# THE JOINTS

by

S. P. S. Teotia, M. Teotia, and N. P. S. Teotia
Meerut, India

SUMMARY: Of 300 patients with endemic skeletal fluorosis 187 (110 children and 77 adults) showed evidence of arthritis. The spine, especially its cervical portion, appeared to be mainly involved; elbow, hip and knee joints followed next in order.

The first comprehensive account of skeletal fluorosis was made by Roholm (1). Since that time symptomatic skeletal fluorosis has been described by several workers (2, 3, 4, 5) from India and sporadic reports have appeared from almost all parts of the world (6-14).

Although skeletal fluorosis still continues to be a public health problem of considerable magnitude in several parts of the world where drinking water contains fluoride naturally at high levels, it has received scant attention in the literature. During the past eight years our experiences with joint manifestations in skeletal fluorosis have not been common. In fact most of the cases before they came to our clinic had received treatment for various rheumatic disorders which had often been interpreted as osteoarthritis and ankylosing spondylitis.

In the current communication, therefore, we wish to discuss the joint manifestations in patients with endemic skeletal fluorosis and the circumstances under which the joint disease may remain unrecognized or may be attributed to causes other than fluoride.

## Material and Methods

A review was undertaken of 300 patients with endemic skeletal fluorosis who had been under our care during the past eight years, namely 200 children (130 male, 70 female) whose ages ranged from 5 to 14 years with a duration of symptoms from 1 to 11 years, and 100 adults (65 male, 35 female), whose ages ranged from 15 to 65 years with a duration of symptoms from 1 to 25 years. All were symptomatic and had been residing since birth in the endemic fluorosis area, District Rai Bareilly of the State of Uttar Pradesh. All were manual workers and all were in a poor state of nutrition. The diagnosis of skeletal fluorosis was confirmed in each case by accepted clinical and biochemical criteria and by radiological and morphometrical studies of the bones (15). The fluoride content in the drinking water ranged from 24 to 26 ppm. The mean daily intake of

---

From the Department of Human Metabolism, L. L. R. M., Medical College, Meerut, India.

fluoride through drinking water was 16 mg in children and 25 mg in adults. Thus the daily fluoride consumption in each patient was excessive. Specific laboratory investigations which included latex fixation test, L.E. cell test, serum uric acid, erythrocyte sedimentation rate and plasma protein electrophoretic strip were performed wherever necessary in order to exclude other known causes of polyarthritis.

## Results

Clinical Findings: The usual symptoms were vague pains, stiffness, backache, rigidity of the spine, inability to close the fists and limitation of joint movements (Table 1). The grossly limited movements of the spine, thoracic kyphosis, flexion deformities at the hips and knees, and the fixed chest with the minimal expansion suggesting crippling fluorosis were present in 1.8% of children and 3.8% of adults. Clinical joint involvement was observed in 110 children and 77 adults. All patients had dental fluorosis which varied from grade I to grade IV.

Radiological Findings: The diagnostic radiological findings observed in each patient included osteosclerosis, particularly of the spine, pelvis and thorax, periosteal bone formation, irregular exostoses, calcification of ligaments of interosseous membrane and muscular attachments (Table 2). The joints showed calcifications in the capsule, chondrocalcinosis, epiphyseal sclerosis, articular erosions, osteoporosis and osteophytosis.

## Discussion

Although joint involvement in patients with skeletal fluorosis has been known since it was first described by Roholm (1) and subsequently by other workers (2-5), only recently has its significance gained recognition. In 1972 Cook (16) reported crippling arthritis due to high intake of fluoride from tea in a 55 year old women, but no obvious signs of fluorosis; the X-rays exhibited degeneration of discs and calcification in disc spaces. Her daily fluoride intake from tea exceeded 9 mg. After she discontinued consuming tea, her fluoride intake fell below 1 mg daily, the arthritic pains diminished and movements were restored. Krishnamachari and Krishnaswamy (17) in 1973 reported 24 male patients (aged 8 to 14 years) with genu valgum deformities from an endemic fluorosis area of Andhra Pradesh, India. The drinking water contained 3.5 to 6 ppm fluoride. All had evidence of spinal osteosclerosis along with extensive osteoporotic changes in the bones of the extremities and typical clinical features of endemic skeletal fluorosis. The occurrence of deformities among the poorer sections of the population suggested an adverse role of undernutrition on fluoride - induced toxicity in their patients.

TABLE 1

Clinical Joint Involvement In 110 Children
And 77 Adults With Endemic Skeletal Fluorosis

| Clinical Features | Children | Adults |
|---|---|---|
| Arthralgia | 100% | 100% |
| Backache | 100% | 100% |
| Stiffness | 100% | 100% |
| Rigidity of the spine | 100% | 100% |
| Flexion at cervical spine | 69.1% | 51.9% |
| Kyphosis | 60% | 68.8% |
| Flexion contractures at hips and knees | 40% | 49.4% |
| Restricted joint movements | 80% | 100% |
| Inability to close fists | 100% | 100% |
| Swelling of joints ( knees and ankles) | 1.8% | 3.8% |
| Clawing of the toes | 1.8% | 3.8% |
| Crippling arthritis | 1.8% | 3.8% |

TABLE 2

Radiological Joint Involvement In 110 Children
And 77 Adults With Endemic Skeletal Fluorosis

| Joint Involved | Children | Adults |
|---|---|---|
| Temporomandibular | 0 | 0 |
| Cervical spine | 75 | 100 |
| Sternoclavicular | 12 | 39 |
| Acromioclavicular | 12 | 39 |
| Shoulder | 38 | 45 |
| Elbow | 68 | 75 |
| Wrist | 21 | 45 |
| Carpo metacarpal-phalangeal joint | 45 | 55 |
| Metacarpo-phalangeal joint | 23 | 28 |
| Proximal interphalangeal joint | 23 | 28 |
| Distal interphalangeal joint | 23 | 28 |
| Hip | 15 | 49 |
| Knee | 35 | 49 |
| Ankle | 2 | 3.8 |
| Talocalcaneal | 2 | 3.8 |
| Midtarsal | 1.5 | 3.8 |
| Metatarsophalangeal joint | 1.5 | 3.8 |
| Proximal-interphalangeal joint | 1.5 | 3.8 |

Our observations have shown (Tables 1 and 2) that joint manifestations of fluorosis are not uncommon among patients with skeletal fluorosis; 55% of the children and 77% of the adults had joint involvement. Symptomatic involvement of joints was more frequent (Table 1) than the radiological lesions observed (Table 2), but the symptoms were not proportionate to the degree of joint change. This suggested to us that some of the complaints could be attributed to muscular involvement rather than to a true joint disease.

Since skeletal fluorosis was present in each patient who showed joint involvement, fluoroarthropathy should be regarded only as a part of skeletal fluorosis and not as a separate clinical entity. Bones and joints bear a great functional relationship to each other and have many features in common. This fact has important implications from the point of view of prognosis and treatment of arthropathies in these patients. Their management remains primarily medical or may involve a cooperative approach between the physician and the physiotherapist. Arthritic symptoms should improve when these patients are moved away from the endemic fluorosis area.

It is known (18) that the underlying metabolic abnormality in skeletal fluorosis is excess of fluoride and calcium in the bones which is due to an excess fluoride intake. Since the joints of fluorosis patients also contain deposits of fluoride, the halogen may act as an irritant and toxic element responsible for articular lesions in these patients. Thus the calcifications of joint capsules, articular cartilage, epiphyseal discs and chondrocalcinosis etc, is likely to result from the same mechanism as in fluoride osteosclerosis. The articular erosions observed in some of our patients were due to hyperparathyroidism secondary to fluorosis (19 ).

In early stages, fluorosis is usually associated only with stiffness, backache, and joint pains which may suggest the diagnosis of rheumatism, rheumatoid arthritis, ankylosing spondylitis and osteomalacia. At this stage the radiological findings of skeletal fluorosis may not be evident and therefore most of these cases are either misdiagnosed for other kinds of arthritis or the patients are treated symptomatically for pains of undetermined diagnosis (PUD). The majority of our patients had received treatment for rheumatoid arthritis and ankylosing spondylitis before they came under our observation.

Therefore, it is important in the management of patients with fluorosis to be aware of their articular complications and differentiate them from other causes of polyarthritis.

## Bibliography

1. Roholm, K.: Fluorine Intoxication. A Clinical - Hygienic Study with a Review of the Literature and Some Experimental Investigations. H. K. Lewis, London, 1937, p. 364.

2. Shortt, H. E., Pandit, C. G. and Raghavachari, T. N. S.: Endemic Fluorosis in the Nellore district of South India. Ind. Med. Gaz., 72:396, 1937.

3. Siddiqui, A. H.: Fluorosis in Nalgonda district Hyderabad-Deccan. Brit. Med. J., 1408, 1955.

4. Singh, A., Jolly, S. S., Bansal, B. C. and Mathur, C. C.: Endemic Fluorosis, Epidemiological, Clinical and Biochemical Study of Chronic Fluorine Intoxication in Punjab (India). Med., 42:229, 1963.

5. Teotia, S. P. S., Kunwar, K. B. and Teotia, M.: Metabolic Studies on Skeletal Fluorosis with a new Approach to its Treatment. Fluoride, 2:142, 1969.

6. Lyth, O.: Endemic Fluorosis. In Kweichow, China, Lancet 1:233, 1946.

7. Takamori, T.: Recent Studies on Fluorosis. Tokushima. J. Exptl. Med., 2:25, 1955.

8. McQuillan, C. J.: Chronic Fluoride Poisoning in the Arusha District Tanganyka Territory. E. African Med. J., 21:131, 1944.

9. Murray, M. M. and Wilson, D. C.: Fluorosis and Nutrition in Morocco. Dental Studies in Relation to Environment. Brit. Dent. J., 84:97, 1948.

10. Raffaele, J. F.: La Fluorosis, El Atenes, Buenos Aires, 1944.

11. Azar, H. A., Nuchco, C. K., Bayyuk, S. I. and Bayyuk, W. S.: Skeletal Sclerosis Due to Chronic Fluoride Intoxication. Cases from an Endemic Area of Fluorosis in the Region of Persian Gulf. Ann. of Int. Med., 55:193, 1961.

12. El Tanner, M. D.: Mottling of Enamel in Mecca and the Arabian Peninsula: A Survey and Research Study Carried out in Saudi Arabia. Amer. J. Public Hlth., 49:45, 1959.

13. Zipkin, I., McClure, F. J., Leone, N. C. and Lee, W. A.: Fluorine Deposition in Human Bones After Prolonged Ingestion of Fluoride in Drinking Water. Pub. Hlth. Rep., 73:721, 1955.

14. Kilborn, L. G., Outerbridge, T. S., and Lei, H. P.: Fluorosis with Report of an Advanced Case. Canad. M.A.J., 62:135, 1950.

15. Faccini, J. M. and Teotia, S. P. S.: Histopathological Assessment of Endemic Skeletal Fluorosis. Calc. Tis. Res. (In press).

16. Cook, H. A.: Crippling Arthritis Related to Fluoride Intake (Case report). Fluoride, 5:209, 1972.

17. Krishnamachari, K. A. V. R. and Krishnaswamy, K.: Genu Valgum and Osteoporosis in an Area of Endemic Fluorosis. The Lancet, 2:877-879, 1973.

18. Teotia, M., Teotia, S. P. S. and Kunwar, K. B.: Endemic Skeletal Fluorosis. Arch. Dis. Children, 46:686, 1971.

19. Teotia, S. P. S. and Teotia, M.: Secondary Hyperparathyroidism in Patients with Endemic Skeletal Fluorosis. Brit. Med. J., 1:637, 1973.

* * * *

## THE ARTERIES

by

G. L. Waldbott
Warren, Michigan

SUMMARY: A review of own data and those of other authors indicates that in skeletal fluorosis arterial calcifications are a common feature, that arteries store more fluoride than any other soft tissue organ and that the levels of fluoride in arteries are unrelated to those of calcium.

That the arteries are playing an important role in chronic fluoride intoxication is indicated by the following observations:

1. Calcifications of both large and small caliber arteries are associated with skeletal fluorosis.

2. Arteries contain more fluoride than any other soft tissue organ.

Calcification of Arteries: The first mention of involvement of arteries in skeletal fluorosis was made by Speder in 1936 (1) in skeletal fluorosis in N. Africa. Since then many others have described the Men-