COMPARATIVE RADIOLOGICAL STUDY OF THE SPINES OF A PRIMITIVE POPULATION WITH NORTH AMERICANS AND NORTHERN EUROPEANS

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The gradual development of malfunction in the intervertebral disc and its subsequent degeneration, was demonstrated by Hansen (1959), who, in a study of the pathogenesis of disc degeneration in animals, outlined a process that appears to have close parallels in the human. He demonstrated in dissected specimens that degenerative change begins at the end of growth and is characterised by a slow change of the nucleus from a plastic amorphous state to a less plastic, fibrocartilaginous one. At the same time the nucleus loses some of its water content, and as hyaluronic acid becomes sulphated to chondroitin sulphate and other polysaccharides the disc becomes firmer, and its function is disturbed as more mechanical strain is taken on the annulus, this process occurring in all discs.

On investigation of the spines of horses, cows, dogs, camels and giraffes Hansen found that degeneration with narrowed disc space and hypertrophic change only occurred at levels where mechanical strain was greatest. In the camel and giraffe these changes are found in the cervico-thoracic region; in the basset hound and dachshund dog they occur in the lower thoracic level, which is the central point of sag of the spine. In bovine animals this change is found in the lumbo-sacral area, which is the level where about 50 per cent of spinal movement occurs.

In the human the relationship between degeneration and heavy labour was demonstrated by Hult (1954) and by Kellgren and Lawrence (1958). Hult showed a parallel increase of degeneration with heavy labour. Kellgren and Lawrence showed that coal miners had a greater incidence of degenerative change than their neighbours. The susceptibility of discs at particular levels to degeneration and the relationship of particular types of movement are more difficult to demonstrate.

The quadrupeds studied by Hansen are not representative of all quadrupeds but of selected mammals in which a particular type of spinal mechanism concentrates forces at one point. In bovine animals most movements occur about one disc. In achondroplastic dogs the strain is focused on the apex of the lordosis of a sagging spine. In the camel and giraffe it is likely that maximum strain and a consistent lordosis focus the strain on a very few discs, suggesting that trauma at the point of maximum load is the cause of these changes.

Quadrupedal stance, however, is not the most important factor. Hansen had no primates in his series and the range of spinal movement in these animals suggests that factors that he described would not be found. In man there is a difference from the other primates in his erect stance, having a less efficient S-shaped curve to his back instead of a gentle C-shaped curve. This produces three areas of concentration of strain: at the apices of the cervical, thoracic and lumbar curves, which correspond roughly to the areas of degenerative change, particularly so in the lumbar spine.

The posture of humans can be divided into squatters and non-squatters. In searching, like Hansen, for a constant traumatic factor in the cause of disc degeneration we made a comparative study of the two groups. American and Swedish radiographic studies were compared with studies of a tribe of jungle dwellers, a squatting tribe in West Central India.

The squatting posture is assumed not only as an alternative sitting position but is also used when a person from a civilised community would be standing up. The lying and standing positions are also different. Civilised people spend most of the time standing still while squatters use the standing position for mobility only, using the attitude that Howorth (1946) has described as the dynamic posture. The lying position in primitive peoples is usually on a hard surface where the body is curled up on the side for purposes of comfort or warmth. Civilised peoples in soft beds, however, get comfortable in unphysiological positions.

MATERIAL

Radiographs were taken of 175 men and 178 women but this report deals only with the men. Measurements were made by an orthopaedic surgeon and a radiologist, but it was difficult accurately to measure narrowing of the disc space due to differing angles of radiological projection. For this reason a block dissection of the fourth and fifth lumbar vertebrae, the first two sacral vertebrae, the alae and upper part of the sacro-iliac joints and iliac bones was

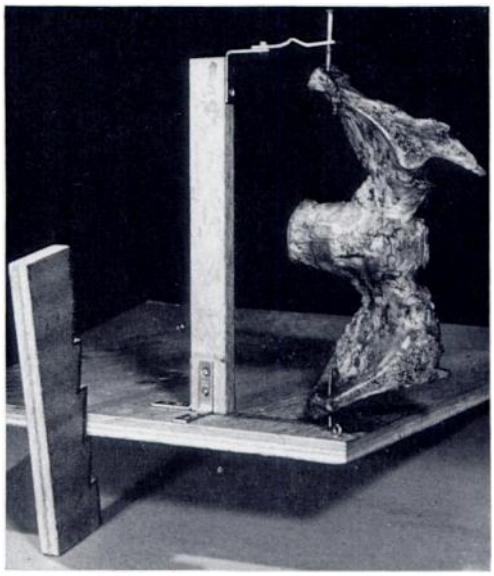

FIG. 1
Showing how the dissection was set up so that radiographs could be taken in varying angles of tilt.

radiographed at varying angles (Fig. 1). Radiographs were taken at 5, 10 and 15 degrees of tilt to the vertical plane, above and below the horizontal. A similar procedure was carried out in the transverse plane, after which a combination of vertical and transverse tilting was used. By this means we established that up to 10 degrees of tilt either vertical, transverse or both could be measured accurately from vertebral edge to vertebral edge.

RESULTS

Findings other than those of degeneration were not remarkable except for the tendency towards straightening of the lumbar spine instead of lordosis. The incidence of transitional vertebrae was 14 per cent, and that of spondylolisthesis was 5 per cent. The incidence of hypertrophic lipping and of disc narrowing showed interesting features (Fig. 2). Hypertrophic

changes were graded into four categories: Grade 1—minimum; Grade 2—small; Grade 3—large osteophytes; and Grade 4—" kissing " osteophytes or bridging. In comparative studies with radiological surveys of civilised peoples the size of osteophytes was not categorised.

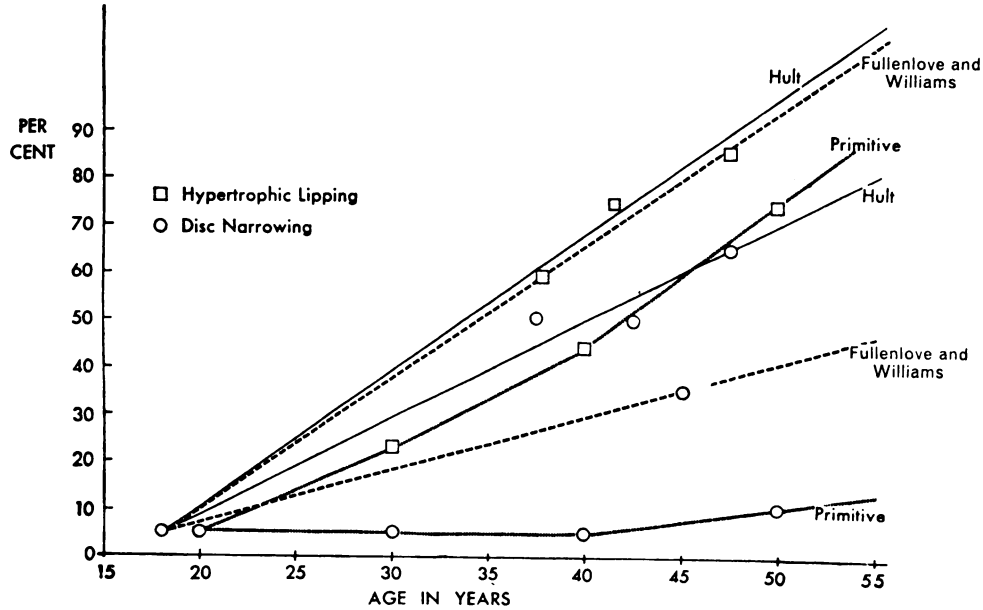

FIG. 2

Graph showing comparative incidence of hypertrophic lipping and narrowing of the disc space in the primitive group and Hult's and Fullenlove and Williams's series in civilised communities.

Narrowing of the disc space was also graded, assuming less than 10 per cent margin of error. Grade 1 included narrowing up to 25 per cent; Grade 2 up to 50 per cent; and Grade 3 up to 75 per cent.

DISCUSSION

We were only able to find two comprehensive radiographic surveys of lumbar spines which were comparable with our own, namely those of Hult (1954) and of Fullenlove and Williams (1957). Hult reported on individuals engaged in physical labour, half of them forestry workers and half workers in heavy industry. Fullenlove and Williams reported on men working for or seeking employment in a telephone company, most of whom were not engaged in heavy work. The work habits of the primitive tribe that we report lie somewhere between these two.

Hult's series showed hypertrophic changes in 85 per cent of men aged forty-seven while Fullenlove and Williams's series showed an incidence of 35 per cent in men of the same age. Hult also showed disc narrowing in 65 per cent of men aged forty-seven while Fullenlove and Williams showed an incidence of 18 per cent in men of the same age. In both series, however, there was a steady rise, both in the incidence of hypertrophic changes and of disc narrowing with age, even though the rate of rise was different.

The primitive tribe revealed a comparable incidence of hypertrophic change of 65 per cent at the age of forty-seven, but it also showed a marked difference in the incidence of disc narrowing, which only rose from 6 per cent in men in their twenties to 10 per cent in men of fifty.

In both the civilised groups the incidence of disc degeneration and of hypertrophic change, although rising at different rates, did so consistently throughout life. In the primitive group, however, while the incidence of hypertrophic change rose at a similar rate to the civilised group, the incidence of disc narrowing rose very slowly, suggesting that a different cause is

involved. It is almost inconceivable that the 25 per cent of men who, at the age of thirty, showed hypertrophic change would, twenty years later, show no more than a further 2 per cent rise in incidence of disc narrowing unless the cause of the hypertrophic change was different from the cause of the narrowing.

SUMMARY AND CONCLUSIONS

1. On the basis of radiographic studies the incidence of degenerative change in the intervertebral disc in primitive squatting populations is considerably less than that found in civilised peoples.

2. The suggestion is made that lordosis is implicated in the pathogenesis of degeneration, but further studies are required.

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