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BACKACHE DUE TO OSTEOPOROSIS IN AN INDUSTRIAL POPULATION

A SURVEY OF 481 PATIENTS

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ABOUT one-fifth of the patients seen in the Orthopaedic Department in Walton Hospital during the period September, 1961, to December, 1962, were complaining of symptoms referable to the axial skeletal system. Some of these cases had obvious pathology amenable to surgical management, disc lesions, fractures, dislocations, etc., but many had no such mechanical derangements. Nonetheless, we had to treat all the cases of backache referred to Out-Patients and in making the diagnosis we were forced to consider the possibility of spinal osteoporosis. We were impressed with the frequency with which osteoporosis presented and decided jointly to survey all the cases of backache referred for spinal *x*-rays in the period January, 1962, to June, 1962, inclusive. These findings are presented here.

This paper reviews the radiological and clinical features of 481 patients referred for radiology of their dorsal and lumbar spines in the first six months of 1962. These patients were referred by the clinicians in the day to day work of the hospital and are to that extent unselected; it must be borne in mind that all these patients had symptoms of spinal diseases and they are, therefore, biased heavily when compared with the population at risk.

The radiological diagnosis of osteoporosis is fraught with problems. Innumerable approaches to these problems have been made, and these are considered elsewhere (Devlin, 1963). It is easy to diagnose the severe cases, but the milder borderline case and the grading of the severity of these cases can present considerable difficulty. Two alternative ways of overcoming this problem are available. Barnett and Nordin (1960) adopted a system of " scores ", which are based on the ratio of least height to greatest height in the lateral projection of the vertebral body. These criteria are open to criticism, as in osteoporosis the vertebra may be so much compressed and deformed that in severe cases the " score " would be normal (vertebra plana); on the other hand, bi-concavity depends on normal disc turgor, and if this is diminished the ratios will not truly represent the state of bone atrophy. Another solution to the problem of grading is that of Smith *et al.* (1960). This is based on rigid criteria and takes in the overall appearance of the spine.

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TABLE I

X-ray Criteria used in Rating Severity of Vertebral Osteoporosis

(Smith *et al* 1960)

Indeterminate	Borderline or equivocal findings.
	Questionable loss of bone density and trabecular thinning.
	No vertebral body deformity.
Grade 1	Over-all density loss and trabecular thinning.
	End plate accentuation and deformity.
	Early biconcavity and minimal vertebral wedging.
Grade 2	Further loss of density and of trabecular markings.
	End plate deformities and biconcavities.
	Definite wedging of one or more vertebral bodies.
Grade 3	Severe demineralization.
	Extensive biconcavities.
	Marked wedging or collapse of several vertebral bodies.

It should be noted that the criteria of these grades are primarily morphological. The shape of the radiographic shadow is judged and this shadow is determined by the trabecular thinning and vertebral body deformity.

Loss of trabecular markings is the essential stigma that distinguishes between osteoporotic and normal bone radiographically. There is much justification for the adoption of this phrase rather than simple " demineralisation ", for as Hall (1961) has pointed out, osteoporosis affects secondary trabeculae in bone initially and only when the disease is advanced do the primary trabeculae become involved. In the vertebral body (as in the upper extremity of the femur) we have an excellent opportunity to compare the density of the vertical primary trabeculae with the horizontal secondary trabeculae. These two sets of trabeculae are subject to the same *x*-ray penetration in any given film and are, therefore, directly comparable. Using this additional interpretation of the Smith *et al.* classification " indeterminate grade " is when the vertical (primary) trabeculae appear denser than the horizontal (secondary) trabeculae; Grade 1 is defined as thinning of the secondary trabeculae to half the density of the primary, Grade 2 when the secondary trabeculae are invisible and Grade 3 when both primary and secondary trabeculae are invisible in the vertebral body radiograph.

All the *x*-rays were examined simultaneously by both of us and on the basis of this joint examination an agreed radiographic diagnosis was made.

The clinical investigations were carried out by one of us (H.B.D.) in the course of his routine Out-Patient work in the Orthopaedic Department.

TABLE II

The Total Number of Males and their X-ray findings

Age	Total	Normal	Grades of Osteoporosis				
			Indeterminate	I	II	III	% Osteo
20/24	11	10		1			9
25/29	18	18					0
30/34	26	23	1	2			10
35/39	30	30					0
40/44	31	26	2	3			12
45/49	25	25		3	2		20
50/54	22	16	2	3	1		28
55/59	17	14	1	2			18
60/64	26	10	4	11	1		61
65/69	12	4	2	4	1	1	67
70/74	5	1	1		2	1	80
75/79	6	2		1	1	2	67
*80+	7	0	1	2		3	100
TOTALS	236	174	14	32	8	7	26

*N.B. One old T.B.—not included in survey.

TABLE III

The Total Number of Females and their X-ray findings

Age	Total	Normal	Grades of Osteoporosis				
			Indeterminate	I	II	III	% Osteo
20/24	5	5					0
25/29	10	8	1	1			20
30/34	20*	19					0
35/39	24	24					0
40/44	18	16		2			3
45/49	23	21	1	1			9
50/54	32	29	1	1		1	10
55/59	16	8	1	5	1	1	50
60/64	34	16	8	8	2		53
65/69	18	4	4	7	3		72
†70/74	18†	4	2	8	1	2	72
75/79	18	2	1	10	2	3	89
80+	9	0	1	4	1	3	100
TOTALS	245	156	20	47	10	10	35

*Includes one case of bone demineralization due to hyperparathyroidism, excluded from survey.

†Includes one case of backache and known to have carcinoma of the breast and found to have Paget's disease of the spine and pelvis, excluded from survey.

Radiological Survey

A total of 481 patients were reviewed, representing six months' routine work for the department, of whom 236 were male, 245 female. They ranged in age from the twenties to over the eighties (Tables II and III).

The largest age group was the 60/64 in the females and the 40/44 in the males, with the smallest group at either end of the scale. The age groups were fairly similarly distributed in either sex, thus allowing direct comparison between the sexes.

In the 481 cases reviewed there were 151 cases of osteoporosis, an incidence of 31 per cent. Osteoporosis was more frequent in females than males: 35 per cent (87 females) compared with 26 per cent (62 males). The age distribution is almost identical in the two sexes (Tables II and III). The incidence is low in both sexes until the age of 35 years, thereafter it shows a fairly uniform rise to a maximum in the over-80 age group. (Histograms A-B). There is also a tendency for the more severe cases to appear in the older age groups (Tables II and III). Six cases of osteoporosis were found in females under 50 years of age, none of whom had suffered an artificial menopause.

In addition to noting the degree of osteoporosis we studied some of the side-effects of the disease on the spine.

Some degree of kyphosis is present in all the cases, and indeed it is indirectly one of Smith's criteria; scoliosis is in a different category. In 74 per cent (65 cases) of the females and in 59 per cent (35 cases) of the male cases earlier reported as osteoporotic there is some scoliosis present.

Gibbus formation (angular kyphosis) is unusual. In 151 cases of osteoporosis there are only three cases of gibbus formation.

When the films of the lumbar spines were analysed separately it was found that sclerosis and pseudarthrosis formation between the spinous processes, so-called Baarstrup's disease, was common, especially in the more severe cases of osteoporosis, occurring in 44 per cent of these cases (i.e. Grades II and III).

It was not possible in this series to decide adequately which vertebral bodies were most severely affected in osteoporosis, but the impression was that those of the dorsi-lumbar junction were most affected.

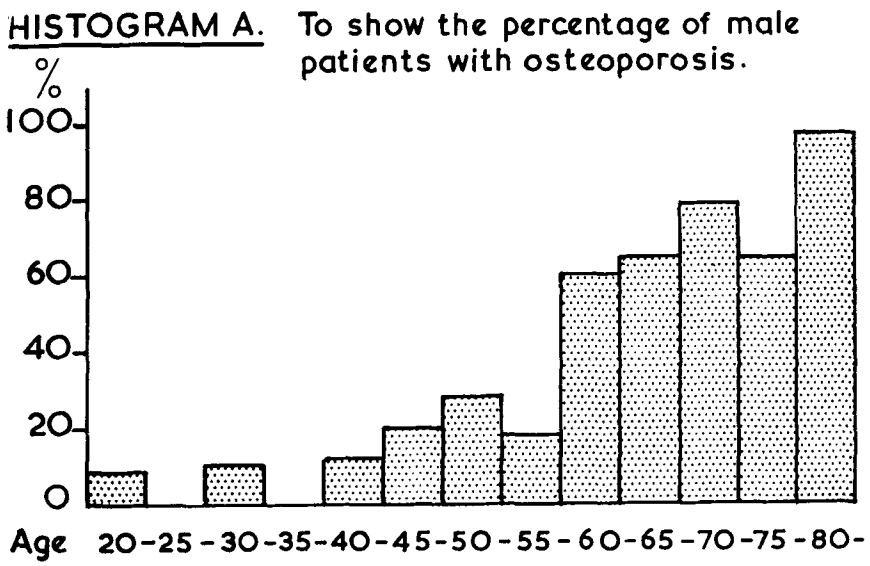
Clinical Features

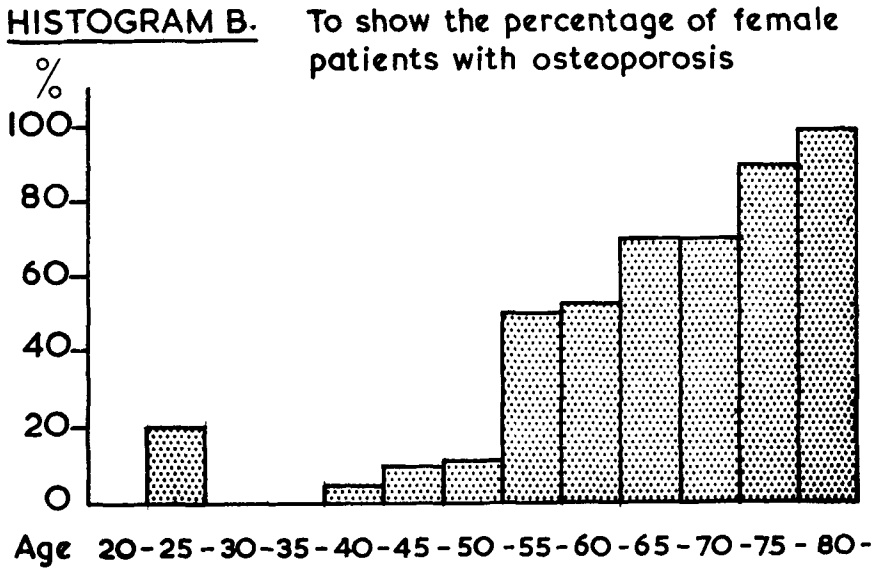
Two hundred and eighty-nine of the patients whose spines were studied radiologically were examined clinically, and 131 of these cases had radiological evidence of osteoporosis (53 males and 78 females).

The clinical features of osteoporosis were evaluated. All the cases recorded here complained of backache, usually a deep-seated pain in the spine with episodes of " stabbing pain ", sleep was often disturbed, and in many cases the pain was worse when the patient lay down in bed. The physical signs in osteoporosis are few. Five clinical signs were studied in this series: kyphosis, tenderness on percussion of the spinous processes, tenderness or spasms in the erector spinae muscles, neurological abnormalities in the lower limbs, and the range of spinal movements.

In 49 per cent (26 males and 37 females) there were no signs referable to the spinal skeleton. Though these 63 cases showed osteoporosis, in three of them other disorders were found to account for the symptoms (two cases of duodenal ulceration, and a case of chronic pyelonephritis with recurrent acute episodes).

Neurological abnormalities were rare. In all the cases examined the





muscle tone and straight leg raising test (Lasseque) were tested, together with the knee and ankle tendon jerks. Four males were found with neurological anomalies, but one of these also had pernicious anaemia which may have been partly responsible. Five females had neurological abnormalities. However, one had subacute combined degeneration of the cord and another diabetic neuropathy.

The most frequently occurring physical findings were restricted movements, tenderness on spinal percussion and tenderness in the spinal muscles, 24 of 53 (46 per cent) males and 42 of 78 (54 per cent) females

having one or more of these signs. These signs generally all appeared together and were especially severe in Grade II and Grade III cases.

Routine clinical examination of these 131 osteoporotic patients also gave a rich harvest of intercurrent disease (Table IV). Particularly interesting is that of 78 females examined 9 were suffering from diabetes mellitus. In this context it is worth recording that the total of 245 female patients in the radiological survey included fourteen diabetics with backache and twelve of these had osteoporosis, a remarkably high proportion.

The fractures found are those classically associated with osteoporosis, broken ribs, Colles fracture of the radius, a femoral neck fracture and a fracture of the surgical neck of the humerus (Cooper, 1824, and Smith, 1847).

TABLE IV

Other morbid conditions found in 131 *osteoporotic patients*

Condition		Males	Females	Total
Diabetes mellitus		0	9	9
Subacute combined degeneration of cord		0	1	1
Pernicious anaemia		1	0	0
Pyelonephritis		1	0	1
Hodgkins disease		1	0	1
Duodenal ulcers		2	0	2
Hemiparesis		0	1	1
Rheumatoid arthritis		0	2	2
Fibro-adenoma breast		0	1	1
Fractures other than thoracic and lumbar crush fractures	Ribs	1		
	Cervical vertebrae		1	
	Femoral neck & Colles		1	
	Humerus		1	4
				22

Discussion

If osteoporosis is suspected clinically the diagnosis can only be made radiologically. We have attempted in this article to point out some of the problems and difficulties involved in making this diagnosis. At the present we are unable to measure bone density accurately by radiographic methods, though various attempts have been made to overcome this fundamental problem. In our view, the best method is to examine the overall appearance of the spine, as suggested by Smith *et al.* (1960), but we would stress the additional information obtained by critical examination of the trabecular paterns in the vertebral bodies. We have applied this method to a series of 481 patients and report our findings here.

The first conclusion we have drawn is the most important—that there is no marked difference in the incidence of osteoporosis in either sex. We cannot from our survey find any evidence that the menopause at the age of 45 in females has any decisive influence on the patients' sub-

sequent chances of developing osteoporosis; in fact, six cases of osteoporosis were found in pre-menopausal women.

We must of course compare our results with those of others in this field. There are three previous surveys of osteoporotic spines in the literature (Kesson *et al.*, 1947, Gershon-Cohen *et al.*, 1953 and Smith *et al.*, 1960).

Kesson, Morris and McCutchon, in Stobhill Hospital, Glasgow, reviewed 181 patients who had had their spines *x*-rayed in the years 1939, 1940, 1941. These patients were all aged above 40 years, and they found 30.9 per cent showed evidence of osteoporosis. This finding agrees closely with ours in this age group. However, in their paper Kesson *et al.* state that kyphosis is common in senile osteoporosis while the reverse is true in osteomalacia, and in osteomalacia scoliosis is common, while scoliosis is rare in osteoporosis. We have not been able to confirm the latter finding. We have found in incidence of 59 per cent scoliosis in the males and 74 per cent in the females who had spinal osteoporosis, and these percentages could not be described as " uncommon ". Gershon-Cohen's survey is rather different and more restricted than ours. He studied a small community of 136 residents in a Home for Jewish Old People in the U.S.A. All his cases were symptomless and were examined radiographically using a standard technique. He found that 29 per cent of the women and 20 per cent of the men studied (both sexes aged 63 to 96 years) had vertebral osteoporosis with from one to seven compression fractures. These findings of the incidence of osteoporosis are not truly comparable with ours. All these cases were asymptomatic while ours all had symptoms. Furthermore, people in a Jewish old person's home in the U.S.A. would probably have had a better diet than our cases, coming very largely from the " working class " area of North Liverpool and its satellite Kirby.

Smith's (1960) survey is similar to ours in two respects. Firstly all his patients, like ours, were ambulant and, secondly, the same criteria were used to make the diagnosis. He examined the thoraco-lumbar region only, this being the region of the spine which shows the greatest degree of deformity is osteoporosis. Smith examined 218 ambulatory women aged over 45 years. He found that 29 per cent of patients had definite osteoporosis, the incidence increasing from 7 per cent in the group aged 45/49 years to 47 per cent in the group aged 60/64 years. There was a peak incidence of 78 per cent for women over 75 years. These figures compare with ours of 37 per cent for the overall period which we studied viz. 20 years to 80 and over; we found an incidence of 9 per cent in the 45/49 age group compared with Smith's 7 per cent, and 89 per cent in the 75/79 and 100 per cent in the 80+ groups compared with Smith's 78 per cent. While we should bear in mind that the age group of 80+years is small, the higher incidence than Smith's may also be due to dietary or other factors which distinguish the American patients from the Liverpool population we studied. Furthermore, all our patients were referred with symptoms.

Finally, we must consider the radiological finding of sclerosis and pseudoarthrosis formation lumbar spinous processes in severe osteoporosis. This condition described by Baarstrup in 1936 is quite

common especially in Grades II and III. Baarstrup in his article noted that it was due to vertebral body and disc collapse. It is also very painful and this may in part account for the pain in osteoporosis. It is worthwhile to look for Baarstrup's disease because in severe cases surgery might relieve the condition.

The clinical findings in osteoporosis are well defined by this survey. The classical patient presents with bachache and has the clinical triad of kyphosis, restricted spinal movements and tenderness on spinal percussion. In fact, the elderly person presenting with these features can confidently be suspected of suffering from osteoporosis. A note of caution must be introduced here: to diagnose osteoporosis is not enough; a full investigation to find its cause is essential. In particular, parathyroid and secondary malignant disease should be foremost in mind, and not until other conditions have been excluded should the diagnosis of " idiopathic osteoporosis " be made. The exact aetiology of osteoporosis remains a mystery; one fascinating finding in this small survey is its high incidence in diabetic patients with backache.

Summary

A radiological technique for the diagnosis of spinal osteoporosis is described.

This technique is used to survey 481 patients with backache. The results of this survey are given. 31 per cent of the patients investigated were found to have spinal osteoporosis.

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Part of this material is included in an M.D. thesis submitted by one of us (H.B.D.).

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