Ann. rheum. Dis (1975), **34**, 292

The foot in chronic rheumatoid arthritis

E. VIDIGAL, R. K. JACOBY, A. ST. J. DIXON, A. H. RATLIFF, AND J. KIRKUP
From the University Departments of Medicine and Orthopaedic Surgery, Bristol Royal Infirmary, and the Royal National Hospital for Rheumatic Diseases, Bath

Vidigal, E., Jacoby, R. K., Dixon, A. St. J., Ratliff, A. H., and Kirkup, J. (1975). *Annals of the Rheumatic Diseases*, **34**, 292–297. **The foot in chronic rheumatoid arthritis.** The feet of 200 consecutive admissions with classical or definite rheumatoid arthritis were studied. 104 were found to have pain or deformity. Clinical involvement of the joints was seen more often than radiological joint damage in the ankle, but the reverse was the case in the midtarsal joints. The metatarsophalangeal joints were involved most frequently both clinically and radiologically.

Sixty per cent. of the patients required modified shoes but only a third of these had received them. The need for more shoes is clear, and although this is a highly selected group of patients they were all under specialist care. The increased expenditure on special footwear would benefit the patient, firstly by improving ambulation, and secondly perhaps by reducing the number of operations necessary.

Hallux valgus was very common and occurred with similar frequency to disease in the other metatarsophalangeal joints. Although not exclusive to rheumatoid arthritis, hallux valgus must have been caused for the most part by the rheumatoid arthritis and if so, then it is suggested that the provision of suitable shoes for patients may be less costly than subsequent surgical treatment.

The foot is a major cause of disability in rheumatoid arthritis and yet there have been few surveys which have examined the frequency, severity, and pattern of the disease as it applies to the individual sufferer. This survey was designed to study these problems in patients with chronic rheumatoid arthritis in order to show what treatment potential exists in the foot. Attention is drawn to the need for better facilities in providing footwear, chiropody, and surgery, so that patients may regain pain-free ambulation.

Method

PATIENTS

200 consecutive admissions for rheumatoid arthritis to either an orthopaedic ward or a rheumatology unit were assessed for admission to the survey.

CRITERIA FOR INCLUSION

(i) Classical or definite rheumatoid arthritis (American Rheumatism Association, 1959). (ii) Pain or deformity of the feet. (iii) Disease for longer than one year (mean 12·9 years).

EXCLUSION FROM SURVEY

Patients who had had any previous operation on the feet that caused significant modification to the foot were excluded.

The following information was obtained on each patient. (1) Functional capacity (Steinbrocker, Traeger, and Batterman, 1949). (2) Patients were asked whether they could buy comfortable shoes at a shoeshop and whether they wore surgical or special shoes. (3) Clinical examination of the feet. (4) Callosities were recorded. (5) Detailed photographs of the feet were taken, in standard positions, from the lateral, anterior, and posterior aspects as well as the plantar surfaces. Further views, deemed necessary to show any unusual feature, were also taken. (6) *X*-rays of the feet were obtained in dorsoplantar and lateral planes, also views of the ankle joint, subtalar and midtarsal joints. All feet were *x*-rayed to show metatarsal heads in tangential view.

Results

The number of patients found to be suitable for inclusion in the survey was 104 and the total number of feet examined 204. Four feet were found to be unsuitable because of surgery. The duration of disease at the time of examination is shown in Table I.

FUNCTIONAL CAPACITY

Functional capacity revealed that more than half the patients had marked restriction of activity, mobility being curtailed by proximal joint disease, particularly

Accepted for publication November 18, 1974.
Correspondence to: Dr. R. K. Jacoby, Department of Medicine, Bristol Royal Infirmary, Bristol BS2 8HW.

Table I *Duration of rheumatoid arthritis at time of examination*

	Duration of disease (years)						
	0–5	6–10	11–15	16–20	21–25	26–30	31–35
No. of patients	21	26	18	18	9	8	4

in the knees and hips. The most frequent target joint causing symptoms was the knee in 55 patients. The feet were the second most frequent site of symptoms in approximately one-quarter of the 200 patients interviewed. Only 3 patients had no restriction of activities (grade I). The majority of patients fell into grades II and III, the groups which can hope to achieve the most benefit after treatment since the bedridden patient has other priorities. Symptoms referable to the lower limb were four times more frequent than elsewhere; the shoulders caused symptoms at the time of interview in eleven patients, the wrists and hands were painful and impeded normal activities in seven, the elbows featured in five, the lumbar spine in three, and the cervical region in two.

SHOES

Only 40% of the patients were able to wear comfortable shoes bought at an ordinary shoe shop. Nineteen patients had been supplied with special shoes, leaving 40% of the patients with unsatisfactory footwear. These patients wore sandals or extra large shoes which were padded or cut to accommodate misshapen feet. Those patients who were wearing surgical shoes found them preferable to normal shoes and were satisfied with them. Of the nineteen patients wearing surgical shoes, sixteen were grade III, the other three were grade II.

CLINICAL EXAMINATION

The following grades were used: 0 = normal function; I = pain only on walking; II = pain on passive movement; III = pain at rest.

The situation and degree of involvement of the midfoot and hindfoot are set out in Table II. The forefoot has been considered separately (see below).

The ankle joint was involved in 97 feet, nearly twice the number with radiological damage, but in few patients was involvement severe. The midtarsal joint was involved in 56 feet, which was less than half of those observed with radiological changes. The subtalar joint was clinically involved in 43 feet, being two-thirds of the observed radiological change.

Examination of the heel revealed that many of the patients suffered from pain in this region in two sites particularly, at the insertion of the Achilles tendon into the os calcis involving 33 feet, and at the insertion of the plantar fascia into the os calcis occurring in 31 feet. Os calcis lesions were not always visible on *x*-ray; however, with palpation it was possible to show an abnormal area of tenderness.

The area of insertion of the Achilles tendon into the calcaneum was eroded in 10 feet; the area of insertion of the plantar fascia into the calcaneum was involved in 31 feet, causing pain and tenderness. There was no evidence of any of the stigmata of Reiter's disease or other seronegative arthritis. The sheep cell agglutination test was positive in all of these patients. There remained a further group of 14 patients with heel pain not localized to any anatomical landmark, and they were recorded as heel pain without localization. The source of the pain was in the subcutaneous tissues with no evidence of external injury from the patients' footwear. It was felt that the source of the pain in these patients was due to nodule formation with resulting pressure on pain-sensitive tissues.

Deformity of the hind foot was shown when standing and was recorded photographically. Subtalar joint involvement, giving rise to valgus deformity, was noted in 55 feet. However, varus deformity was seen in only 2 feet.

The metatarsophalangeal joints were the most frequently involved part of the foot, and related to them are three other structures which function in harmony and suffer with similar frequency: (1) the fibrofatty cushion, which should lie beneath the metatarsal heads; (2) the skin underlying the cushion; (3) the toes. Involvement of these four structures is set out in Table III.

Table II *Number of painful sites in mid and hind foot of 204 feet*

Grade	*Ankle*	*Midtarsal*	*Subtalar*	*Achilles tendon*	*Plantar calcaneal spur area*
I	49	29	32	31	28
II	41	27	11	2	3
III	7	0	0	0	0

Table III *Site and frequency of pain and pressure lesions in the forefoot*

	Hallux	*2nd toe*	*3rd toe*	*4th toe*	*5th toe*
Pain under MTP joint	33	77	81	76	50
Callosities under MTP joint	49	47	67	35	33
Pressure lesions over proximal interphalangeal joint	9	69	67	75	76

MTP = metatarsophalangeal joint.

The metatarsal heads become immediately subcutaneous, having subluxed. This occurred in 157 feet, resulting from metatarsophalangeal joint involvement by rheumatoid arthritis. The middle 3 toes were involved in 40% of the feet. The diseased metatarsal heads that become superficial are prone to develop pressure lesions, and this was observed in over 30% of the feet. Hallux valgus was present when the great toes lay at an angle of 11° or more from the long axis of the first metatarsal bone, and this was the case in 144 feet, 91 of which had a bursa overlying the metatarsophalangeal joint. Pressure lesions occurred on the dorsum of the toes in over 30% of the fibular 4 toes; the hallux was usually spared and pressure lesions developed in only four of them. The location of these lesions was determined by the position of the hallux and the subsequent packing into the shoe that occurred.

Among other clinical features observed, skin circulation was diminished in 10 feet; 2 feet showed evidence of vasculitis and 7 had skin sepsis. Neurological deficit was seen in 7 feet, as evidence of neuropathy in 5, and ankle jerks were absent in 2. Twelve pairs of feet showed gross asymmetry, implying a different type of involvement in either foot, but this was remedied in several patients by wearing shoes of different sizes.

X-RAY CHANGES

The ankle joint was involved in 52 feet (26%). The findings are summarized in Fig. 1. The ankle was damaged eight times more often with midtarsal disease than without it and 16 times more often with metatarsophalangeal joint disease than without it. Midtarsal joint involvement was seen in 124 feet (62%) and occurred 10 times more often with metatarsophalangeal joint disease than without.

Subtalar joint involvement was seen in 64 feet (32%). Subtalar disease was seen with midtarsal disease 20 times more often than without it, and similarly subtalar disease was seen 20 times more often with metatarsophalangeal joint disease than without it. Metatarsophalangeal joint disease was seen in 176 feet and was the commonest site of radiological damage.

Unusual features showed that vessel calcification occurred in nine patients and calcaneal spurs in seventeen, eleven of whom were seropositive. Erosion of the os calcis was seen in 11 feet of nine patients. In all except one case the erosion was found in the region of the insertion of the Achilles tendon. The one exception was seen on the plantar surface (Fig. 2).

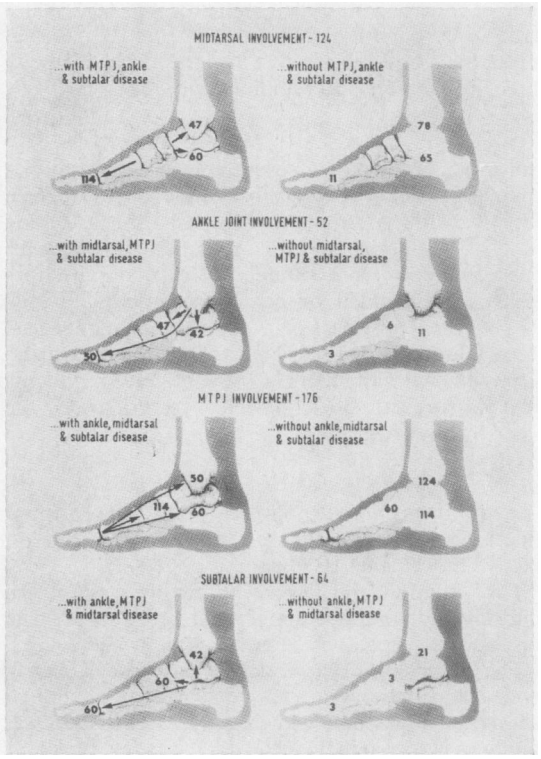

FIG. 1 *Diagrams representing the frequency of radiological involvement of four regions in the foot: the midtarsal, ankle, subtalar, and metatarsophalangeal joints. Left-hand diagrams refer to the number of occasions on which the reference joint was involved with the three other joints, emphasized by arrows on the diagram. The reference joint is named above the diagrams in question. Right-hand diagrams refer to the number of occasions on which the reference joint was involved without the other three joints. Figures are placed over the noninvolved joints*

Tangential views of the metatarsal heads showed the erosion of bone at this site and the sesamoid dislocation (Figs 3*B*, 3*C*). The transverse arch of the foot was well demonstrated and in some cases was completely reversed (Fig. 3*B*). The soft tissue profile in this view shows the dislocation of the fibrofatty cushion and the subcutaneous position of the metatarsal heads. If there is significant erosion at this site, it is seen how a jagged promontory can cause pain on weight bearing (Fig. 3*C*). The patient complained that it was like walking on a drawing pin, an appropriate simile.

Discussion

Although this was a highly selected group of patients, the study is relevant to specialists in hospital practice who prescribe surgical shoes and recommend patients for surgery. It is noteworthy that patients, all of whom were under our care, had to purchase inappropriate shoes and make their own modifications. Sandals were a frequent alternative to ill-fitting shoes, but they give little protection from the cold or mechanical injury. Although there is evidence to suggest that patients with rheumatoid arthritis have a lower pain threshold (Huskisson and Hart, 1972), patients may not give high priority to their footwear. It is all too often appreciated by patients that the more complaints they have, the less attention is focused on any one. We believe that this is a strong argument for establishing foot clinics. Our own experience has been rewarding from both patient satisfaction and medical interest, the latter being fed by a plethora of extra-connective tissue diseases, diabetes in particular.

The commonest site for involvement of the foot by rheumatoid arthritis is in the metatarsophalangeal joints; the subsequent pattern of events follows a common pathway (Calabro, 1962; Dixon, 1970). (i) Spread of the forefoot occurs, as the intermetatarsophalangeal joint ligaments become stretched, (ii) the tethering of the fibrofatty cushion is weakened and may become displaced anteriorly, (iii) the toes then become dislocated dorsally with subsequent extensor tendon shortening, and (iv) the result of the previous three steps leads to the metatarsal heads taking up a subcutaneous position. They then sustain more of the weight-bearing function, the toes being inactive, and this can lead to metatarsal fracture. Collis and Jayson (1972) noted that the greatest pressures in the forefoot were sustained under the 2nd and 3rd metatarsal heads. The development of pressure lesions under the 2nd and 3rd metatarsal heads, noted in 40% of patients, is therefore to be expected and has been observed already by J. Rotes Querol (personal communication) who coined the term 'centre forward callosity'.

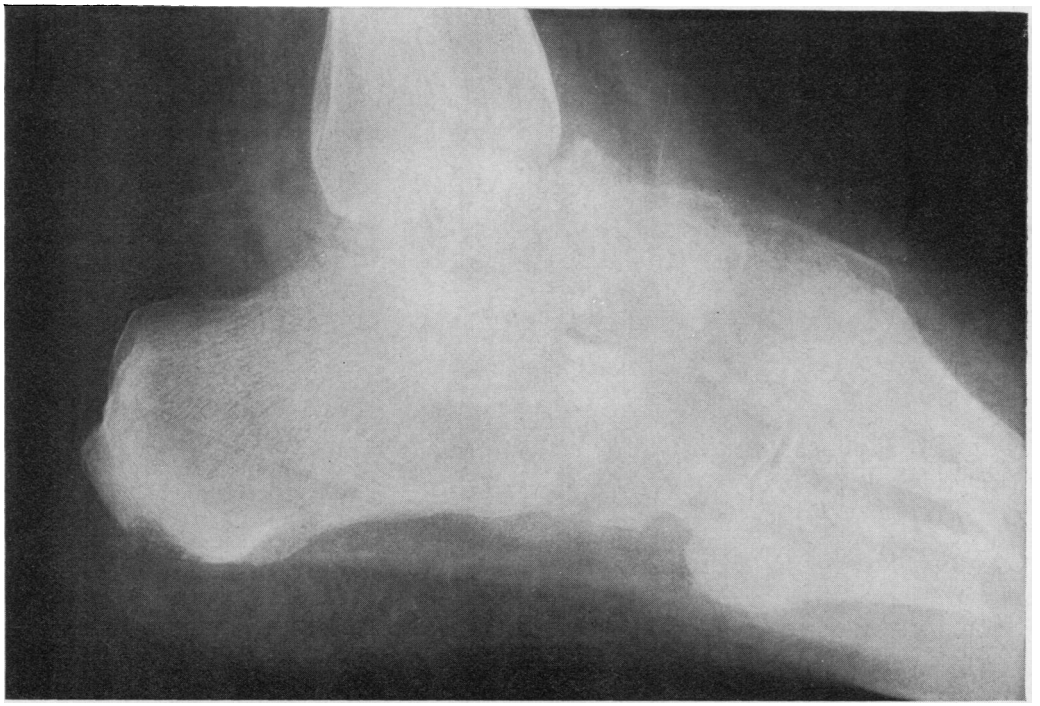

FIG. 2 *X-ray showing erosion of the os calcis on the plantar surface*

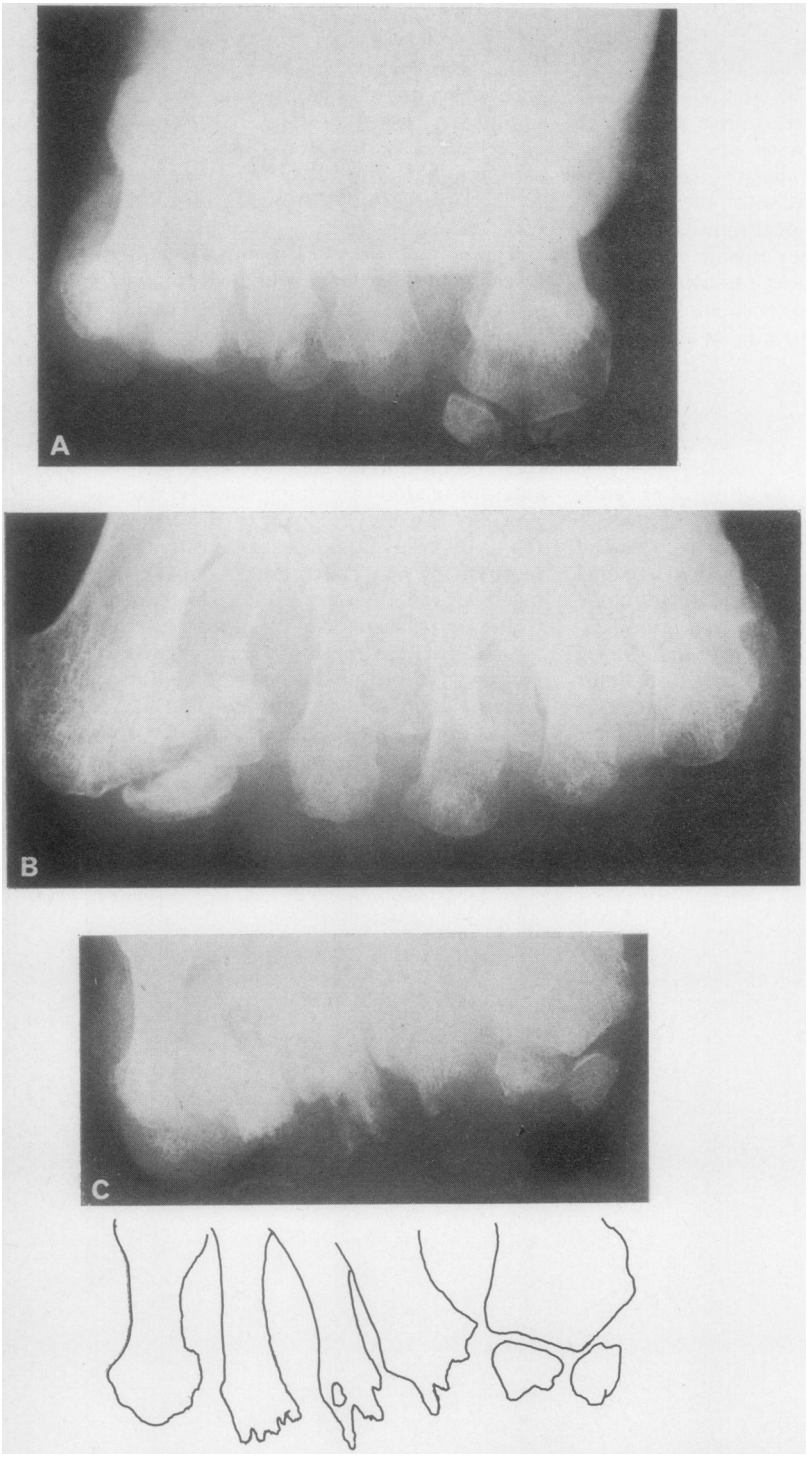

FIG. 3(A) *Normal relationship shown on tangential view of the metatarsal heads. The sesamoids are lying in the correct position; there is an erosion of the medial sesamoid.* (B) *Tangential view of the metatarsal heads. X-ray shows reversal of the forefoot arch and lateral dislocation of the sesamoid bones.* (C) *Tangential view of the metatarsal heads with a tracing of the bones and soft tissue. The presence of spike formation due to gross plantar erosion is seen. The spikes are forced into the deep surface of the plantar skin, which contains the pain-sensitive structures*

The ensuing events are then modified by the patients' own footwear, hallux valgus occurring with great frequency. However, it is not always possible to distinguish between rheumatoid arthritis and the common type of hallux valgus seen in women without arthritis (Gheith and Dixon, 1973). The distorted packing of the toes is also influenced very much by the position of the great toe, and the callosities that occur indicate the abrasive action of the overlying shoe. The additional feature that occurs with similar frequency is the dislocation of the sesamoid bones in flexor hallucis brevis, which become repositioned in the first web space and take no part in weight bearing (Fig. 3*B*).

This survey does suggest that the hindfoot is rarely involved in the absence of midtarsal and metatarsophalangeal joint disease. Subtalar joint disease, likewise, rarely occurs without midtarsal or metatarsophalangeal joint disease.

It is of interest that the ankle was a source of symptoms in 97 feet, twice the number in which there was radiological damage, and the reverse of that seen in the midtarsal joints, in which symptoms occurred in only 56 feet but radiological changes were seen in 125. It must therefore be assumed that midtarsal disease is transient with fewer symptoms than disease in the ankle joint, but more prone to undergo serious radiological damage. Could it be the case that the midtarsal joints cause symptoms in the ankle without becoming painful themselves?

Valgus deformity of the foot was noted more frequently than varus deformity. The aetiology of pes valgus was discussed by Vainio (1956), who stressed the importance of the talonavicular and naviculo cuneiform joints, and that damage to them through rheumatoid arthritis causes the longitudinal arch of the foot to be disturbed. The foot then undergoes flattening, subsequently adopting a valgus position through the weight-bearing forces. The cause of pes varus is more obscure and Vainio felt that pes cavus may have been a predisposing factor. In the two patients seen in this survey, pes cavus could have been present early in the disease.

The calcaneal erosions result from inflammatory changes in the subachilles bursa (Bywaters, 1954). These changes were seen radiologically in 11 of the feet; however, pre-erosive disease was found in 33.

Increased expenditure on special footwear is indicated to improve ambulation and perhaps reduce the need for surgery.

Hallux valgus was common, occurring as often as disease in other metatarsophalangeal joints. This was probably caused for the most part by rheumatoid arthritis, which would only serve to make the hallux valgus worse.

We are indebted to the Brazilian Government for their sponsorship of E.V., and to the Dr. Hadwen Trust which has also supported this work.

References

AMERICAN RHEUMATISM ASSOCIATION (1959) *Ann. rheum. Dis.*, **18**, 49 (Diagnostic criteria for rheumatoid arthritis, 1958 revision)

BYWATERS, E. G. L. (1954) *Ann. rheum. Dis.*, **13**, 42 (Heel lesions of rheumatoid arthritis)

CALABRO, J. J. (1962) *Arthr. and Rheum.* **5**, 19 (A critical evaluation of the diagnostic features of the feet in rheumatoid arthritis)

COLLIS, W. J. M. F., AND JAYSON, M. I. V. (1972) *Ann. rheum. Dis.*, **31**, 215 (Measurement of pedal pressures)

DIXON, A. ST. J. (1970) *Proc. roy. Soc. Med.*, **63**, 677 (The rheumatoid foot)

GHEITH, S. L., AND DIXON, A. ST. J. (1973) *Ann. rheum. Dis.*, **32**, 92 (Tangential *x*-ray of the forefoot in rheumatoid arthritis)

HUSKISSON, E. L., AND HART, F. D. (1972) *Brit. med. J.*, **4**, 193 (Pain threshold in arthritis)

STEINBROCKER, O., TRAEGER, C. H., AND BATTERMAN, R. C. (1949) *J. Amer. med. Ass.*, **140**, 659 (Therapeutic criteria in rheumatoid arthritis)

VAINIO, K. (1956) *Ann. Chir. Gynaec. Fenn.*, **45**, *Suppl.* **1** (The rheumatoid foot: a clinical study with pathological and roentgenological comments)