PT

SURGERY OF THE WRIST IN RHEUMATOID ARTHRITIS

Submitted for the completion of Part III

Degree of Master of Medicine

University of Cape Town

SUBMITTED BY	GARTH GROBLER	MBChB (UCT) FRCS (Edin) FCS (SA)Orth
SUPERVISOR	PROFESSOR ID LEARMONTH	MBChB (Stell) FRCS (Eng) FRCS (Edin) FCS (SA)Orth

DATE 1990

To Wendy, Freda and Tolly

ACKNOWLEDGEMENTS

Professors AWB Heywood and ID Learmonth and Dr R Jaffe performed most of the operations on which this dissertation is based. I would like to thank them for the opportunity to report on their patients.

I would like to thank Professor Learmonth for his support and guidance as a clinician as well as a teacher, Dr A Kalla for his help with the references, Michael Wyeth for the illustrations and Vera Barrow for the typing.

RHEUMATOID ARTHRITIS IS A COMMON, POTENTIALLY CRIPPLING POLYARTHRITIS WITH A VARIABLE INVOLVEMENT IN DIFFERENT ETHNIC GROUPS. THE WRIST IS INVOLVED IN 80% OF PATIENTS, WHILE INVOLVEMENT IS OF SUFFICIENT SEVERITY TO NECESSITATE SURGICAL INTERVENTION IN UP TO 20% OF CASES. THIS DISSERTATION REVIEWS THE AETIOLOGY AND PATHOGENESIS OF RHEUMATOID ARTHRITIS WITH PARTICULAR REFERENCE TO WRIST INVOLVEMENT.

A STABLE, PAIN-FREE WRIST IS AN ESSENTIAL PRE-REQUISITE TO GOOD HAND FUNCTION. A LITERATURE REVIEW IDENTIFIES THE EFFICACY OF SURGICAL PROCEDURES OF THE RHEUMATOID WRIST DESIGNED TO ACHIEVE THIS GOAL.

FINALLY A RETROSPECTIVE CLINICAL AND RADIOLOGICAL REVIEW COMPARING WRIST ARTHRODESIS WITH INTERPOSITION ARTHROPLASTY CARRIED OUT AT THE PRINCESS ALICE ORTHOPAEDIC HOSPITAL IS PRESENTED. THE MERITS AND DISADVANTAGES OF EACH PROCEDURE ARE DISCUSSED.

TABLE OF CONTENTS

PART I

LITERATURE REVIEW

A. RHEUMATOID ARTHRITIS

I.A.1. DEFINITION

Rheumatoid arthritis is a common and widespread form of chronic polyarthritis falling within the classification of diffuse connective tissue diseases. It is characterised by bilateral symmetrical joint involvement with distinctive radiological changes and typical but not diagnostic biochemical findings. There are various diagnostic criteria. The most commonly used were The 1956 American Rheumatism Association criteria. (35) These have however recently been revised into a more workable format with a 91-94% sensitivity and 89% specificity (44), and include the following:

1) Morning stiffness in or around joints lasting at least 1 hour before maximal improvement.
2) Soft tissue swelling (arthritis) of 3 or more joints observed by a physician.
3) Swelling (arthritis) of the proximal inter-phalangeal, metacarpo-phalangeal or wrist joints.
4) Symmetric joint swelling (arthritis)
5) Rheumatoid nodules.
6) Presence of rheumatoid factor.
7) Radiographic erosion and/or peri-articular osteopaenia in hand or wrist joint.

Criteria 1 - 4 must have been present for at least 5 weeks. Rheumatoid arthritis is defined by the presence of 4 or more criteria.

I.A.2 EPIDEMIOLOGY

The prevalence depends on the criteria used but overall rates in an adult population usually vary between 0.3 and 1.5%. Population variations have been shown; for example, the prevalence in urban South African Blacks is 3.3% compared to 0.87% of the rural population. (4) The disease is probably a fairly "modern" one as there is little palaeo-pathological evidence of rheumatoid arthritis before 1800. Some authors have attempted to identify rheumatoid deformities in Rubens paintings; for example, the hand of St Anne in "The Holy Family with St Anne", 1533-1635 (2) and the hand in Jan Gossaert's "The donators", 1525-30(11). These however, are not entirely convincing. (fig 1, 2, and 3)

Fig.1. The donators with close up view of the hand.

Fig.2. The Holy Family with St Anne.

Fig.3. Close up of St Anne's hand.

The term rheumatoid arthritis was first introduced by Garrod in 1859 in his "The Nature and Treatment of Gout and Rheumatic Gout". However it was only at the turn of the century that the terms rheumatoid arthritis, degenerative joint disease and tuberculous arthritis became known as distinct entities.

I.A.3 **AETIOLOGY**

The aetiology of rheumatoid arthritis is unknown but it is probable that an infective agent e.g. the Epstein-Barr virus provides the environmental trigger that acts on a susceptible host (with specific D locus genes) resulting in disordered immuno-regulation giving rise to arthritis. The following theories have been postulated:

a) Infection:

Sera from patients with rheumatoid arthritis contain an antibody which reacts with nuclear antigen (RANA) extracted from human lymphoblast cell lines infected with Epstein-Barr virus (31). It would appear that the rheumatoid lymphocyte is more readily infected by this virus, thus providing the necessary trigger mechanism.

b) Genetic Predisposition

HLA Dw5 occurs 3-4 times more often in adults with rheumatoid arthritis than the normal population. This gene is thought to influence immunological processes that are prominent in the pathogenesis of rheumatoid arthritis.

c) Auto-immune Reaction:

In active rheumatoid arthritis OKT5 (suppressor T cells) numbers and function are decreased which points to abnormal immuno-regulation.

It is likely that when the eventual cause of rheumatoid arthritis is found it will be due to numerous aetiological agents and interactions.

I.A.4 **PATHOGENISIS**

The precise mechanism is still to be delineated. Synovial reaction is thought to be the earliest event in rheumatoid arthritis. The antigen (post infective) gains access to the joint via the circulation and triggers a local antibody-antigen reaction resulting in the activation of complement. Increasing vascular permeability follows which results in exudation of fluid and leucocyte migration. A diversity of substances including prostaglandins, superoxides and proteolytic enzymes such as collagenases, elastases and cathepsin D and G are thus released. These in effect melt surrounding tissues and result in the features of articular damage characterised by erosive dissolution of cartilage and bone. Rheumatoid factors which are measured are in fact immuno-globulins directed against the FC portion of IgG. Although IgM is the most often measured, IgG has recently been shown to be self

associated which may be significant in those patients that are IgM negative.

The cause of the chronicity of the disease is not clear. It could be due to persistence of foreign antigen, the development of auto antigens, a defective host response or a combination of these. Whatever the process, an inflammatory synovial mass called pannus develops. Although not malignant in a neoplastic sense, the pannus is aggressive and invades and destroys joint tissues. (fig. 4)

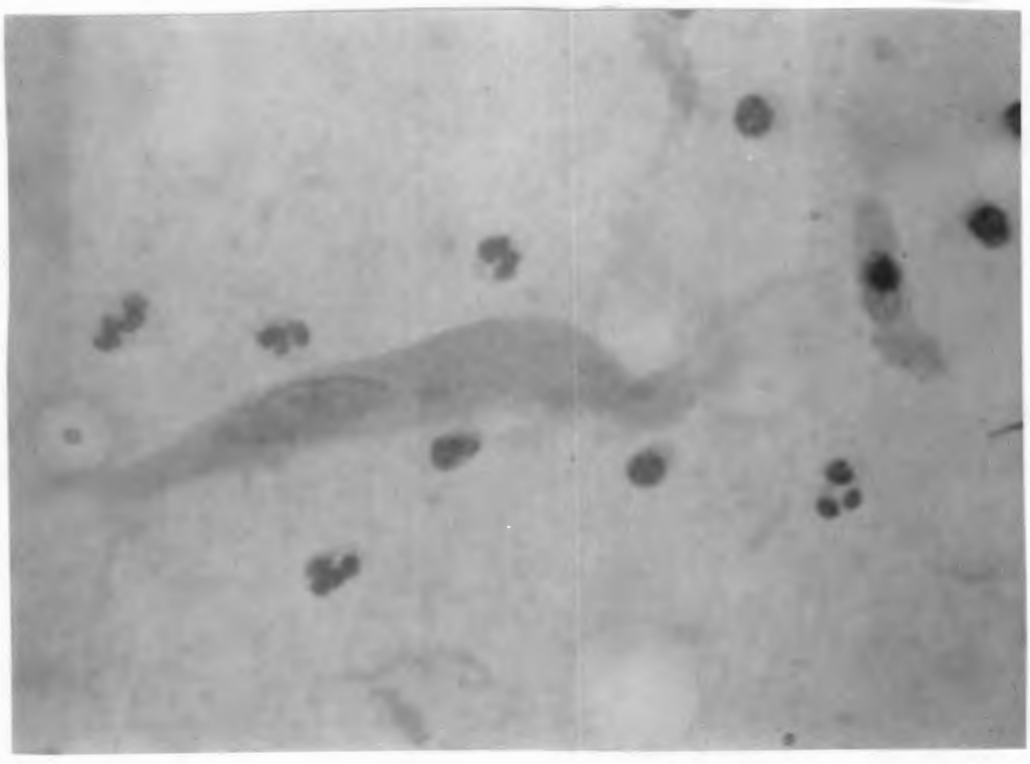
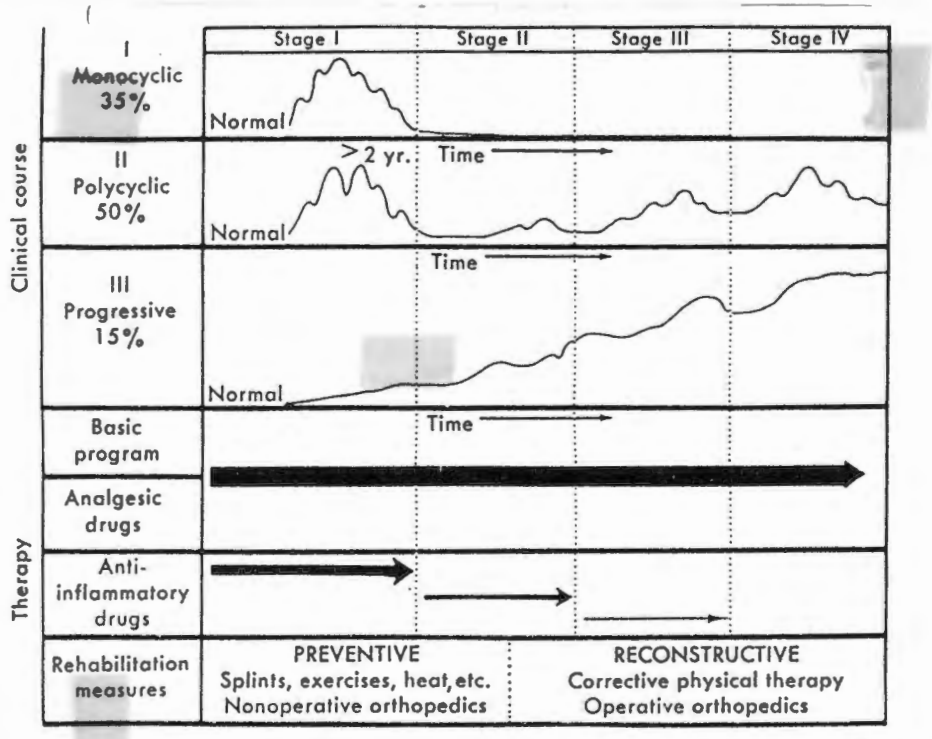


Fig.4. Large bizarre cell with abnormal nucleus showing features of a sarcomatoid cell.

I.A.5. PRESENTATION AND NATURAL HISTORY

The onset of rheumatoid arthritis peaks in the 35-45 year age group and is 2.5 times more common in females than males.

The course of the disease varies as shown in fig 5.



Course of rheumatoid disease. The upper half shows three hypothetical clinical courses of rheumatoid disease, with early disease (Stage I) on the left and more advanced stages extending toward the right. Increases and decreases in disease activity are shown in the perpendicular axis, and time along the horizontal axis.

Certain features are unfavourable:

a) Insidious onset

b) Early large joint involvement

c) Persistent active disease for more than 1 year

d) Positive serology in the first year

e) Early erosions and nodules

f) Males

Joint destruction is dependent on the severity of active disease and its duration.

Time x Inflammation = Destruction

The end result is therefore unpredictable.

The reported frequency of patients that require surgery is dependent on a number of factors such as the selection of patients for study - e.g. whether a survey is conducted in the community or in a specialised arthritis unit, the age of the patients, duration of the disease and the availability of surgical expertise. In 1986 Mody (30) studied 255 patients with rheumatoid arthritis at the Princess Alice Rheumatology Unit and found that 49.2% of the patients underwent surgery. More specifically 18.8% of patients had surgery performed at the wrist joint. (fig 6).

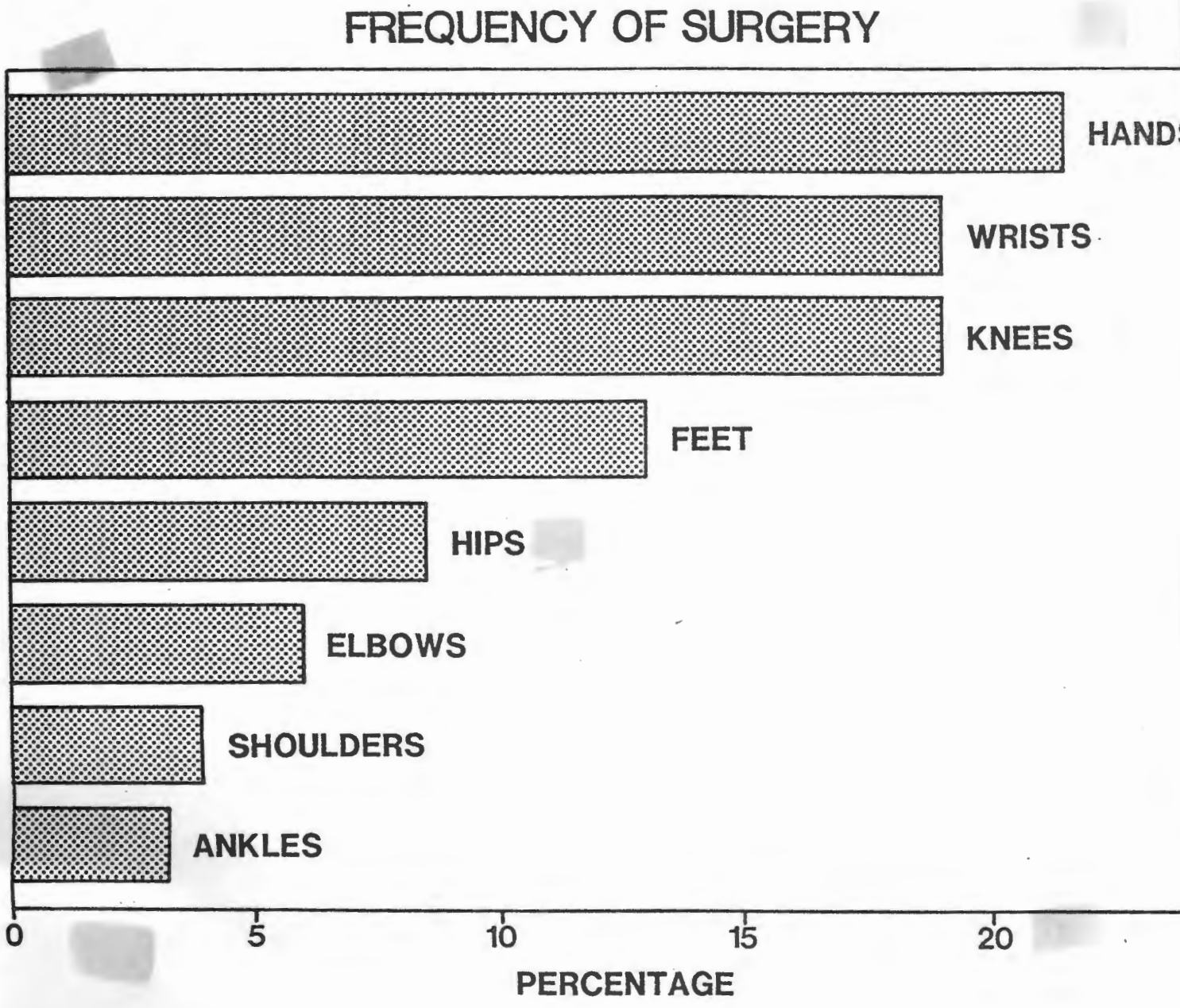

FREQUENCY OF SURGERY
HANDS
WRISTS
KNEES
FEET
HIPS
ELBOWS
SHOULDERS
ANKLES
0
5
10
15
20
PERCENTAGE

Fig.6.

B. THE WRIST IN RHEUMATOID ARTHRITIS

I.B.1. FREQUENCY OF INVOLVEMENT

The wrist is involved in more than 80% of patients with rheumatoid arthritis. (8)

I.B.2. CLINICAL EVALUATION

Evaluation of the wrist in patients with rheumatoid arthritis cannot be made in isolation as the overall clinical profile may alter the management strategy at the wrist. Other joints may be in need of more urgent intervention; intubation at anaesthesia may be dangerous in the presence of neck instability ; weight bearing joint involvement may necessitate the patient using crutches.

At the wrist joint synovitis leads to pain, swelling, limitation of movement and weakness. Dorsal synovitis is easier to detect because the dorsal structures lined by synovium are more superficial and are covered by thinner, less restrictive ligaments and capsules. Dorsal and volar tendons may be involved and rupture due to synovial invasion and attrition against bony spicules may occur e.g. rupture of extensor pollicus longus at Lister's tubercle or rupture of the ulna finger extensors at the exposed ulna head. Rupture of the dorsal wrist extensors is important because the resultant wrist instability will influence the choice

of surgical procedure. Progressive erosion produces deformity due to destruction of soft tissue and bony structures. Certain patterns of deformity occur :

a) Dorsal subluxation of the distal ulna with volar subluxation of, in particular, the ulna half of the carpus, while the metacarpals angulate radially. The nett effect is one of supination of the carpus and metacarpals in relation to the forearm (fig 7)

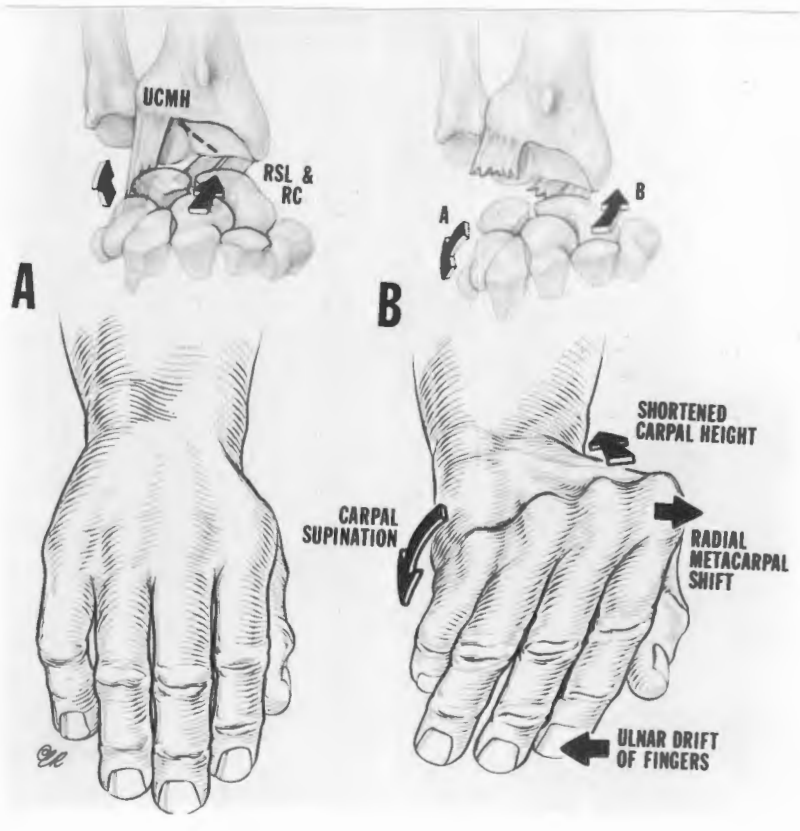


Fig.7.

b) Another pattern of deformity occurs with palmar dislocation of the carpus (fig 8) and

Fig.8.

c) ulna translocation of the carpus with a prominent radial styloid (fig 9)

Fig.9.

The end result in a patient with progressive involvement of the wrist without treatment is one of severe pain, deformity and significant loss of function.

I.B.3 RADIOLOGY

The earliest radiological sign is soft tissue swelling. Later juxta-articular osteoporosis and marginal erosion occurs. Later changes are joint space narrowing and bone destruction. Bony ankylosis is uncommon but may occur. The severity of the disease has been graded radiologically by Larsen et al (21)(figs 10 - 14) into:

0	:	Normal
I	:	Slight abnormality : soft tissue swelling, osteoporosis
II	:	Definite early abnormality : joint space narrows. Erosion of non-weight bearing joints only.
III	:	Medium destructive abnormality : erosion in all joints.
IV	:	Severe destructive abnormality : bone destruction in weight bearing joints.
V	:	Mutilating abnormality : gross bone destruction.

Fig.10. Larsen Stage I in the right wrist.

Fig.11. Larsen Stage II in the left wrist.

Fig.12.
Larsen stage III.

Fig.13. Larsen Stage IV in right wrist.

Fig.10. Larsen Stage I in the right wrist.

Fig.11. Larsen Stage II in the left wrist.

Fig.12.
Larsen stage III.

Fig.13. Larsen Stage IV in right wrist.

Fig.14. Larsen Stage V in right wrist.

Disease progression can also be determined by the Carpometacarpal Ratio (CMC ratio) (fig10) (1) which is less cumbersome than the Larsen Dale and Eek method. The numerator is the length of the carpus from the vola/ulna margin of the distal radius to the base of the 3rd metacarpal and the denominator the greatest length of the 3rd metacarpal. This method has been found to be statistically reliable for progression by independent authors when compared to the method of Larsen (1). The normal ratio is 0,54 +/- 0.03. (fig 15)

Fig.15.

Simmen (38) has suggested that the following three different types of wrist disease could be recognised in the early stages of the rheumatoid process by looking critically at various radiological parameters:

1: RA - ankylosis : particularly characteristic in patients with juvenile onset of rheumatoid arthritis.

2: RA with osteoarthritis : the inflammatory process appears to be in equilibrium with the secondary degenerative changes.

3: RA with destruction and disintegration : mechanisms of disintegration include :

   a) advanced erosive disease with carpal collapse and deformity

   b) extensive loss of bone substance characteristic of arthritis mutilans and

   c) predominant destruction of the ligamentous structures resulting in severe ulna translocation, scapho-lunate disassociation and rotatory subluxation of the scaphoid.

Simmen felt that it was particularly important that patients in group 3 be identified as they required some additional procedure to obtain stabilisation at the wrist joint.

I.B.4 TREATMENT

Adequate treatment of patients with rheumatoid arthritis can only be accomplished by a dedicated team comprising rheumatologists, orthopaedic surgeons, physiotherapists, occupational therapists, nurses and social workers. Treatment protocol is decided initially by the rheumatologist and at a later stage prophylactic and corrective surgical decisions are made in conjunction with an orthopaedic surgeon. The modern concept is that of a Cooperative Care Programme in which the patient is part of the Executive that makes the final management decisions.

MEDICAL MANAGEMENT

Three broad groups of drugs are used by the rheumatologists.

A) Drugs providing symptomatic relief such as analgesics and non-steroidal anti-inflammatory agents

B) Disease modifying agents including gold, penicillamine, cytotoxic drugs etc.

C) Cortico-steroids. The use of cortico-steroids is contentious, but local intra-lesional and intra-articular steroid therapy is often indicated.

These agents, in conjunction with rest and splintage, are sometimes sufficient to preserve function and prevent deformity. If not, surgical procedures are then indicated.

SURGICAL MANAGEMENT

A detailed assessment of the patient as a whole is an essential pre-requisite to the successful planning and execution of surgical treatment of the rheumatoid hand. In particular the decision whether to operate must emerge from a careful evaluation of the severity of the patients symptoms, signs and physical disability against the benefits which are likely to accrue from surgical treatment assessed in relation to the patients own individual requirements. Procedures are used to relieve pain, restore function, achieve cosmetic improvement and prevent further damage but must avoid further compromise to the already impaired function of the hand. These include synovectomy, capsular or ligament repair, tendon transfer and repair, partial or total arthrodesis and arthroplasties. William Souter (40) quotes Proverbs 4:7

"Wisdom is the principle thing;
therefore get wisdom: and with all
thy getting, get understanding"

Perhaps nowhere in the field of reconstructive surgery is the truth enshrined in these much quoted words more than in the care of the rheumatoid hand.

The surgical programme must be tailored to the individual patient and the mere existence of

deformities is not necessarily an indication for surgery. A brief review of the place of synovectomy introduces an in depth discussion of the Bone and Joint procedures.

SYNOVECTOMY

Synovectomy was initially performed for tuberculosis. It was only much later that reports of synovectomies for rheumatoid arthritis began appearing in the literature (44). The procedure later fell into disfavour because of the indiscriminate use in patients with advanced disease. However it was later resurrected (45) after it became apparent that bone and tendon damage began and remained confined for long periods of time to areas in close contact with diseased synovium. Synovectomy was performed most frequently in the larger joints and has only recently become acceptable in the wrist joint (6,15,20,23,27,28,40). It is indicated in patients with persistent, uncontrolled, slowly progressive synovitis after six months of adequate medical treatment, particularly if radiological changes are early or absent. The operation affords excellent relief of pain and prevention of tendon ruptures. Mongan (32) reported that 67% of their patients showed progressive x-ray changes post-operatively. Eikem (12) reviewed 314 synovectomies and concluded that the hope that synovectomy might arrest or prevent progression of

skeletal changes was not realised. Namba (44) reviewed 36 patients with bilateral disease who had unilateral synovectomies and concluded that destruction progressed bilaterally but that there was less pain and disability on the operated side. While the place of synovectomy in the management of rheumatoid joint disease remains contentious, its use at the wrist combined with extensor synovectomy remains unchallenged.

BONE AND JOINT PROCEDURES

(i) TOTAL ARTHRODESIS

Radio-carpal arthrodesis is an accepted method of treatment for patients with advanced destruction of the wrist joint in rheumatoid arthritis. Up to 1970 a number of techniques had been described using autografts following joint resection as well as immobilisation in plaster of Paris (24).

Grafts from the radius or ulna		Grafts from the tibia	
a: Stein	1953	a: Davidson	1954
b: McKenzie	1960	b: Campbell	1964
c: Davidson	1963	c: Stzernsward	1967
d: Danielson	1963	d: Hoddard	1967
e: Clayton	1965	e: Schwartz	1970
f: Schwartz	1967	f: Allgower	1970
g: Dupont and Vainio	1968		

The average time for immobilisation in these cases was 2-4 months. Such long periods of immobilisation were contra-indicated in patients with advanced rheumatoid arthritis. In addition fractures occurred of the donor graft as well as at the donor site, ie tibia and radius. Because of these limitations new techniques were developed and published by Mannerfelt and Malmsten in 1971 (24) and by Millender and Nalebuff in 1973.(29)

MANNERFELT ARTHRODESIS

Mannerfelt reported on 124 wrist arthrodeses for varying pathologies in which the joint was excised and fixed with a Rush pin passed down the 3rd metacarpal across the carpus and up the radius. "Compression" was obtained via staples in order to prevent rotation.

In 43 patients with rheumatoid arthritis, successful fusion was achieved in 42 patients. The complications were:

i) Sepsis in one case requiring removal of Rush pin with failure of fusion.

ii) Extensor tendon adhesion requiring tenolysis in one cases

iii) Carpal tunnel syndrome in 2 cases requiring decompression.

NALEBUFF ARTHRODESIS

The Mannerfelt technique of arthrodesis was modified by Nalebuff who passed a Steinman pin between the metacarpals across the carpus and into the radius. As the size of the pin was not determined by the diameter of the metacarpal a larger pin could be used, affording better purchase in the radius. The length of the incision is shorter and size of skin flap therefore smaller which it was felt would lead to fewer complications.

Nalebuff reported on 70 wrist fusions performed between 1965 and 1972 with successful arthrodeses in all but 2 cases. His complications included:

1. Wound sepsis in two cases.
2. Pseudo-arthrosis in two cases resulting from premature removal of the Steinman pin.
3. Distal migration of the pin which required removal in 12 cases : 4 of these subsequently required immobilisation in plaster of paris.

The technique was later modified by using staples and countersinking the pin. No further problems of pin migration were encountered, although the number of cases reviewed was not reported.

Despite the greater number of complications encountered using this technique, these were of a relatively minor nature and the procedure itself was technically easier. These two procedures were subsequently widely practised in many rheumatoid units internationally. Ryan, Visser and Barton and Clayton all reported 100% fusion rates using these techniques.

INDICATIONS FOR ARTHRODESIS

The following authors have identified a variety of indications for wrist arthrodesis in RA : Mannerfelt, Nalebuff, Clayton (7), Souter (40), Straub (41), Swanson (42), Volz (50), Meuli (26) and Flatt (14).

Generally accepted indications include:

1. Gross joint destruction
2. Ruptured wrist extensor tendons
3. Patients requiring permanent use of crutches
4. Very poor bone stock especially of radius
5. Very unstable joints
6. Severe flexion deformity

However a large group of patients will not meet these indications and their management remains contentious. Although bone stock and stability are not severely compromised, advanced disease excludes synovectomy as a useful alternative. In these patients some authors would prefer arthroplasty to arthrodesis. (26, 36, 42, 48)

OPTIMAL POSITION OF ARTHRODESIS

Most authors agree to fusing the wrist in the neutral position. When bilateral wrist fusions are performed, 5 to 10 degrees of palmar flexion is acceptable in order to facilitate certain functions, particularly those of toilet and personal hygiene. Teleisnick (44) quotes Clayton's explanation for adopting the neutral position (fig 16): with the wrist in neutral, the point of thumb-to-fingertip contact is approximately 7,5cm palmar to the axis of rotation of the forearm and can, in consequence, traverse a much greater arc from full pronation to supination and vice versa allowing a less awkward placement of the hand in space. A dorsiflexed position is generally reserved for the more active patient with unilateral degenerative arthritis.

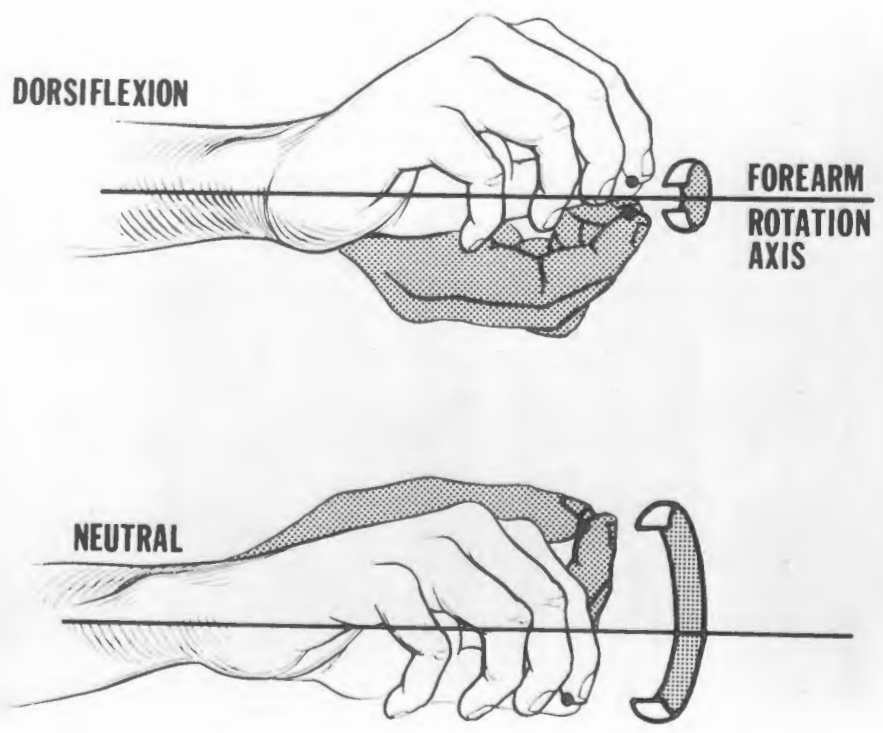


Fig.16.

FUNCTIONAL RESULTS OF ARTHRODESIS

Successful arthrodesis is clearly not difficult to achieve in rheumatoid arthritis patients. What then are the functional results of a stiff wrist in these patients? The procedure may improve or detract from upper limb function. The abolition of pain which contributes to functional improvement is universal in a successful arthrodesis. Positive aspects reported include increased strength and stability, better pinch and grip strength and increased dexterity (eg typing, shaving, guitar playing etc). Certain functions were however compromised, including writing, the use of eating utensils, picking up objects from the floor and personal hygiene. Nine patients with bilateral fusions would have preferred more dexterity in one hand (Vicar and Burton) (49) while four who had one arthrodesis and one arthroplasty selected the non-dominant hand for fusion.

(ii) **WRIST ARTHROPLASTY**

Interposition or replacement arthroplasty are indicated in candidates where the preservation of motion is a priority. Meuli (26) attributes to Beyer, a German military surgeon, the first wrist joint resection arthroplasty performed in 1709. In 1767 Doedali presented a 28-year follow up of what may have been the first successful arthroplasty in a patient with rheumatoid arthritis performed in 1737 by a Swiss surgeon, Hans Budliger.

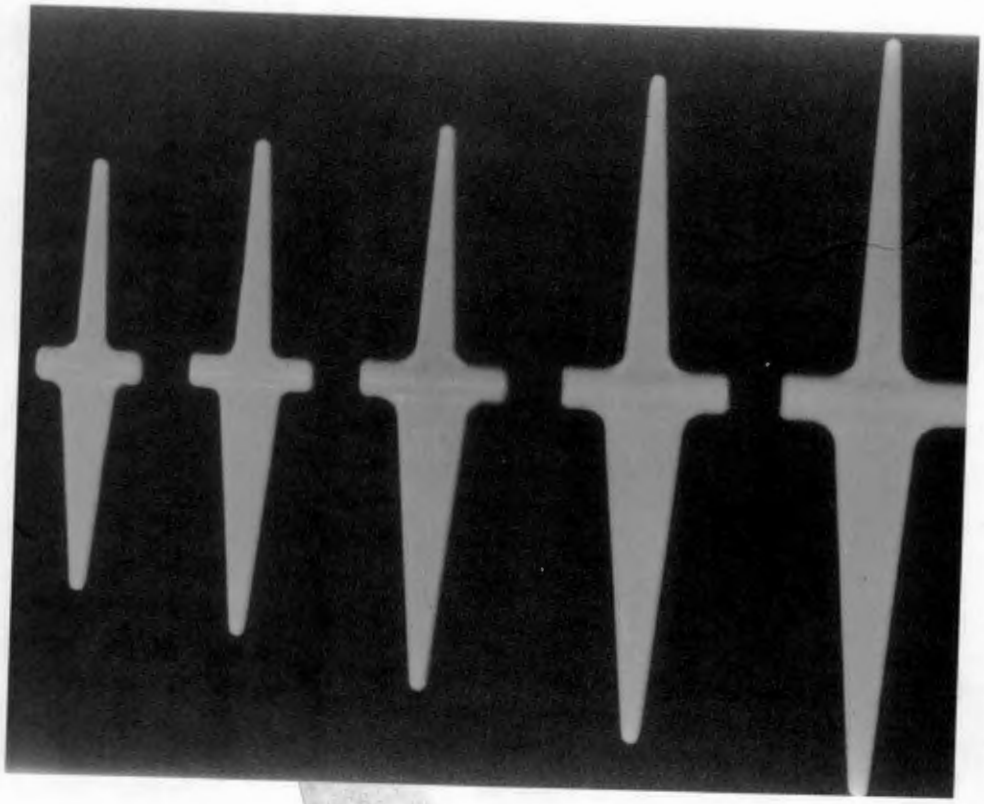
SILASTIC IMPLANT ARTHROPLASTY

In 1967 Swanson (43)(fig 17) developed a silicone radio-carpal implant that acted as a joint spacer to afford relief of symptoms and correct deformities whilst maintaining joint movement. A few degrees of wrist movement will increase the reach of the fingers in space by 5 or 6 cms, thus greatly improving their functional potential.

Alfred B. Swanson

Fig.17.

Organo-silicone research began in 1890 at Nottingham University where new resins were formulated called "silicones" that have no counterparts in nature. Because of their excellent insulating properties, resistance to heat and cold, imperviousness to moisture and weathering qualities, they are of great value in industry as well as in medicine. The basic raw material is silica, the main ingredient of common sand. Pure silicon (SiO2) heated with charcoal at white heat combines with oxygen to form silicone. This compound is further purified and modified to eventually yield Silastic. Four different designs were initially developed by Swanson. The eventual implant was a double stemmed, flexible hinge with a barrel-shaped mid-section slightly flattened on the dorsal and volar surfaces. The core contained a dacron reinforcement to provide axial stability and resistance to rotatory torque. From 1974 high performance Silicone elastomere was used which had been tested to 200,000,000 flexion repetitions to 90 degrees without evidence of material fatigue or fracture. The implant comes in five different sizes (fig 18).



18.

Swansons indications for interpositional arthroplasty are :

1. Instability of the wrist due to subluxation or dislocation of the radiocarpal joint.
2. Severe deviation of the wrist causing musculotendinous imbalance of the digits.
3. Stiffness or fusion of the wrist in a non-functional position.
4. Stiffness of the wrist when movement is a requirement for hand purchase function.

He believes that arthrodesis of the wrist is not a good operation although the indications overlap. Contra-indications given by other authors include previous sepsis, crutch walking, absent wrist extensors and deficient radial bone stock.

RESULTS

Table 1 reflects the results of a number of series of Swanson interpositional arthroplasties :

	No. of cases	Follow-up (years)	Fractures	Resorption	Revisions
Hardock	51	1	4%	6%	4%
Fatti	53	2	9%	?	25%
Gschwend	48	3	10%	20%	?
Brunelli	20	4	5%	0	5%
Swanson	150	4	10%	?	14%
Basio	71	4	20%	?	25%
Comstock	20	6	65%	"progressive"	30%

Table I

The series with longer term follow up show increasing failure rates with time which includes implant fracture and bone resorption. There are no long term results published of the use of metal grommets which were designed to overcome the high fracture rates.

TOTAL WRIST ARTHROPLASTY

In 1971 Meuli (36) introduced a metal-polyester prosthesis with its stem cemented proximally in the radius and distally in the 2nd and 3rd metacarpals. (fig 19)

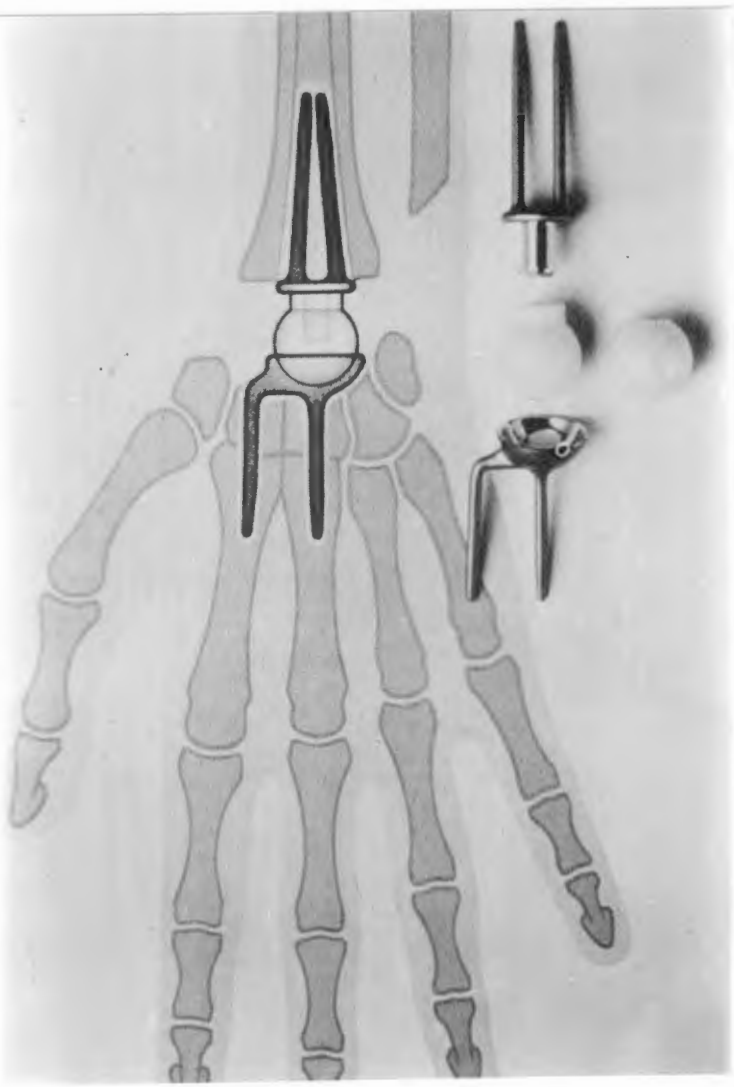


Fig.19.

In 1979 Volz reported on the use of his metal-polyethylene prosthesis. (48)

The Guepar prosthesis was designed in 1979 and also consists of metal and polyethylene.(36)

All these prostheses are technically difficult to insert and have a high failure rate. Revision to another arthroplasty or an arthrodesis is difficult to achieve because of loss of bone stock. They are not widely used internationally and we have a very limited experience with them in the Arthritis Unit at The Princess Alice Orthopaedic Hospital.

PART II

A RETROSPECTIVE ANALYSIS AND COMPARISON OF PATIENTS WITH RHEUMATOID ARTHRITIS OF THE WRIST TREATED EITHER BY ARTHRODESIS OR SILASTIC INTERPOSITIONAL ARTHROPLASTY

II.A. ABSTRACT

In this study patients with inflammatory arthritis who had undergone either a wrist arthrodesis or a Swanson silastic wrist arthroplasty at The Princess Alice Orthopaedic from 1976 - 1988 were retrospectively reviewed.

Follow up period for arthrodesis was 65 months with a range of 12 - 168 months and for arthroplasty a mean of 44.7 months with a range of 12 - 98 months.

Solid arthrodesis was obtained in 44 of 47 wrists and of the 3 failures, only 1 was symptomatic.

Arthroplasties were successful in 11 of 16 cases with fractures of the implant being the major complication.

An analysis of the results is made in terms of the clinical and radiological findings as well as of patient satisfaction.

II.B. WRIST ARTHRODESIS

a. Material and Method

A retrospective analysis of patients with inflammatory arthritis having undergone an arthrodesis of the radiocarpal joints at the Princess Alice Orthopaedic Hospital between 1976 and 1988 was carried out.
Forty-seven wrist arthrodeses in 40 patients were reviewed. There were 33 female and 7 male patients. The mean age at surgery was 44 years and the range was 17 to 78 years. The mean follow up time was 65 months with a range of 12 to 168 months.

The principal indication for surgery was pain in 40 wrists and loss of function in 7 wrists.

Pre-operative carpal deficiency was evaluated in all wrists on a Grade from I to III. In Grade I (fig 20) the loss of carpal height was less than 25% and this was present in 4 wrists. In grade II (fig 21) the loss of carpal height was 25 - 50% and this was present in 12 wrists. In Grade III (fig 22) the loss of carpal height exceeded 50% and this was found in 31 wrists.

Fig.20. Grade I.

Fig. 21. Grade II.

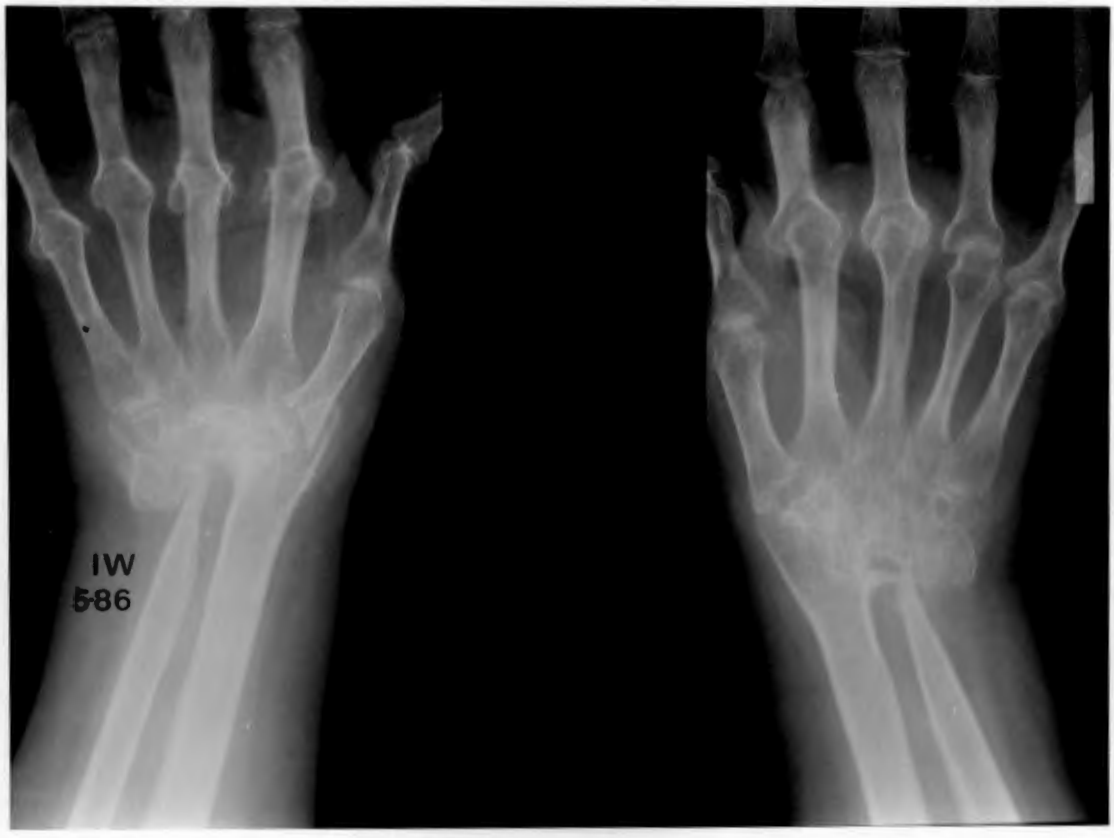


Fig.22. Grade III.

Surgical Technique

i) Synovectomy

This technique is described as it is performed concomitantly with an arthrodesis or an arthroplasty. A dorsal longitudinal incision is centred over the wrist joint. The skin flaps are maintained at full thickness by dissecting directly down onto the dorsal retinaculum (fig 23). Care must be taken not to injure the cutaneous branches of the radial and ulna nerves. The entire expanse of the retinaculum is exposed and elevated starting from the ulnar side. If a synovectomy alone or a Swanson arthroplasty is to be performed, a step-cut retinacular incision is made with the tongue being used to retain the extensor carpi ulnaris in a more dorsal position at the completion of the procedure. If combined with an arthrodesis, a straight incision will suffice. All the dorsal tendons are exposed and a tenosynovectomy performed (fig 24). The extensor tendons are retracted and the dorsal wrist capsule is divided and retracted proximally. The articular stage of the procedure is then completed using a small nibbler (fig 25). The retinaculum is repaired deep to the extensor tendons with a separate sling for extensor carpi ulnaris if indicated (fig 26). The skin is closed and a pressure dressing applied.

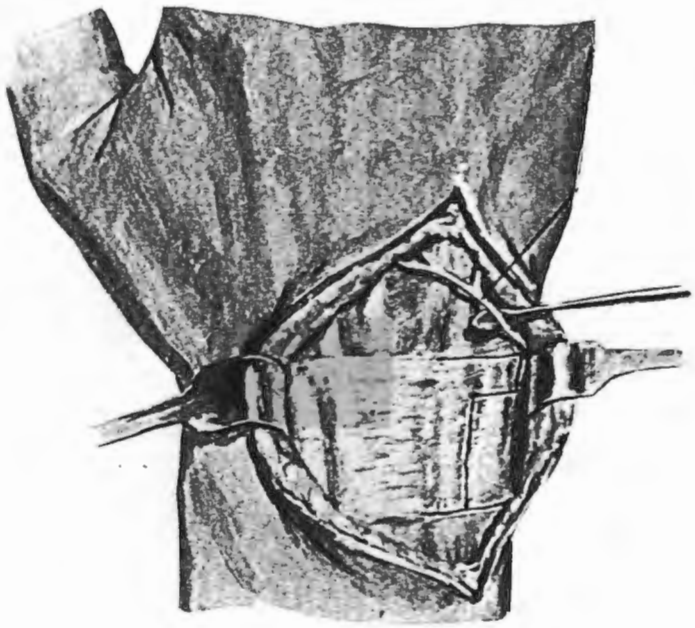


Fig. 23.

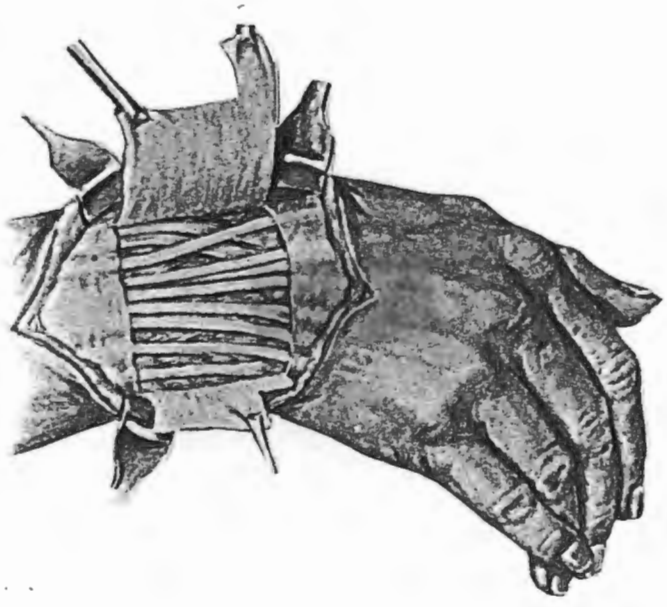


Fig. 24.

Fig. 25.

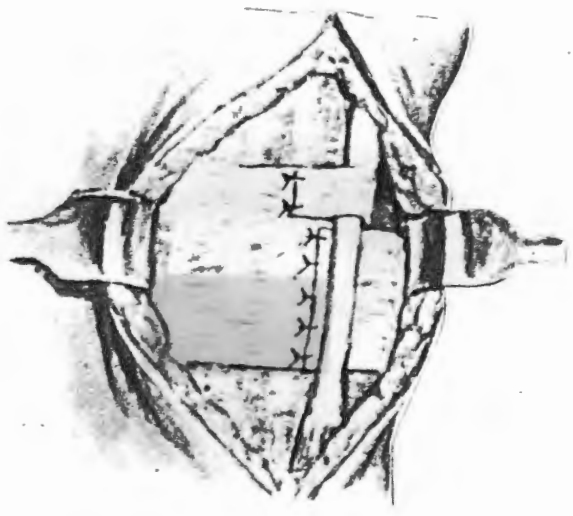


Fig. 26.

ii) **Mannerfelt Arthrodesis**

The carpal bones are exposed as per synovectomy. All joint surfaces are excised exposing cancellous bone. The cortex of the third metacarpal is breached on the ulnar side and a Rush pin is passed from a distal direction along the medulla of the third metacarpal through the capitate and the lunate and up the radial shaft whilst the carpus is held in a reduced position (fig 27). The Rush pin is driven home to the crook. The wrist will lie in a slight volar flexed position. The pin may then be bent dorsally to achieve a neutral wrist position. Care must however be exercised as the bone is osteoporotic and may easily fracture. Closure is obtained with re-routing of the extensor tendons. A one-eighth inch drain is inserted and a pressure dressing applied.

Fig. 27.

iii) **Nalebuff Arthrodesis**

The carpus is exposed as previously described. The cartilage and sclerotic bone are rongeured from the distal radius and carpal bones. The medullary cavity of the radius is entered with a pointed awl and the size of the cavity is judged. The appropriate Steinmann pin is then carefully drilled through the carpus to exit between the second and third or between the third and fourth metacarpals depending on the alignment required. The pin is then tapped into the radius and counter-sunk into the intermetacarpal space (fig 28). One or two staples may be used to span the radiocarpal joint to provide additional stability in very unstable situations (fig 29). The wound is closed over an one-eighth inch suction drain and a pressure dressing applied. No additional splinting is required.

Fig. 28.

Fig. 29.

Thirty seven of the wrists were arthrodesed in a neutral position, five in 5-10 dorsiflexion and three in 5-10 palmarflexion.

b. Results

A solid arthrodesis was obtained in 44 of 47 wrists. The soundness of the arthrodesis was determined clinically and by the absence of any radiolucency around the fixation pins. Two of the 3 mobile wrists were asymptomatic and functionally acceptable. One wrist was mobile and painful and this constituted the only poor result.

c. Function

In all the wrists, excluding the one failure, function was improved because of pain relief and stability of the joint. None of the 7 patients that had bilateral arthrodesis volunteered any functional disability. One patient had an arthrodesis on the non-dominant side and a Swanson arthroplasty on the other. This patient has some residual pain following the arthroplasty and therefore changed hand dominance to that of the arthrodesis. All patients with severe rheumatoid arthritis affecting their hands and wrists will have a degree of functional disability irrespective of the type or success of surgery. It is difficult to objectively quantify the contribution of one joint to function against a background of polyarticular involvement and deformity. Functional restoration of an independent ability to cope with the activities of daily living is a realistic and satisfactory goal.

d. Complications

Two patients developed wound dehiscence that required formal secondary suturing.

Pin placement escaped the confines of the radial medullary cavity in 2 patients (fig 30) and we now routinely use Image Intensification Control in theatre.

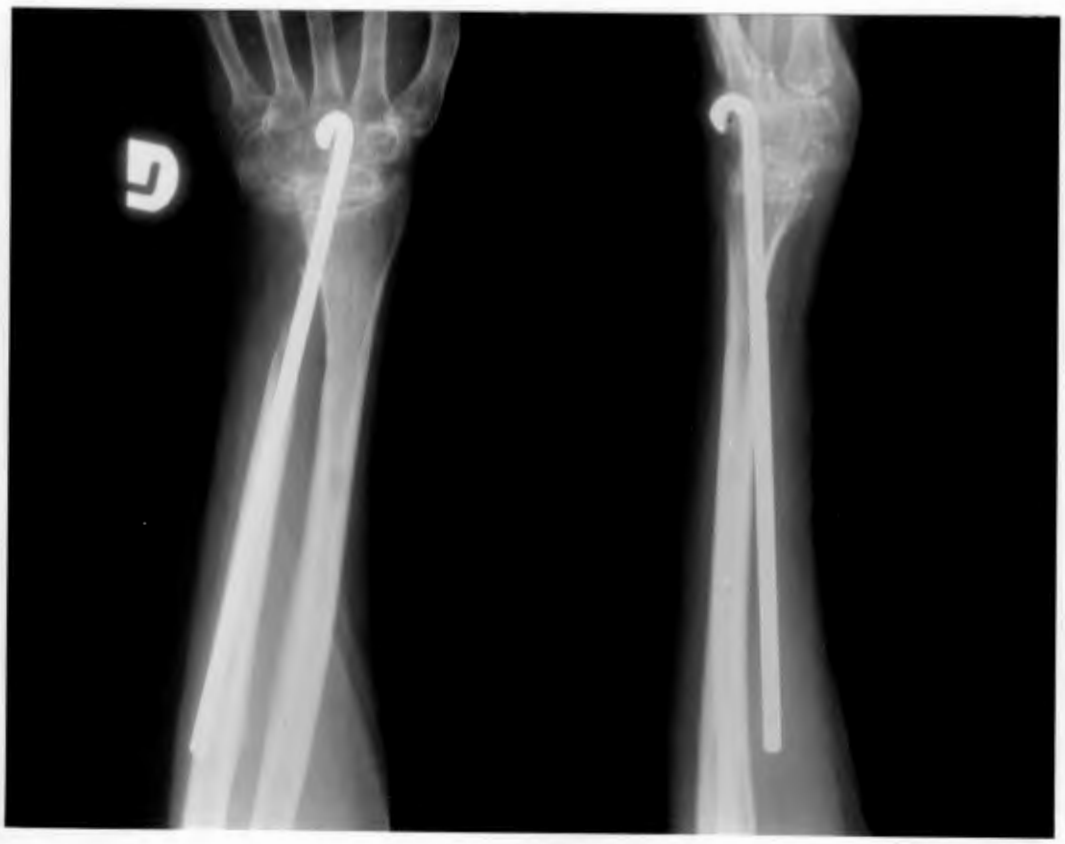


Fig. 30.

In 2 wrists the internal fixation was adjusted and in 3 cases the pins were removed because of local irritation (fig 31).

In 4 patients the surgical procedure precipitated the Carpal Tunnel Syndrome. Decompression relieved the symptoms in all patients but a recovery was delayed in the 2 patients in which the diagnosis was missed initially. We have learnt from this experience to be more aware of the possibility of carpal tunnel syndrome in the early post-operative period. Early decompression is then essential.

Fig. 31.

II.C. SILASTIC ARTHROPLASTY

a. Material and Methods

A retrospective analysis of patients with rheumatoid arthritis having undergone a silastic radiocarpal arthroplasty at the Princess Alice Orthopaedic Hospital between 1970 and 1980 was made.

16 Arthroplasties in 15 patients were reviewed. There were 13 female and 2 male patients. The mean age at surgery was 43.4 years with a range of 30 - 60 years. The mean follow-up time was 44.7 months with a range of 12 to 98 months. The principal indication for surgery was pain in all cases. Surgical technique was as described by Swanson and a synovectomy of the wrist joint with re-routing of the extensor tendons was performed simultaneously.

Technique

The carpus is exposed as before. The scaphoid and lunate are excised and the capitate squared off (fig 32). The end of the radius is prepared to fit against the distal carpal row. The radiocarpal subluxation is completely reduced. The intramedullary canal is prepared with a broach to receive the proximal stem of the implant. The capitate and the intramedullary canal of the third metacarpal are then prepared to accept the distal stem of the implant. Trial implants are used to determine the proper-sized implant. Bone preparation and soft tissue release should allow adequate passive motion without buckling or impingement of the implant. Usually a 1.0-

1.5cm joint space is required for proper implant insertion (fig 33). The capsule of the radiocarpal joint is repaired to permit a maximum arc of 30 degrees flexion and 30 degrees extension. The wound is closed in layers, including re-routing of the extensor tendons. A pressure dressing is applied initially followed by a short arm cast which is worn for four weeks.

Fig.32.

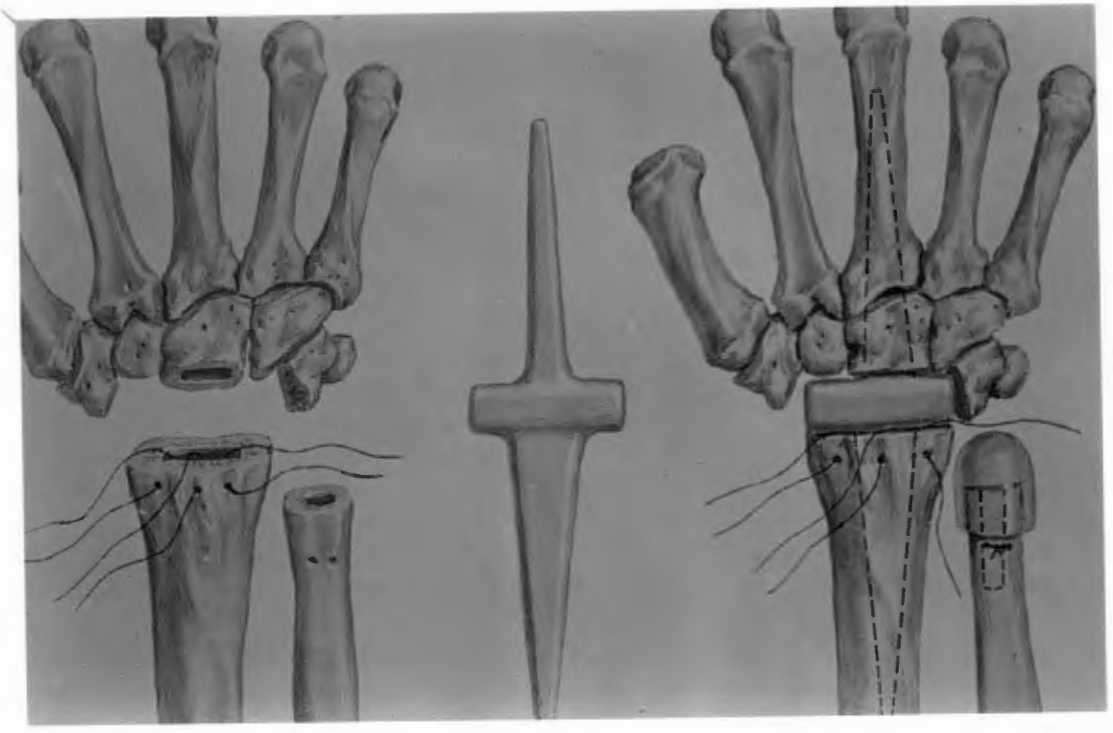


Fig. 33.

Fig. 34.

b. Results

At the time of review 11 of the 16 were regarded as excellent results in that the wrists were painfree, stable and retained motion (fig 34). The range of motion had however decreased with time in 4 of these patients and this was attributed to settling of the prosthesis (fig 35).

Fig. 35.

The x-ray appearance of the patient with the longest follow-up also showed evidence of marked bone resorption and this was probably due to silastic granuloma formation. This patient is at present asymptomatic (35).

5 of the 16 cases were not successful. The cause of failure in all of these cases was fracture of the prosthesis (figs 36 and 37). Three of the cases have been revised; One to a Meuli total joint prosthesis (fig 38) and two to an arthrodesis. One patient is awaiting revision while one was asymptomatic at review.

Fig. 36. Right Swanson fractured.

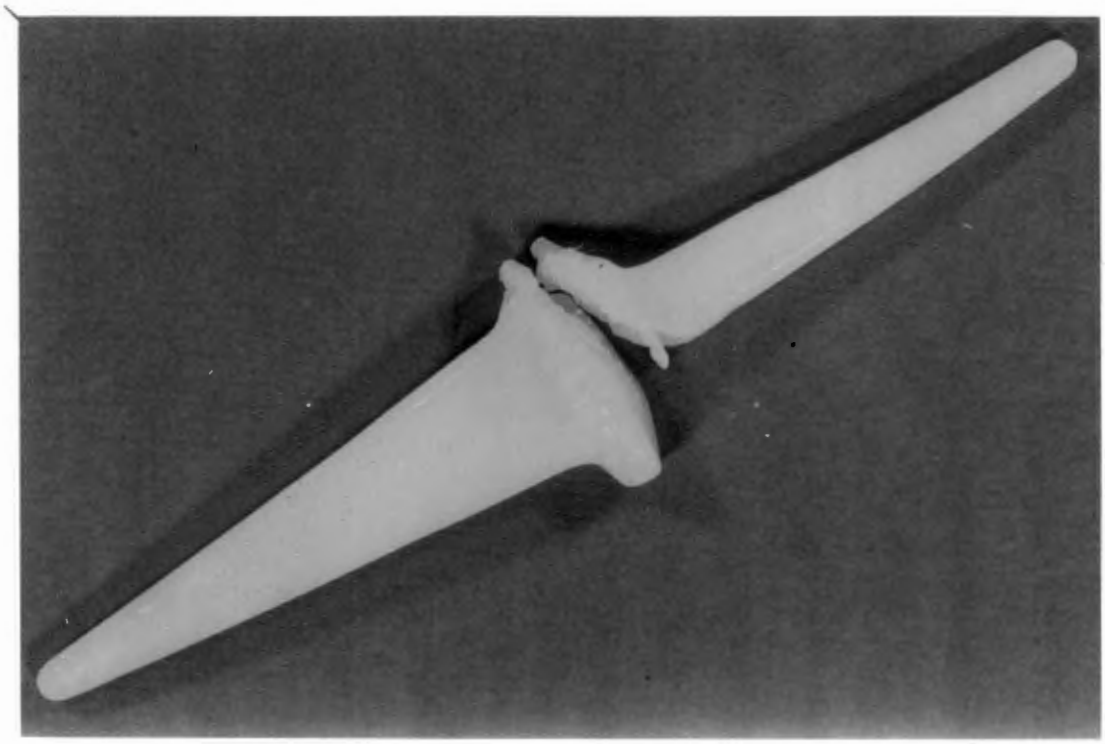


Fig. 37.Fractured Swanson prosthesis at removal.

The failure rate of this operation at 4 years is therefore just under 30% with further prosthetic fracture predicted from the longer follow-up periods reported in the literature.

c. Complications

There were no early complications. Five of the components fractured three of which required revision.

Fig. 38.

DISCUSSION

Patients with severe rheumatoid arthritis often require multiple surgical procedures in order to alleviate pain and disability. It is therefore imperative that the correct management decision is made in order to minimise the period of hospitalisation.

Arthrodesis and arthroplasty at the radiocarpal joint undoubtedly both afford excellent short term relief of pain and restoration of overall hand function with few perioperative complications.

Arthrodesis of the wrists in rheumatoid patients can be satisfactorily achieved using either the Mannerfelt or the Nalebuff method. This results in relief of pain and instability and gives a stable base from which the fingers are able to function. The resultant arthrodesis is permanent and therefore at least one of many potential causes of revision surgery is eliminated. However the trade-off is that motion is lost and therefore certain finer functions requiring wrist mobility become difficult, such as combing of hair, picking up objects from the floor and from high shelves as well as personal hygiene. This does however not usually represent a major obstacle to these patients as they are well used to modifying their activities to adjust to these inconveniences. In those patients that have a limited range of movement at the shoulder and elbow joints this lack of movement may however significantly compromise function.

The Swanson silastic prosthesis was developed in order to maintain movement at the wrist as well as eliminate pain and restore function. In the short term this is undoubtedly achieved. However, in the longer term, the clinical results have not fulfilled the expectations of the experimental findings. Although the prosthesis did not fracture experimentally after 200,000,000 flexions to 90 degrees, the prosthesis does unfortunately fracture in vivo.

Swanson has put this down to attrition of the prosthesis by sharp bone spicules at the mobile interface and has therefore developed metal grommets to protect the prosthesis (fig 39).

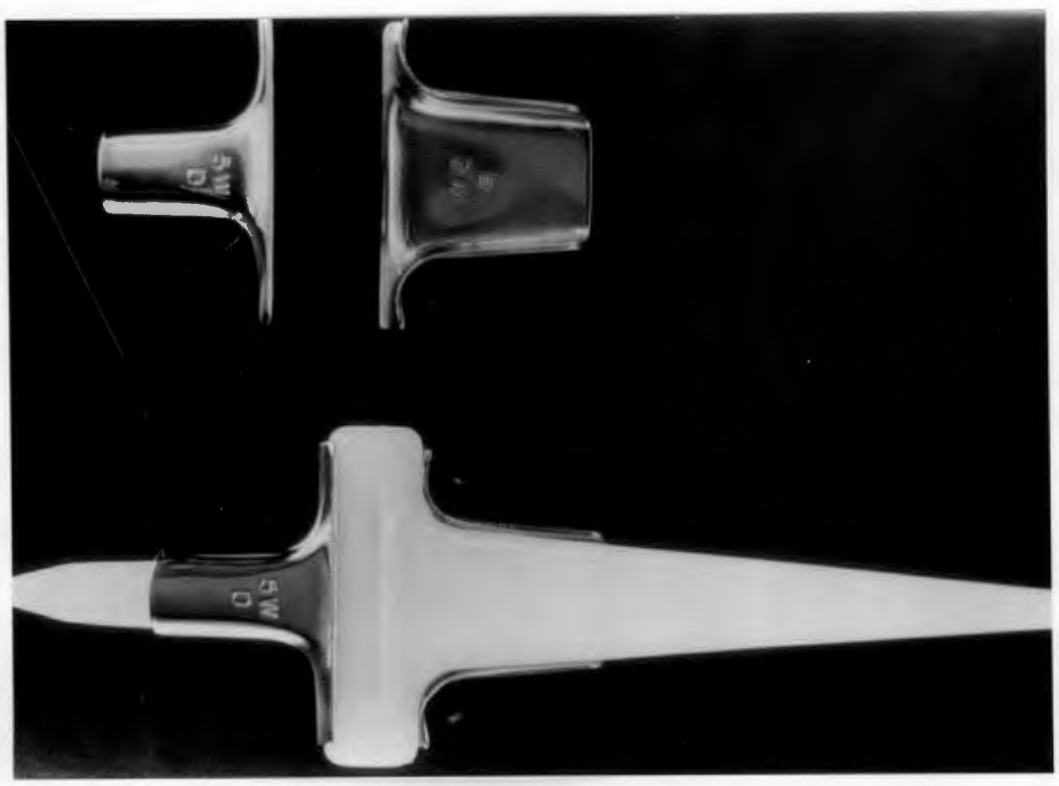


Fig. 39.

There are no long term results as yet reported as to the efficacy of this modification and our unit has only a very limited experience of its use. However other features may contribute to the failure of the prosthesis. There is no report in the literature of the prosthesis being tested to determine its ability to withstand functional loading and torsional stresses. If these mechanical stresses contribute to fracture, the use of grommets will not protect the prosthesis.

Another problem with the use of the prosthesis is the development of silicone synovitis. The patient with the longest follow-up (8 years) (fig 35) showed undoubted resorption of bone. Silicone synovitis is a major complication of silastic carpal prostheses in active, non rheumatoid patients and the manifestation thereof in rheumatoid patients is perhaps only delayed rather than absent. Bone resorption has been noted in previous papers, however all reports to date have an average follow-up time of less than 6 years.

CONCLUSION

Surgical intervention at the wrist alleviates symptoms and restores function in patients with rheumatoid arthritis.

Excellent results are realised with arthrodesis of the wrist but at the expense of movement. In rheumatoid patients this generally constitutes no more than a minor disability.

Excellent early results are obtained with silastic wrist arthroplasty, but medium to long term complication rates are high, with prosthetic fracture and bone resorption being the principal culprits. However, revision to an arthrodesis or another arthroplasty is relatively easy.

What then are the indications for the different procedures? The following are absolute contra-indications to arthroplasty:

1) Previous sepsis
2) Loss of wrist extensors
3) Permanent use of crutches
4) Very poor bone stock, especially of radius

I also feel that in the few patients where only one wrist is involved, an arthrodesis should be the procedure of choice.

In the patients who have more advanced disease in the non-dominant hand and where surgery is indicated an arthrodesis should be offered in the first instance. The patient will then be in a position to evaluate the amount of disability, if any, this causes and so

provide more objective input if the dominant wrist requires surgery at a later stage.

In patients with bilateral disease where the dominant hand is most severely affected, I feel that the patient should make the decision after the limitations of the prosthesis have been explained. In such cases the wrist can be splinted in a neutral position pre-operatively so that the patient is able to make an informed decision concerning arthrodesis. Patients with very stiff shoulders and elbows should be offered an arthroplasty. In the final analysis, the advisability of any operation must be assessed in terms of the potential functional improvement relative to the individual patients needs taking into account a knowledge of the patient's work, his hobbies, and his requirements for daily living. The patient himself must be part of the executive that makes the final decision.

In summary :

1. Patients with mostly unilateral disease : **arthrodesis.**
2. Patients with bilateral disease where the non-dominant hand requires surgery first : **arthrodesis.**
3. Bilateral disease with dominant hand requiring surgery first : **collaboration with the patient.**
4. Very stiff shoulder and elbow : **arthroplasty.**

Finally I wish to mention the rheumatoid arthritis patients themselves. These unfortunate people are afflicted with a chronic and crippling disease that often results in great pain and disability. However, time and time again we, in the medical profession, are warmly thanked for the little we do achieve in helping them.

It is to the courage of these people that I would like to pay a final tribute.

References

1. Alarcon S, Koopman WJ. The Carpometacarpal Ratio: a useful method for assessing disease progression in rheumatoid arthritis. The Journal of Rheumatology 12:5:846 1985

2. Appelboom T: Rheubens and the question of antiquity of rheumatoid arthritis. JAMA 245:483, 1981

3. Arnett FC: The A.R.A 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis and Rheumatism, Vol.31, No. 3,1988

4. Beighton P, Soloman L, Valkenburg HA: Rheumatoid arthritis in a rural South African Negro population

5. Brase DW, Millender EH, et al. Failure of silicone rubber wrist arthroplasty in rheumatoid arthritis. J Hand Surg 11A: 175, 1986

6. Clayton ML: Surgical treatment at the wrist in rheumatoid arthritis. A review of 37 patients. JBJS (A)47:741, 1965

7. Clayton ML, Ferlic D: Arthrodesis of the arthritic wrist. CORR 187: 89, 1984

8. Comstock CP, et al: Silicone wrist implant: long-term follow up study. J Hand Surg 13A: 201, 1988

9. Cooney WP, Beckenbaugh RD, et al: Total wrist arthroplasty: problems with implant failures. OCNA 187: 121, 1984

10. Dennis DA, Clayton ML: Volz total wrist arthroplasty in rheumatoid arthritis. J Hand Surg 11A: 483, 1986

11. DeQueker J: Arthritis in Flemish paintings (1400-1700).BMJ 1:1203,1977

12. Eiken O: Assessment of surgery of the rheumatoid wrist. Scand J Plast Reconstr Surg 9:207, 1975

13. Fatti JF, et al: The long-term results of Swanson silicone rubber wrist arthroplasty. J Hand Surg 11A: 166, 1986

14. Flatt AE: The care of the rheumatoid hand. Mosby Third edition 1974.

15. Freiburg RA, Weinstein A: The scallop sign and spontaneous rupture of the finger extensor tendons in rheumatoid arthritis. Clin Orthop 83:128,1972

16. Geschwend N, Bell S: Wrist arthroplasty using the Swanson silastic prosthesis. JBJS 71B: 163, 1989

17. Harris NH: Clinical Orthopaedics. Wright. PSG 1983

18. Hodgson SP, Stanley JK, Muirhead A: The Wrightington classification of rheumatoid wrist X-rays. J Hand Surg 14B: 451, 1989

19. Hastings DE, Evans JA: Rheumatoid wrist deformities and their relation to ulnar drift. JBJS 57A: 930,1975

20. Kleinert HE, Frykman G: The wrist and thumb in rheumatoid arthritis. O.C.N.A. 4:1085,1973

21. Larsen A, Dale K, Eek M. Radiographic evaluation of rheumatoid arthritis and related conditions by standard reference films. Acta Radiological Diagnosis 18:481, 1977

22. Lipscomb PR: Surgery for rheumatoid arthritis - timing and techniques. JBJS 50A: 614, 1968

23. Mannerfelt L, Norman O: Attrition ruptures of flexor tendons in rheumatoid arthritis caused by bony spurs in the carpal tunnel. JBJS (B)51:270,1969

24. Mannerfelt L, Malmsten M: Arthrodesis of the wrist in rheumatoid arthritis. Scand J Plast Reconstr Surg 5: 124, 1971

25. Marmor L: Arthritis surgery. Lea and Fibiger 1976

26. Meuli HC: Meuli total wrist arthroplasty. OCNA 187: 107, 1984

27. Millender LH, Nalebuff EA, Albin R, et al: Dorsal tenosynovectomy and tendon transfer in the rheumatoid hand. JBJS (A)56:601, 1974

28. Millender LH, Nalebuff EA: Preventative surgery. Tenosynovectomy and synovectomy. O.C.N.A. 6:765, 1975

29. Millender LH, Nalebuff EA: Arthrodesis of the rheumatoid wrist. JBJS 55 A: 1026, 1973

30. Mody GM, Learmonth ID, Meyers OL, Heywood AWB: Surgical Requirements in Rheumatoid Arthritis. Journal of Orthopaedic Rheumatology 1987

31. Moll JH: Rheumatology in clinical practice. Blackwood Scientific Publications: 310, 1987

32. Mongan ES, Boger WM, Gilliland BC, et al: Synovectomy in rheumatoid arthritis. A retrospective study. Arthritis Rheumatology 13:76, 1970

33. Nalebuff EA, Garrod KJ: Present approach to severely involved rheumatoid wrist. OCNA 15: 369, 1984

34. Rayan GM, et al: Functional assesment of bilateral wrist arthrodesis. J Hand Surg 12A: 1021, 1987

35. Ropes MW, Bennet GA, Cobb S, Jacox R, Jessar RA: Proposed diagnostic criteria for rheumatoid arthritis. Bull Rheum Dis 7:121-124, 1956

36. Rozeman and Fisk: The Wrist. Churchill Livingstone: 1988

37. Short CL, et al: A definition of the disease and clinical description based on a numerical study of 293 patients and controls. Cambridge, Harvard University Press:1957

38. Simmen BR: Morphotypes of the rheumatoid wrist. 5th ERASS Congress 1989.

39. Sones DA: Surgery for rheumatoid arthritis - timing and techniques. JBJS 50A: 576, 1968

40. Souter W: Planning treatment of the rheumatoid hand. The Hand volume 2 No. 1:3, 1979

41. Straub LR, Ranawat CS: The wrist in rheumatoid arthritis. JBJS 51A:1, 1969

42. Swanson AB: Flexible implant arthroplasty in the hand and extremities. Mosby 1973

43. Swanson AB, Swanson GdG, Maupin K: Flexible implant arthroplasty of the radiocarpal joint. OCNA 187: 94, 1984

44. Taleisnick J: The Wrist. Churchill Livingstone: 365,1985

45. The ARA 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis and Rheumatism, Vol.31, No. 3,1988

46. Vaughan-Jackson OJ: Rheumatoid hand deformities considered in the light of tendon imbalance. JBJS (B) 44:764,1962

47. Vicar AJ, Burton RI: Surgical management of the rheumatoid wrist - fusion or arthroplasty? J Hand Surg 11A: 790,1986

48. Volz RG: Total wrist arthroplasty.CORR 187:112,1984