# THE EPIDEMIOLOGY OF CHRONIC RHEUMATISM

**A SYMPOSIUM ORGANIZED BY**
**THE COUNCIL FOR INTERNATIONAL**
**ORGANIZATIONS OF MEDICAL SCIENCES**
**ESTABLISHED UNDER THE**
**JOINT AUSPICES OF**
**UNESCO & WHO**



## VOLUME TWO

## ATLAS OF STANDARD RADIOGRAPHS OF ARTHRITIS

prepared by
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University of Manchester and Manchester Royal Infirmary
and the Empire Rheumatism Council's Field Unit

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# PREFACE

Specimen volumes were prepared with financial assistance from the Empire Rheumatism Council. These were exhibited during the symposium on Population Studies in relation to Chronic Rheumatic Diseases which was sponsored by the Council for International Organisations of Medical Sciences with partial support by grants from the National Institute of Arthritis and Metabolic Diseases and the Arthritis and Rheumatism Foundation and held in Rome from the 29th August to the 1st September, 1961.

The Members of the Symposium recommended that the Atlas be adopted and published as Volume 2 of their Proceedings.

The section on Ankylosing Spondylitis was added subsequent to the Symposium and it was therefore not possible for the Members of the Symposium to endorse this section but it was felt that it would increase the usefulness of the Atlas.



# INTRODUCTION

For therapeutic trials and epidemiological studies it is essential to have some agreed system of grading radiological changes in the joints. The illustrations in this Atlas have been derived from studies reported in the following publications:

Radiological signs of rheumatoid arthritis. J. H. Kellgren with the assistance of F. Bier (1956). *Ann. Rheum. Dis.* **15**, 55.

Radiological assessment of rheumatoid arthritis. J. H. Kellgren and J. S. Lawrence (1957). *Ann Rheum. Dis.* **16**, 485.

Radiological assessments of osteoarthrosis. J. H. Kellgren and J. S. Lawrence (1957). *Ann. Rheum. Dis.* **16**, 494.

Rheumatoid arthritis of the cervical spine in the adult. J. Sharp, D. W. Purser and J. S. Lawrence (1958). *Ann. Rheum. Dis.* **17**, 303.

# OSTEOARTHROSIS

The following radiological features are considered evidence of osteoarthrosis:

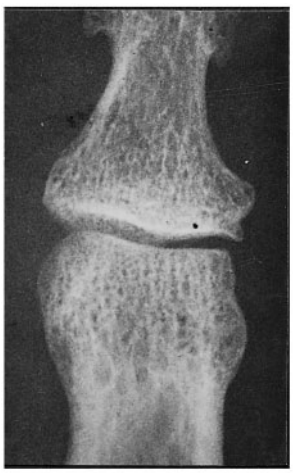
(a) Formation of osteophytes on the joint margins or in ligamentous attachments, as on the tibial spines.
(b) Periarticular ossicles; these are found chiefly in relation to the distal and proximal interphalangeal joints.
(c) Narrowing of joint space associated with sclerosis of subchondral bone.
(d) Cystic areas with sclerotic walls situated in the subchondral bone.
(e) Altered shape of the bone ends, particularly the head of femur.

All these changes were considered together to arrive at a grading for severity which was recorded numerically:

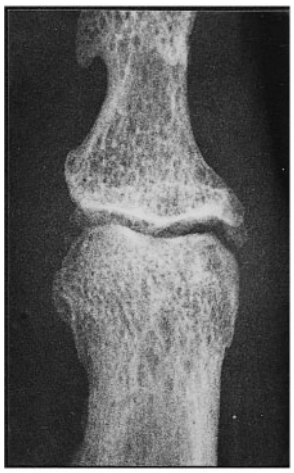
0 . . . None
1 . . . Doubtful
2 . . . Minimal
3 . . . Moderate
4 . . . Severe

In different joints different characteristics were used for grading because in some joints certain characteristics were considered to be unreliable. For instance narrowing of joint space in the metacarpo-phalangeal joints was usually associated with rheumatoid arthritis and was therefore an unreliable index of osteoarthrosis.

The radiographs illustrating standard grades of osteoarthrosis were obtained by studying a random sample of a population aged 55–64 years. The films were read by two observers, first together and then independently. For the Atlas examples have been chosen on which there was agreement in grading on all three occasions.



Grade 1



Grade 2

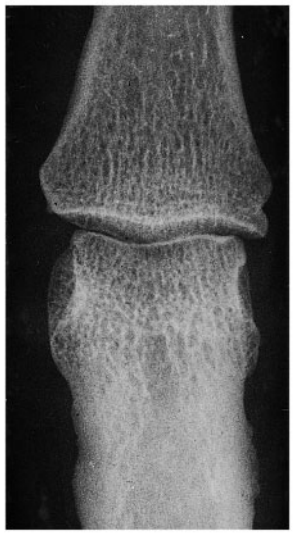
Grade 3

Grade 4

## Distal interphalangeal joints

**Grade 1:** Normal joint except for one minimal osteophyte.
**Grade 2:** Definite osteophytes at two points with minimal subchondral sclerosis and doubtful subchondral cysts, but good joint space and no deformity.
**Grade 3:** Moderate osteophytes, some deformity of bone and narrowing of joint space.
**Grade 4:** Large osteophytes and deformity of bone ends with loss of joint space, sclerosis and cysts.

Grade 1



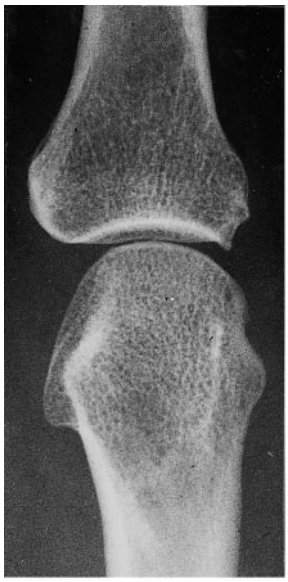
Grade 2

Grade 3

Grade 4

## Proximal interphalangeal joints

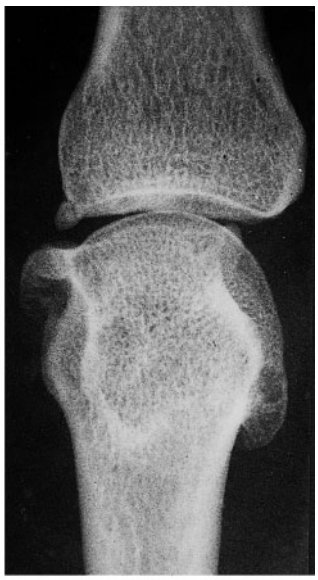
**Grade 1:** Minimal osteophytosis at one point and possible cyst.
**Grade 2:** Definite osteophytes at two points and possible narrowing of joint space at one point.
**Grade 3:** Moderate osteophytes at many points, deformity of bone ends.
**Grade 4:** Large osteophytes, marked narrowing of joint space, subchondral sclerosis and slight deformity.



Grade 1

Grade 2

Grade 3



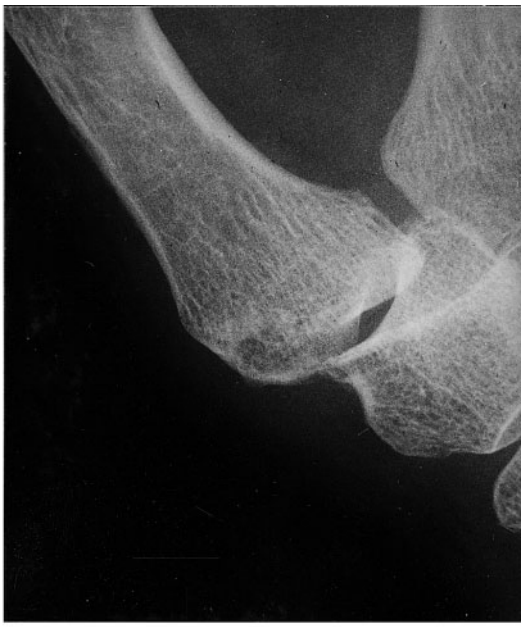
Grade 4

## Metacarpo-phalangeal joints

**Grade 1:** Minimal osteophytes at one point.
**Grade 2:** Definite osteophytes at two points.
**Grade 3:** Moderate osteophytosis at many points.
**Grade 4:** Large osteophytes at many points.

In this joint osteophytosis was used as the main criterion of osteoarthrosis, since other changes are more often due to rheumatoid arthritis and are therefore unreliable.

Grade 1



Grade 2

Grade 3

Grade 4

## First carpo-metacarpal joints

**Grade 1:** Minimal osteophytosis and possible cyst formation.
**Grade 2:** Definite osteophytes and possible cysts.
**Grade 3:** Moderate osteophytes, narrowing of joint space and sub-chondral sclerosis and deformity of bone ends.
**Grade 4:** Large osteophytes, severe sclerosis and narrowing of joint space.

Grade 1

Grade 2

Grade 3

Grade 4

## Wrist joints

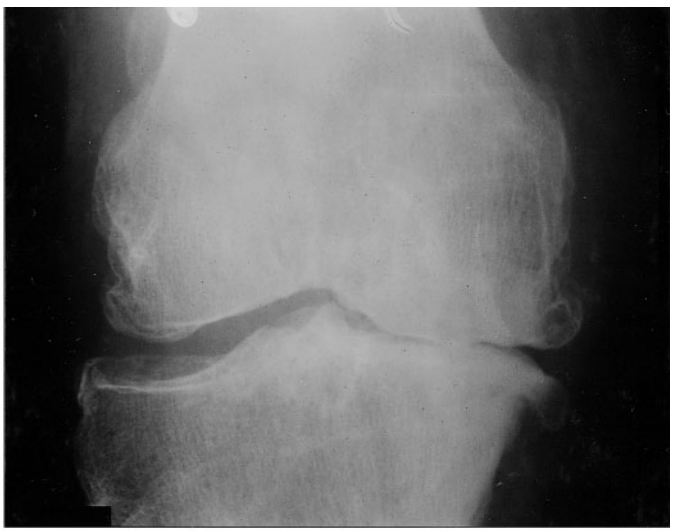
**Grade 1:** Possible sclerosis and minimal osteophytosis.
**Grade 2:** Definite narrowing of joint space and osteophytes in relation to deformed scaphoid.
**Grade 3:** Narrowing of joint space, possible cyst formation and slight osteophytosis, separate ulnar styloid and deformed carpal bones, probably due to old trauma.
**Grade 4:** Severe narrowing of joint space, osteophytosis and sclerosis in relation to deformed scaphoid.

Osteoarthrosis of the wrist is usually secondary to trauma as in these films or, alternatively, secondary to previous inflammatory arthritis. Primary osteoarthrosis of the wrist is rare.

Grade 1

Grade 2

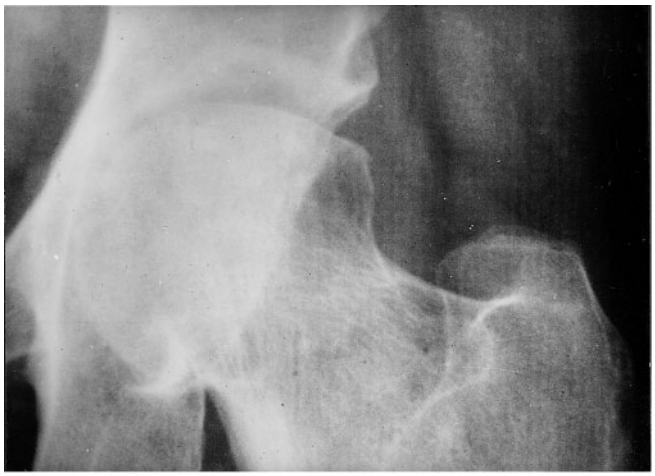
Grade 3



Grade 4

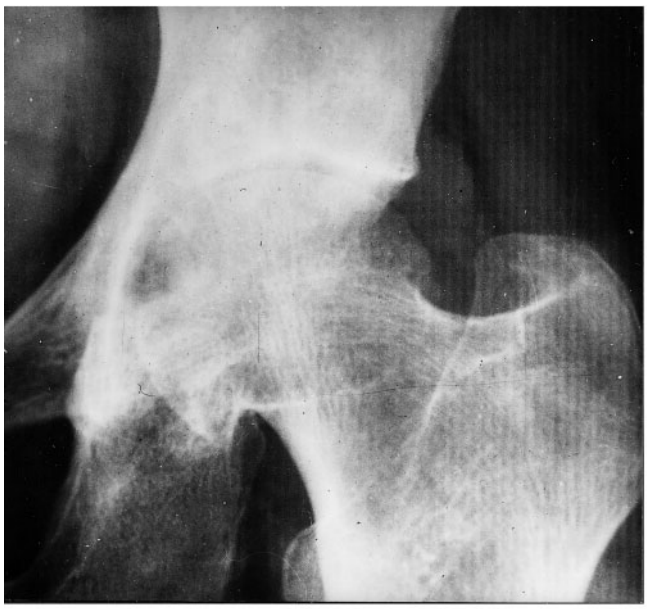
## Knee joints

**Grade 1:** Doubtful narrowing of joint space and possible osteophytic lipping.
**Grade 2:** Definite osteophytes and possible narrowing of joint space.
**Grade 3:** Moderate multiple osteophytes, definite narrowing of joint space and some sclerosis and possible deformity of bone ends.
**Grade 4:** Large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity of bone ends.



Grade 1

Grade 2



Grade 3

Grade 4

## Hip joints

**Grade 1:** Possible narrowing of joint space medially and possible osteophytes around femoral head.
**Grade 2:** Definite narrowing of joint space inferiorly, definite osteophytes and slight sclerosis.
**Grade 3:** Marked narrowing of joint space, slight osteophytes, some sclerosis and cyst formation and deformity of fermoral head and acetabulum.
**Grade 4:** Gross loss of joint space with sclerosis and cysts, marked deformity of femoral head and acetabulum and large osteophytes.

Grade 1 Grade 2 Grade 3 Grade 4

## Apophyseal joints of cervical spine

Changes of disk degeneration are not included and should be disregarded in grading.

**Grade 1:** Doubtful osteophytes on margins of articular facets of apophyseal joints.
**Grade 2:** Definite osteophytes and subchondral sclerosis in apophyseal joints.
**Grade 3:** Moderate osteophytes, sclerosis and some irregularity of articular facets.
**Grade 4:** Many large osteophytes and severe sclerosis and irregularity of apophyseal joints.

In lateral films narrowing of apophyseal joints cannot be assessed accurately.

# DISK DEGENERATION

The following radiological features are considered evidence of disk degeneration:

(a) Narrowing of the disk space
(b) Sclerosis of the vertebral plates
(c) Marginal osteophytosis

Grade 1

Grade 2

Grade 3

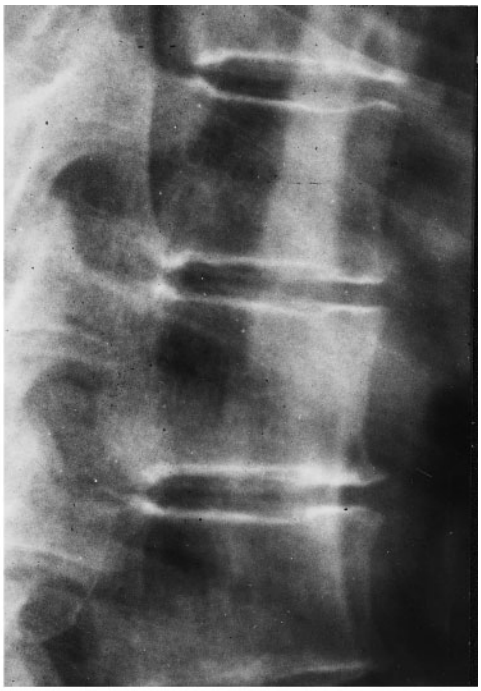
Grade 4

## Cervical disk degeneration

Changes in the apophyseal joints are not included and should be disregarded in grading. The most severely affected disk space determines the grading.

**Grade 1:** Minimal anterior osteophytosis.
**Grade 2:** Definite anterior osteophytosis with possible narrowing of disk space and some sclerosis of vertebral plates.
**Grade 3:** Moderate narrowing of disk space with definite sclerosis of vertebral plates and osteophytosis.
**Grade 4:** Severe narrowing of disk space with sclerosis of vertebral plates and multiple large osteophytes.

Grade 1



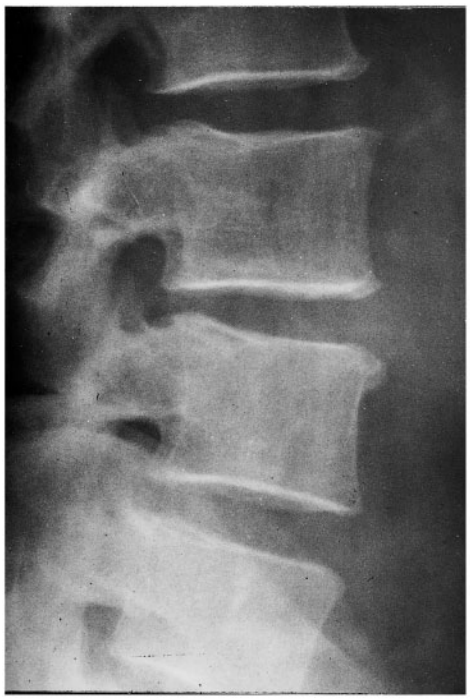
Grade 2

Grade 3

Grade 4

## Dorsal disk degeneration

**Grade 1:** Possible sclerosis and osteophytosis at anterior margin of disk space.
**Grade 2:** Definite but slight osteophytosis and sclerosis of vertebral plates.
**Grade 3:** Moderate narrowing of disk space with sclerosis of vertebral plates and osteophytosis.
**Grade 4:** Severe narrowing of disk space, marked sclerosis of vertebral plates and large osteophytes.



Grade 1

Grade 2

Grade 3

Grade 4

## Lumbar disk degeneration

**Grade 1:** Minimal osteophytosis only.
**Grade 2:** Definite osteophytosis with some sclerosis of anterior part of vertebral plates.
**Grade 3:** Marked osteophytosis and sclerosis of vertebral plates with slight narrowing of disk space.
**Grade 4:** Large osteophytes, marked sclerosis of vertebral plates and marked narrowing of disk space.

# RHEUMATOID ARTHRITIS

In grading rheumatoid arthritis in radiographs of the hands and feet the following radiological characteristics are used:

(a) Osteoporosis, especially when juxta-articular.
(b) Narrowing of joint space *without* subchondral sclerosis.
(c) Surface and pocketed erosions.
(d) Subluxations.

In population studies osteoporosis is most frequently due to conditions other than rheumatoid arthritis so that osteoporosis is given a low weighting in the total grading. Osteoporosis without other changes is not accepted as definite radiological evidence of rheumatoid arthritis.

The standard radiographs were chosen from a random sample of a population aged 55–64 years by the same method as the standard films of osteoarthrosis. The hand films were also exhibited at the 9th International Congress on Rheumatic Diseases where they were read by 60 observers. The results of the 60 gradings obtained on this occasion are shown in the following table:

| | Grades as illustrated | | | |
|---|---|---|---|---|
| Grades recorded at Congress | None | Minimal | Moderate | Severe |
| 0 (None) | 48 | 13 | 1 | – |
| 1 (Doubtful) | 9 | 4 | 1 | – |
| 2 (Minimal) | 3 | 25 | 2 | – |
| 3 (Moderate) | – | 17 | 36 | 8 |
| 4 (Severe) | – | 1 | 2 | 52 |

Single hands and feet of Grades 2, 3, and 4 are shown.

The radiographs showing rheumatoid changes in the cervical spine were obtained by studying 44 hospital patients aged 55–64 years who were suffering from rheumatoid arthritis; the films were read by three observers. Grades 2, 3, and 4 are shown.

**Grade 2**

## Rheumatoid arthritis of hands

**Grade 2:** The film illustrates the upper limit of Grade 2 with multiple pocketed and surface erosions, slight osteoporosis and little, if any, narrowing of joint space. One or two such erosions with or without slight porosis would qualify for inclusion in Grade 2.

**Grade 3**

## Rheumatoid arthritis of hands

**Grade 3:** This film is characteristic of Grade 3 with multiple pocketed and surface erosions, marked narrowing of joint spaces, especially in carpus and wrist, plus subluxation of wrist and slight osteoporosis.

**Grade 4**

## Rheumatoid arthritis of hands

**Grade 4:** The changes in this film are very severe, with gross osteoporosis, marked narrowing of joint spaces, widespread erosions and multiple subluxations.

**Grade 2**

## Rheumatoid arthritis of feet

**Grade 2:** This film illustrates minimal criteria for inclusion in Grade 2. Definite slight erosions in 5th and possibly 4th metatarsal heads, with minimal osteoporosis.

**Grade 3**

## Rheumatoid arthritis of feet

**Grade 3:** Erosions and deformity of 2nd, 3rd and 5th metatarsal heads with narrowing and subluxation of 2nd and 3rd metatarsophalangeal joints. Erosion in interphalangeal joints of 1st and 5th toes. Definite juxta-articular osteoporosis. Narrowing of joint spaces in tarsus. The erosions in this film have the rounded smooth appearance of partial healing.

**Grade 4**

## Rheumatoid arthritis of feet

**Grade 4:** Severe erosion, narrowing of joint space and subluxation of all metatarso-phalangeal joints, erosions of interphalangeal joints and moderate osteoporosis. Ankylosis of tarsal and tarso-metatarsal joints.

Grade 2

Grade 3

Grade 4

## Rheumatoid arthritis of cervical spine

The changes illustrated are those of rheumatoid arthritis and not ankylosing spondylitis which has occasionally been referred to as rheumatoid spondylitis.

**Grade 2:** Narrowing of several upper cervical disk spaces without osteophytosis.
**Grade 3:** Narrowing of several disk spaces without osteophytosis, with slight forward subluxation of $C_1$ and $C_3$, and erosion of apophyseal joint at $C_{3-4}$ and possible ankylosis of apophyseal joints $C_{4-5}$.
**Grade 4:** Severe narrowing of several disks, with bony fusion of $C_{4-5}$ vertebral bodies and articular facets, erosion of vertebral plates and apophyseal joints and slight forward subluxation of $C_1$.

The severe subluxation of C1 and lower vertebrae, often encountered in rheumatoid arthritis, are not illustrated in these films.

# ANKYLOSING SPONDYLITIS

The films in this section have been selected from patients attending the spondylitis clinic at the Manchester Royal Infirmary, and they have not been tested in observer difference studies or population surveys, but since radiological changes are a major diagnostic criterion for ankylosing spondylitis it was felt that the Atlas would be incomplete without illustrations of some typical examples.

**Grade 2**

## Sacro-iliac joints

**Grade 2:** Irregular widening of the joint spaces with adjacent bone sclerosis.

Grade 3

## Sacro-iliac joints

**Grade 3:** Irregularity of joint spaces, marked adjacent bone sclerosis and partial ankylosis.

**Grade 4**

## Sacro-iliac joints

**Grade 4:** Complete bony ankylosis.

Grade 2

Grade 3

Grade 4

## Lumbar spine

**Grade 2:** Definite squaring of at least one vertebral body. Apophyseal joints are indistinct.
**Grade 3:** Increased height and squaring of several vertebral bodies and bony bridging at one point, possible ankylosis of one or two apophyseal joints.
**Grade 4:** Extensive bony bridging of vertebral bodies and ankylosis of apophyseal joints.

Note that the disk spaces are generally preserved and that the bony bridging is in the outer layers of the annulus fibrosus of the disks and not in the longitudinal ligaments as in the osteophytosis associated with disk degeneration.