder caused by the concurrent intensification of osteoblastic activity and osteoclastic activity. The current study demonstrated that this phenomenon also exists in the recovery period of skeletal fluorosis, which should be given due attention while assessing the effect of prevention and control of endemic fluorosis. The definite mechanism for this phenomenon remains to be clarified further by fundamental studies.

While making the current observation, we also reexamined cases with severe osteomalacic skeletal fluorosis diagnosed definitely in 1982 by X-ray. A lot of osseous substances settled down in the bones of those cases after changing to drink low-fluorine water for 16 years, and therefore the bone density was increased remarkably, indicating serious mixed-type skeletal fluorosis. Those cases are typical cases of osteomalacia followed by osteosclerosis.

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