Rheumatoid arthritis and ankle surgery

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Twenty years' experience in a foot clinic combining the interests of a rheumatologist with those of an orthopaedic surgeon indicates that the foot disabled by rheumatoid arthritis commonly presents with (a) multiple joint damage at different stages of evolution and also of asymmetrical distribution between the two feet; (b) a commonly progressive and yet often erratic pathology; and (c) management problems posed by proximal joint disease, especially at the knee and in the hip.

Thus rheumatoid disease can affect many and occasionally all of some 25 closely interrelated joints in the foot, including the ankle joint, which is rarely attacked in isolation and is usually influenced by the other joints. For example, damaged subtalar and midtarsal joints may cause a valgus or, less frequently, a varus attitude of the foot, leading to a valgus or varus strain, or, indeed, a subluxation at the ankle joint. Thus intertarsal correction takes precedence over ankle surgery. Similarly, severe destruction of the metatarsophalangeal joints combined with skin breakdown and infection in the sole demands their prior solution. Knee valgus induces a valgus strain on the foot, and if the knee is painful and unstable it may need surgical attention before the foot, which can often be stabilised with orthoses. A fixed flexion attitude of the hip and particularly of the knee induces a dorsiflexed attitude of the foot under load, and thus arthrodesis of the ankle in the classical position of moderate equinus may prove a disservice to the patient.

Statistical background

In a survey of 200 consecutive patients with definite rheumatoid arthritis¹ 104 were noted to have painful deformity of one or both feet. Four of these feet had been subjected to previous surgery, leaving 204 feet for analysis. Radiological changes were noted in 176 forefeet (metatarsophalangeal and toe joints) and 133 hindfeet involving 124 midtarsal, 64 subtalar, and 52 ankle joints.

A further survey of 150 consecutive patients attending the foot clinic of the Royal National Hospital for Rheumatic Diseases, Bath, with hindfoot pain or deformity, and usually other foot complaints, also confirmed that the ankle joint was relatively resistant to attack. All these patients had attended the clinic for at least one year and had had rheumatoid arthritis for from two to 47 years (average 15). A radiographic survey of the 300 limbs (table 1) showed joint disease or previous surgery in 276 (92%) of the forefeet, 263 (88%) of the intertarsal joints, 155

(52%) of the ankles, 153 (51%) of the knees, and 68 (23%) of the hips. Of the damaged joints in each anatomical category, the operative rates were as follows: 89/276 (32%) of the forefeet, 28/263 (11%) of the intertarsal joints, 22/155 (14%) of the ankles, 64/153 (42%) of the knees, and 39/68 (57%) of the hips.

Of the 300 feet, some two thirds presented a valgus attitude, principally owing to intertarsal subluxation but also to tilting of the talus in the ankle mortise, or both. Varus and equinus was uncommon, the latter always being associated with ankle joint disease (table 2).

Although the hip was often spared disease, the chances of surgical intervention relative to damaged joints was high, occurring in 39/68 (57%) cases (table 1). In contrast with the hip, although pathological changes were often present in the feet, operative surgical intervention was less common and, in the case of the hindfeet the lowest of all, occurring in only 28/263 (11%) of the intertarsal joints and 22/155 (14%) of the ankle joints.

Natural history of the rheumatoid ankle

Initially, pain, joint effusion, and tendon sheath swelling present without radiological changes. The tendon sheaths often communicate with the effusion² and may become chronically enlarged with synovium infiltrating the tendons themselves, leading to attrition rupture.³ If the arthritis progresses, radiological changes now develop and generally follow two patterns.

Firstly, provided that the foot remains in neutral or in slight valgus or varus, the joint narrows, erosions appear, cysts develop, and

Table 1 Radiological changes and previous surgery in 150 consecutive rheumatoid patients with hindfoot symptoms. Mean disease duration 15 years. Number of joints affected is shown

Joint	No x ray changes	x Ray changes	Operations
Forefeet	24	187	89
Intertarsal	37	235	28
Ankle	145	133	22
Knee	147	89	64
Hip	232	29	39

Table 2 Radiographic analysis of foot attitude in 150 consecutive rheumatoid patients with hindfoot symptoms. Mean disease duration 15 years. Number of joints is shown

Foot attitude	Intertarsal	Ankle
Valgus	165	43
Varus	17	15
Equinus	2	8

Figure 1 Standing radiographs of advanced rheumatoid arthritis of hindfoot. Valgus deformity is minimal and the talus has impacted into the mortise, leading to equinus and secondary osteophytes.

Figure 2 Severe hindfoot valgus affecting both the subtaloid and the ankle joint on the left.

Figure 3 Standing radiographs showing early valgus tilt of the right talus and secondary changes in the left ankle with more pronounced tilt and diastasis of the inferior tibiofibular joint.

the talus may collapse proximally into the mortise; in longstanding cases osteophytes appear and the foot tends to assume an equinus position (fig 1).

Secondly, in those patients with marked valgus, often associated with subtaloid joint disease or joint laxity, or both, the ankle assumes a valgus position (fig 2). Initially, very

little is seen on routine radiographs, but standing anteroposterior views are more revealing and disclose tilting of the talus into a valgus position relative to the mortise (fig 3). At a certain stage of this subluxation bony changes develop at the point of contact of the superolateral corner of the talus and the tibial surface (fig 3); as the valgus progresses the lateral surface of the talus makes contact against the tip of the lateral malleolus and bending of the latter may be seen. At a more advanced stage the lower fibula may undergo stress fracture (fig 4) and, rarely, the distal tibia may fracture and realign the valgus. Ultimately, general changes of joint damage appear, mainly owing to mechanical forces acting on an incompetent mortise, leading to increasing pain and instability, though surprisingly good movement is often retained. On weight bearing the foot assumes a valgus attitude combined with dorsiflexion, which induces a flexed attitude at the knee (fig 5). Severe valgus due to both ankle and subtaloid changes can result in the medial aspect of the midfoot taking abnormal pressure on skin ill-adapted to such stress, resulting in painful callouses opposite the navicular or even the head of the talus and ultimately skin breakdown and local infection (fig 6).

If the foot remains in neutral or close to neutral the sequence of destruction may be very slow, often over many years. Proximal migration of the talus in the mortise leads to profound stiffness, though actual bony fusion is rare (fig 1); occasionally even badly destroyed joints may present evidence of imperfect repair (fig 7).

Although the ankle joint can be the first site of rheumatoid change in the foot, this is unusual, and in such cases there is often a history of previous trauma, usually a significant fracture before the onset of the arthritis. More often disease of the ankle follows established subtaloid and forefoot pathology and the changes are usually bilateral, though frequently one joint causes disability before the other. At a later date this joint may ease and the second joint then becomes the major source of disability.

Surgical treatment

As hinted above, most ankles attacked by rheumatoid arthritis can be treated conservatively and only some 14% (22/155) in our clinic required surgical intervention (table 1).

The prime indication for surgery is persistent pain. In some instances, abnormal gait due to severe valgus, or more especially equinus, or instability due to varus are factors in confirming an operative approach, but deformity without pain is rarely an indication. Occasionally skin necrosis medially may demand intervention, though it is unwise to intervene before local infection is controlled and scabs have separated.

When intertarsal disease is also significant it may require an operative solution before the ankle is considered. Sometimes both ankle and intertarsal joints have to be tackled together, as when pantalar fusion is necessary. If bilateral disease causes disability, a staged programme of surgery on the two sides may be needed. Clearly, adequate arterial circulation and sound

Figure 4 Standing radiographs showing late effects of severe valgus, including ankle joint changes, bending of the fibula, and stress fractures of both fibula and tibia.

Figure 7 Radiographs of the same ankle taken at intervals between 1961 and 1975 showing gradual deterioration and finally some attempt at repair (inferior film on right). Note that the talus has remained in neutral.

Figure 5 Severe foot valgus and dorsiflexion combined with knee varus and flexion.

Figure 6 Severe left foot valgus, culminating in skin necrosis over the head of the talus. The right foot remains in neutral but shows severe forefoot disorganisation.

skin are vital prerequisites for safe intervention. Even normal feet have sluggish capillary circulation and thin skin over the anterior aspect of the ankle. Rheumatoid skin, especially in those treated with steroids, is more vulnerable and has to be handled gently. Undue thumb pressure or an exsanguinating Esmarch bandage can easily produce a degloving injury (fig 8).

The patient needs to appreciate the constraints and limitations of surgery. For example, pain relief by ankle arthrodesis is achieved at the expense of loss of movement in a major joint and a permanently fixed heel height for footwear. Further, the rehabilitation phase after operation is often difficult and dependent on the patient's active participation. Unilateral staged operations on the ankle require a period of diminished or complete non-weightbearing on the operated side and hence increased load on the other side, which may deteriorate as a consequence. In certain instances the arms are incapable of controlling crutches and non-weightbearing may be impossible for six weeks after an arthrodesis procedure, at which point a weightbearing cast becomes possible; thus patients may need to be in hospital for a prolonged period. After ankle arthroplasty active movement is required within 48 hours of surgery if not sooner, and a personal exercise programme should continue for at least three months.

The operative procedures available are synovectomy, tendon repair and transfer, osteotomy, decompression of the lateral compartment, arthrodesis including pantalar arthrodesis, and ankle joint replacement.

Synovectomy and tenosynovectomy

Swelling of the peroneal and tibialis posterior tendon sheaths is common and can lead to rheumatoid synovial infiltration of the tendons themselves. This may lead to rupture of the latter, resulting in a sudden increase of valgus

Figure 8 Degloving type injury of fragile rheumatoid skin and wound edge necrosis after ankle arthroplasty. Both lesions healed uneventfully.

and weakness of the foot. Wilkinson in 1965 and Marmor in 1967 advised ankle synovectomy for rheumatoid arthritis,^{4 5} but Vahvanen, Jakubowski, and Gschwend were the first to report a significant series of patients.⁶⁻⁸ All recommended early tenosynovectomy of affected sheaths through lateral and medial incisions, often combining this procedure with partial ankle joint synovectomy through the lateral wound. Gschwend reported 20 patients, of whom 16 underwent tenosynovectomy; on follow up at 4.4 years 15 patients were free from pain, the results being better when the articular cartilage was intact. There has been little enthusiasm for ankle synovectomy in Britain, perhaps because intervention has been offered too late in the disease. In addition, patients are reluctant to accept what is an essentially prophylactic operation when there is hope that the condition may resolve. Indeed the response to treatment, including local steroid injections, is often excellent (A St J Dixon, personal communication). On two occasions we have undertaken synovectomy, including tenosynovectomy, as a secondary procedure when performing intertarsal fusion, with the resolution of ankle symptoms.

If tendons have ruptured, direct repair is impossible and either a tendon graft is necessary⁵ or the ends are motored to adjacent tendons. In the case of tibialis posterior, Jahss has recommended suture to flexor digitorum longus as the

best available procedure,⁹ though the foot remains in valgus.

Tendon transfer

In an endeavour to control valgus deformity before tendon rupture and before significant joint damage and fixed deformity appears Solomon has recommended correction by tendon transfer of flexor digitorum longus into the navicular tubercle (personal communication). This procedure requires at least six weeks in a plaster cast, and patients are often reluctant to accept surgery when pain, valgus, and swelling are minimal.

Lateral compartment decompression

Some patients with mobile valgus deformities have pain well localised to the tip of the lateral malleolus when weight bearing. If the joint is radiologically intact, except between the malleolus and the lateral facet of the talus or the os calcis, then resection of the distal one centimetre of the fibula may resolve symptoms, at least temporarily.¹⁰ It is a minor procedure, enabling the patient to resume activity within 48 hours or so. In five instances after a Bath ankle arthroplasty pain developed and localised in the lateral malleolus; exploration showed abnormal contact of its tip with the talus in four ankles, which were helped by resection of the distal extremity of the malleolus (fig 9).

Ankle arthrodesis

Sound fusion is the best method of relieving ankle pain in unilateral disease and particularly when the midtarsal joint remains intact, for at this joint significant dorsiplantar flexion of the foot may develop to compensate for true ankle movement. These circumstances are usual with osteoarthritis of the ankle but regrettably rare in rheumatoid arthritis.

In the presence of bilateral stiff or spontaneously fused subtaloid and midtarsal joints it has to be recognised that successful fusions of both ankles increase loading and wear of the metatarsophalangeal and knee joints which, if already attacked by disease, will deteriorate further. If the hallux and tarsus are already ankylosed, a not uncommon situation, then the knee is the most distal mobile joint, perhaps tolerable on one side but not on both. To rise from a chair or lavatory seat some dorsiflexion in one foot is required unless the hands and arms are strong and pain free; an unlikely situation in rheumatoid arthritis. The problem is compounded if the ankles are fused in the classical equinus position. For these reasons fusion has to be approached with caution.

Nevertheless, a number of authors, including Gschwend,¹¹ Hamblen,¹² Bolton-Maggs *et al*,¹³ Cracchiolo,¹⁴ Smith *et al*,¹⁵ and Smith and Wood¹⁶ are firmly of the opinion that the alternative of ankle arthroplasty is not viable in the longer term and thus arthrodesis is preferable. The few published reports of ankle fusion for rheumatoid arthritis show that it is not a simple alternative and that complications of

Figure 9 Bath Ankle arthroplasty before (left) and after (right) resection of the distal fibula.

surgery are common. Thus Smith S R *et al*, commenting on the results of 30 ankle fusions observed that 12 (40%) developed wound breakdown and infection and 12 (40%) non-union, six patients requiring further attempts at fusion.¹⁵ Of 25 operations reviewed after an average of four years' follow up, 52% were considered good or excellent, 38% fair, and 10% poor. Although emphasising the technical difficulties and high morbidity, they still concluded that arthrodesis was the procedure of choice. Similarly, Smith and Wood reporting on 11 fusions by the Charnley compression technique noted that four (36%) suffered pin track sepsis and two (18%) delayed union, though eventually 100% fusion resulted.¹⁶ Neither of these papers discusses the significant problem of the disabled patient having to avoid weight bearing for six weeks—during which, in our experience, the weightbearing ankle and foot often deteriorate, nor do they discuss difficulties posed by fusion of both ankles. Further, we have found that Charnley clamps inhibit independent mobility in these frail patients and often damage the fragile skin of their other leg. For these reasons we have abandoned this method.

Cracchiolo has noted the extensive range of fusion techniques published and divides them into four groups¹⁴: (a) using compression clamps, (b) using the fibula as a strut graft, (c) using the tibia as a transposed graft, and (d) a dowel technique and others. He emphasises that the final choice depends on the actual disease, previous incisions and internal fixation devices, and individual preference. Latterly, we have favoured an anterolateral approach, dividing the fibula at the level of the joint, which provides good access to clear the joint surfaces and to correct deformity; a curved gouge is useful in preparing the medial malleolus. Satisfactory cancellous bony contact is usual and can be supplemented with cancellous bone from the fibula, tibia, or os calcis. The position is adjusted and held with three or more wire staples at tibiotalar level while the distal fibula is stapled into the talus and beneath the tibia,

though the latter is not essential. A plaster back slab is applied and changed to a full cast at two weeks. Weight bearing is avoided for six weeks after surgery and then a weightbearing cast is fitted until there is radiological fusion.

The angle of fusion is highly critical. Buck *et al* studied the optimum position by gait analysis in 19 patients after fusion for trauma.¹⁷ They concluded that the best position was neutral, 0–5° of valgus, and 5–10° of external rotation, and noted that 5° of dorsiflexion was better tolerated than 5° of plantar flexion. We are in complete agreement that plantar flexion must be avoided at all costs and find that most rheumatoid patients are best in slight dorsiflexion (fig 10), though patients with a knee flexion contracture need at least 10° of dorsiflexion.

Ankle joint replacement

If both ankles are severely disabled the question of ankle arthroplasty arises, on at least one side, especially if there is bilateral tarsal ankylosis and fixed great toes. For these patients arthroplasty offers potential advantages compared with arthrodesis, including a quick return to weight bearing often without splintage or apparatus.

Since Buchholz¹⁸ and Lord¹⁹ first reported ankle arthroplasty with modern materials in 1973 a variety of prostheses have become available. Most of these are constrained prostheses designed to reproduce dorsiplantar flexion in the sagittal plane only; the Lord, Smith,²⁰ and Bath²¹ joints, however, have a spherocentric configuration, which permits unconstrained motion, including supination and pronation. The rationale for using such a 'ball and socket' joint is derived from observations that, when the intertarsal joints are fused, the ankle joint can develop polyaxial motion to compensate for the loss of subtalar and mid-tarsal motion. Thus children with congenital tarsal fusion (fig 11), children after Still's disease, and adults after longstanding rheumatoid arthritis may form ball and socket ankle configurations and present polyaxial foot movement.

In 1979 Demottaz *et al* studied 21 total ankle replacements, of which 16 were for rheumatoid arthritis, with an average follow up of 14.7 months.²² Seven of the joints were Smith or similar multiple axis joints, while the remainder were single axis articulations, principally of the Mayo design. The follow up was very comprehensive and included gait analysis and electromyographic studies. Pain relief was considered complete in only four instances, while radiolucent lines were present in 19 joints, of which two were loose. In this small series with a short follow up no significant difference between the two groups was observed. They concluded that ankle arthrodesis was the preferred operation, except for elderly patients with limited midtarsal motion. In 1985, Bolton-Maggs *et al* followed up 41 of 62 uniaxially designed Imperial College London Hospital ankle prostheses inserted between 1972 and 1981 (mean follow up 5.5 years), during which the prosthesis was modified several times and both anterior and posterior

Figure 10 Spontaneous tarsal fusion followed by surgical ankle arthrodesis in slight dorsiflexion.

Figure 11 Congenital tarsal fusion with 'ball and socket' ankle providing universal motion.

approaches were used.¹³ Of 34 arthroplasties for rheumatoid arthritis, seven were lost to follow up, five underwent arthrodesis for loosening, and 22 were reviewed. Pain was absent in seven, mild in seven, moderate in five, and severe in three. The average range of movement changed from 18° to 23° and walking ability was generally improved. Only six rheumatoid arthroplasties were considered fully satisfactory, and it was concluded that total ankle replacement could not be recommended as a long term solution. They also noted, however, that arthrodesis in rheumatoid arthritis might be less satisfactory than in osteoarthritis.

In a review editorial stimulated by the latter paper Hamblen considered that the ankle could not be replaced reliably by current prostheses but expressed the view that improved uncemented designs might reverse that conclusion.¹²

Other reports have been more optimistic. In 1982 Herberts *et al* reporting on 18 ICLH prostheses, 13 for rheumatoid arthritis, at a mean of 36 months, concluded that ankle arthroplasty has a definite place in the treatment of severe arthritis in rheumatoid patients.²³ They considered that the osteoarthritic ankle did less well and found a high incidence of loosening and radiolucent zones. In 1984 Lachiewicz *et al* reporting on 15 uniaxial arthroplasties (14 of the Mayo type) all for rheumatoid arthritis, at a mean of 39 months, noted gratifying pain relief and rated seven ankles excellent and eight good.²⁴ Nevertheless, 11 ankles developed radiolucent lines and six components showed evidence of subsidence.

Our own experience supports the view that arthroplasty benefits the severely disabled rheumatoid patient with bilateral hindfoot disease. Of 20 polyaxial Smith prostheses (figs 12 and 13) inserted in 17 rheumatoid patients between 1975 and 1979, 15 were reviewed at a mean of seven years. Six components became painfully loose, two of which were revised and one of which developed infection at 6.8 years and was removed, while nine ankles had little or no pain, though two of these had ankylosed totally. Skin healing was often delayed (fig 8) but ultimately sound in all cases. This experience indicated that the polyaxial concept could provide adequate movement in all planes in the best cases, and was not prone to dislocation. The single thickness design of the Smith joint, however, restricted the surgeon's ability to

Figure 12 (A) Richard Smith ankle joint with steel tibial and polyethylene talar implant. (B) Bath and Wessex ankle joint with polyethylene tibial and steel talar implant.

Figure 13 Smith joint 16 months after operation; in addition, the talonavicular joint was stapled. After seven years the patient was very pleased and able to dance.

Figure 14 A selection of Bath and Wessex ankle trials and implants. Upper row: talar trials. Middle row: tibial trial and polyethylene implant cut to length in the anteroposterior plane. Lower row: talar implants.

accommodate variations of vertical joint space due to individual variations of collateral ligamentous tension. We therefore designed a prosthesis with a polyethylene tibial implant to be cemented in situ under pressure with a special clamp, and a choice of steel talar implants of 2, 3, 4, 5, and 6 mm thickness inserted during os calcis pin traction (figs 12 and 14).

A preliminary report²¹ of these Bath and Wessex prostheses, inserted in 20 patients between 1980 and 1982, at a minimum follow up of three years, was encouraging (fig 15). A fuller account was presented in 1987 at the 16th congress of the International College of Foot Medicine and Surgery, Vienna (Kirkup, unpublished data), when 66 Bath prostheses (1980–85), as well as 24 Smith prostheses (1975–79) were analysed. Of the Bath joints, 57 were for rheumatoid arthritis, including 10 patients with bilateral replacements. Delayed

Figure 15 Bath and Wessex implant in situ showing movement at the implant interface under load, and also radiolucent lines. Note the previous talonavicular arthrodesis. After five years the patient is pleased and able to cycle.

wound healing was seen in 14 patients three of whom while receiving long term steroids developed a low grade infection and sinus formation; one ankle developed a late infection after a trouble free 13 months. All four infected prostheses were removed leading to resolution of the infection and a stable ankylosis after a prolonged period in a cast. At a mean of 4.2 years five patients had died for reasons unconnected with their ankle and one underwent mid-thigh amputation for an infected knee prosthesis.

Of the remaining 47 joints, most had radiolucent lines without symptoms (fig 15). Six were under observation for loosening, while two were revised and one underwent arthrodesis for loosening. Dorsiflexion and plantar flexion improved in 24, was the same in 16, and diminished in seven ankles. Prosupination improved in 20, was the same in 20, and diminished in seven feet. Thirty two ankles were free from pain or experienced discomfort after walking or standing for half an hour, 15 ankles experienced moderate pain on weight bearing, and none experienced severe pain.

Thus, of 57 Bath prostheses, six could not be assessed owing to death or amputation; of the remainder, 44 (86%) were in situ at an average of 4.2 years, and 32 (63%) were either free from pain or experienced discomfort after activity. Although these results are modest and do not compare favourably with current hip and knee replacement arthroplasties, they resemble those of the earlier versions of knee prostheses. Clearly, modifications of ankle prostheses and operative techniques can be expected and may parallel the evolution of knee replacement.

We conclude that for severely disabled rheumatoid patients with bilateral tarsal ankylosis and crippling ankle pain, spherocentric joint replacement is justified on one side and sometimes on both. The advantages include the preservation of hindfoot movement, rapid rehabilitation often without splintage, and improvement of the patients' independence. The disadvantages include a risk of early or late infection, and implant loosening in osteoporotic

bone. Careful selection of patients is essential, and those receiving steroids, those with fragile skin or with severe foot valgus may have to accept either the limitations and risks of arthrodesis or continued conservative management.

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