# Radiological Analysis of Fluorotic Elbow Arthritis

Xuguang Chen

(Department of Radiology)

**ABSTRACT** This article has reported the radiological signs in 109 cases of fluorotic elbow arthritis: sclerosis, irregularity and discontinuity of the articular surfaces; coarsened bone striation below the articular surface, trabecular coarsening and rarefaction, sparseness of trabeculae or density changes along with areas of cystic radiolucency. The author first suggested osteophyte formation in the lateral trochlear crest and ossification in the bilateral ligaments as the characteristic radiological signs for fluorotic elbow arthritis.

**KEYWORDS** Arthritis; Elbow Joint; Fluorosis; Radiography

Endemic skeletal fluorosis mostly has joint symptoms, which have statistically occurred in 77% of the cases according to Teotia(1). However, there have not been many studies on the pathological joint changes of endemic skeletal fluorosis, which has long been considered hypertrophic osteoarthritis(2). In actuality, there are features unique to the articular changes in skeletal fluorosis, particularly in the elbow joint, and these can be differentiated from the pathological joint changes induced by other causes. The 109 cases of fluorotic elbow arthritis, which we describe here, will be reported as follows:

## MATERIALS AND METHODS

The data originated from survey-defined areas of endemic skeletal fluorosis. All the subjects under study had undergone radiography in the anteroposterior (AP) views of both hips and pelvis, in the AP view of right elbow/forearm, and in the AP view of the right shank; of these, 20 cases had undergone additional radiography in the lateral view of joints. In accordance with the "Standards for the Prevention and Treatment of Endemic Fluorosis"(3) enacted in Shijiazhuang in 1981, there were 180 definitely diagnosed cases of skeletal fluorosis; of these, 109 cases conformed to the diagnostic criteria for fluorotic elbow arthritis. Moreover, 12 cases of hypertrophic osteoarthritis of the elbow were collected as a control for observation.

## RESULTS

The changes in the 109 cases of fluorotic elbow arthritis were:

1. **Sclerosis, irregularity and discontinuity of articular surfaces:** There were 40 cases in which the articular surface was sclerotic and dense and appeared like a thick-pencil-sketch contour; there were 54 cases of irregular sclerosis and non-uniform thickness in the articular surfaces and there were 27 cases of irregular discontinuity in the articular surfaces; 95 cases occurred in the humeroulnar joints; 74 cases occurred in the humeroradial joints and 76 cases occurred in the proximal radioulnar joints.
2. **Joint space narrowing:** The humeroulnar joints in AP radiographs were taken as the sites under observation and the mean space width was 2.4mm, which was markedly narrowed if compared to the space width within the normal range of 3.1~4.4mm. There were varying degrees of space narrowing at other sites such as the humeroradial joints and the proximal radioulnar joints.
3. **Coarsened trabeculae present below the articular surface:** The number of trabeculae below the articular surface was reduced, which resulted in the formation of coarsened trabeculae and caused 67 cases of local reductions in density. There were 21 cases of more numerous, coarsened and dense trabeculae; of these cases, 78 cases occurred at the lower end of the humerus bone; 32 cases occurred at the upper end of the ulna bone and at least 12 cases occurred at the proximal end of the radius bone.
4. **Cystic degeneration below the articular surface:** There were 45 cases of cystic degeneration below the articular surface. Almost all of these occurred in the bone substance below the articular surface of the humeroradial joints and appeared as areas of cystic radiolucency of non-uniform sizes (Fig. 1).
5. **Ossification in the ulnar collateral ligament:** There were 35 cases of ossification in this ligament in total. Of them, there were 20 cases which occurred at the medial border of the semilunar notch of the ulna and appeared like triangular upward-convex dense opacity (Fig. 2). There were 12 cases of downward-convex bone radiographic shadows from the attachment sites of the ulnar collateral ligament to the medial condyle of the humerus. There were 7 cases of small-sesamoid-bone-shaped ossification at the intermediate part of the ligament.
6. **Ossification in the radial collateral ligament:** There were 24 cases of ossification in this ligament. Of these, there were 13 cases of bony prominence downward from the attachment sites of the radial collateral ligament to the lateral condyle of the humerus (Fig. 2). There were 9 cases of small-sesamoid-bone-shaped ossification at

the intermediate part of the ligament (Fig. 3). There were 7 cases of shadows indicative of bony prominence upward or downward from the lateral side of the radial bone.

7. **Lateral trochlear osteophyte formation:** There were 46 cases of osteophytic proliferation in the lateral trochlear crest. Osteophytes could be in the shape of a triangle or a pestle and were present in the middle of the articular surface at the lower end of the humerus bone (Fig. 1 and Fig. 3).

## DISCUSSION

The effects of fluorosis on joints have previously been recognized(2); it is considered that fluoride may be deposited in joints and that fluoride toxicity will affect the physiological process of joint tissues, which may cause pathological changes. This is the pathologic basis of fluorotic arthritis. According to the findings of the pathological slices from fluorotic joint specimens prepared by Xu Junchao et al.(4), the following changes could be classified:

1. Degeneration and necrosis, ulceration and calcification of articular cartilages: There was extensive degeneration and necrosis of articular cartilages, which demonstrated changes in joint space narrowing. Ulceration caused the bony articular surface to become ill-defined and discontinuous. The calcification of articular cartilages was one of the causes for the sclerosis of bony articular surfaces.
2. Thickening of the bone substance and trabecular coarsening at the subchondral articular surface in joints were the major causes for the sclerosis of bony articular surfaces.
3. Osteosclerosis or osteoporosis of the bony substance near the joints: Osteosclerosis was manifested as an increase in the number, coarsening, fusion, coarse mesh-like radiographic pattern, and density changes of trabeculae. Osteoporosis was manifested as a scarcity in, thickening of, or non-uniform thickness of trabeculae and revealed a disorganized pattern of osteogenesis and osteoclastogenesis. Consequently, X-ray findings were manifested as coarsening and rarefaction.
4. Ossification of ligaments and tendons: Proliferation and hypertrophy occurred to the localized fibrochondrocytes and this caused progressive endochondral osteogenesis. Bony ligaments thus increased in length and size and could be present at the attachment sites of ligaments and tendons and also at the middle of the ligaments.

In the 109 cases of fluorotic elbow arthritis in this study, joint space narrowing and sclerosis as well as irregularity and discontinuity in the articular surfaces were very common. The bone substance at the articular surface might be characterized by two types of changes, that is, sclerosis along with coarsening and rarefaction but the changes in trabeculae coarsening were common. The disorganized pattern of osteogenesis and osteoclastogenesis in the elbow joint is the major cause for the two different types of manifestations characterized by osteoporosis and osteosclerosis in the elbow joint. The osteosclerosis of the articular surfaces on the elbow joint and the osteoporosis below the joints could concurrently happen to the same patient.

It is worth noting the presence of osteophytic proliferation in the lateral trochlear crest at the articular surface below the humerus bone. This was absent in the normal AP radiographs of the elbow joint and was also absent in the 12 cases of hypertrophic arthritis of the elbow joint. Hence, this has special diagnostic significance in fluorotic elbow arthritis. Sclerosis and cartilage calcification in the articular surface at the lateral trochlear crest were the causes for the osteophytic proliferation in the lateral trochlear crest.

The ulnar collateral ligament starts from the anterior medial border of the medial epicondyle of humerus and radially downward ends at the ulnar border in the semilunar notch of the ulnar olecranon. Hence, the ossification in the ulnar collateral ligament could be manifested as density changes in the medial border at the semilunar notch of the ulna, or triangular bony prominence, or bony prominence at the attachment sites of the ulnar collateral ligament to the medial condyle of the humerus, or small-sesamoid-bone-shaped ossification at the intermediate part of the ligament.

The radial collateral ligament starts from the lateral inferior side of the medial epicondyle of humerus and ends between the lateral side of the radius bone and the annular ligament, and a part of the fibers ends at the supinator crest of the ulna via the annular ligament. Hence, the ossification in the radial collateral ligament could be manifested as bony prominence from the attachment sites of the ligament to the medial epicondyle of the humerus, or bony prominence upward or downward from the lateral side of the radial bone and the evidence of shadows indicative of ossification at the intermediate part of the ligament.

The ossification at the ligaments in these two sites occurred at the starting and the ending [sites] of the ligaments and their course of movement and was perpendicular to the articular surface. Hyperostosis and osteophyte formation in hypertrophic osteoarthritis occurred in the border of the articular surface and appeared as a parallel extension of the articular surface. Hence, fluorotic elbow arthritis and hypertrophic arthritis of the elbow could be differentiated on the basis of hyperostosis and osteophyte formation. Small-sesamoid-bone-shaped ossification occurred at the intermediate part of the ulnar collateral ligament and the radial collateral ligament and might be mistaken as unclosed medial and lateral condyle epiphyses of humerus. The cases in this study were all adults whose medial and lateral condyle epiphyses of humerus had been closed. Evidence of ossification in the ulnar collateral ligament and the radial collateral ligament was noted in the AP radiographs of the elbow joint. The X-ray radiographic signs were very pronounced, which was of critical importance to the diagnosis of fluorotic elbow arthritis.

On the lateral side of the elbow joint, the proliferation of the articular surface was pronounced at the semilunar notch of the olecranon; the triceps brachii tendons attached to the olecranon and the biceps brachii tendons attached to the [deltoid] impression of humerus could reveal irregular changes, which also facilitated diagnosis.

Although the elbow joint has a small range, it can completely manifest the changes of skeletal fluorosis in three major aspects: bone density (changes in the bone density around the joints), bone circumference (changes in the ossification of the ligaments), and joints (changes in the articular surface and the joint space). These also demonstrate the value of observing the elbow joint in skeletal fluorosis.

In summary, the sclerosis, irregularity and discontinuity in the articular surface of the elbow joint, joint space narrowing, and appearance of coarsening and rarefaction along with areas of cystic radiolucency at the bony, coarsened trabeculae below the articular surface are the common radiographic signs of fluorotic elbow arthritis. Osteophyte formation in the lateral trochlear crest and the ossification of the ulnar collateral ligament reveal significant characteristic signs for the diagnosis of fluorotic elbow arthritis. (See the accompanying pages for the illustrations of this article)


**REFERENCE**

1. Teotia SPS, et al. Symposium on non-skeletal phase of chronic fluorosis, 3. The Oint. *Fluoride*, 1976; 9(1): 19.
2. Xie Dazhao. Status of the research on skeletal fluorosis. *The Chinese Journal of Radiography*, 1980; 14(3): 164.
3. The Endemic Disease Control Office of the CPC. *The Standards for the Prevention and Treatment of Endemic Fluorosis (for Trial Implementation)*. Shijiazhuang, 1981.
4. Xu Junchao et al. Presentations of basic radiography for skeletal fluorosis and the pathological basis. *The Chinese Journal of Radiography*, 1982; 16(1): 9.


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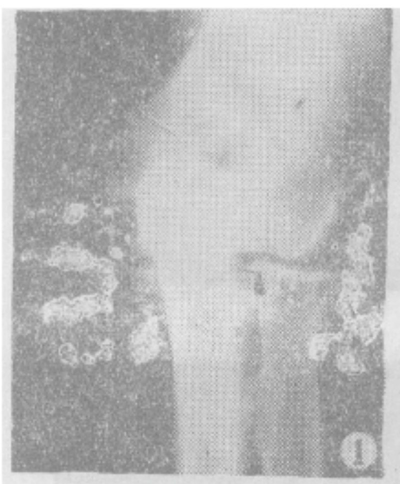
## Radiographic Distribution in the 109 Cases of Fluorotic Elbow Arthritis



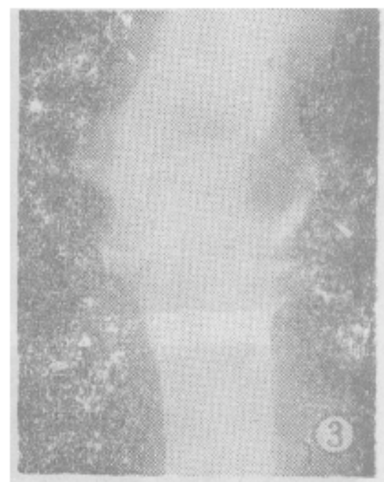



Fig. 1 Areas of cystic radiolucency in the humerus; osteophyte formation in the lateral trochlear crest
Fig. 2 Ossification in the ulnar collateral ligament ( □ ) and the radial collateral ligament
Fig. 3 Ossification in the radial collateral ligament.

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*Translated from Chinese into English by **TransPerfect Translations International, Inc.,** courtesy of the Fluoride Action Network (2012). For more translations of Chinese research on fluoride toxicity, see [www.fluoridealert.org/researchers/translations/](www.fluoridealert.org/researchers/translations/)*