

RECENT ADVANCES  
IN PLASTIC SURGERY

No. 1

JAMES CALNAN

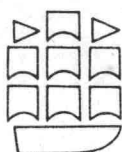
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EDITED BY  
JAMES CALNAN

NUMBER ONE



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# PREFACE

What is recent? What is an advance? It is easy to be confused for nowadays five years is a long time in surgery, even though so-called new discoveries were often recorded many years ago. So let's say that anything new in the past five years is *recent* and that any technique or better understanding of disease which benefits the patient is an *advance*.

This volume is an attempt to bring surgeons up to date by writing about a limited number of subjects, considered in detail. It is hoped that it will be the forerunner of other volumes on other subjects as knowledge advances. It is realised, too, that in raising our standards of surgery, technology has tended to lower the quality of life, so we must set our social and ethical priorities right. In particular, there are two areas for serious concern. Gross congenital deformities in children can now be remoulded to presentable appearances by new skills which yet are unable to reduce the burden of care required from the patients. There are more road traffic accidents and more serious wounds treated by new skills which replace a dead hero by a living cabbage. In most instances, the expenditure of money, manpower, skills and time go far beyond what any single patient can provide in return.

Society has not yet asked us to revise the current practice of saving life at all times, but the day is coming when someone will. Already the Rothchild Report (1972) on Government aided research, has introduced a new principle into an area previously completely free of restrictions, that of the 'consumer-contractor'. The concept that moneys used should ensure results for the good of the greatest number and that the outstanding social problems of our times (mental illness, addiction, ageing and accidents) should receive adequate investigation and treatment by doctors, is surely unanswerable.

To many people plastic surgery implied several things: that an operation meant a stay in hospital; that reconstruction meant a long stay in hospital; and that cosmetic surgery was something shameful. Yet things are changing. More operations are carried out on outpatients under local anaesthesia than ever before, more reconstructions are completed under the same anaesthetic at the time of the ablative procedure, and the importance of personal appearance is becoming better recognised.

Only five different subjects, in 13 chapters, are covered in this volume, which might interest surgeons and physicians generally. Most of the subjects

have had their origins in the specialty of plastic surgery but have grown to become the concern of all practising doctors. Each chapter is complete in itself, providing personal opinions and interpretation of present knowledge from the author. Not all were written by plastic surgeons, indicating a wider contribution to the specialty from those working beyond it.

London, 1975

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# 1 THE CARE OF THE RHEUMATOID HAND

*F. V. Nicolle*

Technology has opened the way to many modern fields of surgery and in the past 10 years we have seen this stimulate a great advance and an increased interest in surgery for the rheumatoid hand.

Our medical colleagues have now come to recognise the value of a combined medical and surgical approach to those diseased hands which fail to respond adequately to medical treatment alone. This has resulted in mutual benefit, with the establishment of combined outpatient clinics in many such specialised centres; a general trend that can be seen in the several fields of recent surgical advancement, which emphasises the need for close integration of all specialist branches of surgery and, indeed, of medicine.

Advancement in technology has provided us with improved materials for implantation which offer new scope in joint and tendon reconstruction, as well as joint fixation. Improved instrumentation in the form of power drills and bone cutters has introduced a higher standard of precision and general technique which is vital to the success of surgery in tissues of such low vitality. Technical advances have also been made in the objective assessment of hand function, where previously the success or failure was largely judged by the subjective assessment of the surgeon and the patient. Today, we have progressed beyond measurement of the arc of motion and grip strength and can accurately record individual digital flexion force. This, of course, is essential in assessing results where treatment is directed at individual finger joints and is a subject which is covered fully by Dickson.

With this increased interest in rheumatoid hand surgery has come a much better understanding of the hospital management of patients undergoing treatment. Such patients value their independence very greatly and although they accept the need for frequent outpatient visits, they are usually reluctant to accept the need for inpatient treatment. This has stimulated the trend towards more surgical outpatient treatment and, if properly organised, can offer an ideal method of management for all but the more major procedures on the hand.

For these reasons we now perform 60 per cent of our rheumatoid hand surgery on an outpatient basis, most of which is done under axillary block anaesthesia, with a suitable but brief recuperative interval afterwards before going home. High hospitalisation costs in the United States has necessitated

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this type of treatment for a wide variety of conditions and can be predicted as an increasing trend in our country and elsewhere, particularly wherever a shortage of nursing staff and beds exists.

### THE OBJECT OF SURGERY

#### Prophylaxis

The justification for surgical intervention is now more readily accepted and the surgeon no longer has to argue in support of each individual case. According to the diffuseness of joint involvement, the patient's response to medication and the drug employed, the physician will normally decide when surgical synovectomy is indicated. All such cases can usually be handled on an outpatient basis in much the same way as their current medical management.

#### Reconstruction

Here, clearly the objective is restoration of better function. Such a surgical undertaking is obviously contraindicated by an excessive degree of frailty, or poor health, or by unsuitable personality where the patient lacks adequate motivation.

Contraindications more localised to the hand, include any evidence of circulatory impairment due to arteritis, often demonstrated by small petechial haemorrhages seen at the nail margins. Disabling joint disease proximal to the hand will require correction prior to any attempt at surgery on the hand.

Provided that these contraindications have been considered we can then assume that 'restoration of function' will imply the following:

1. Improved mobility
2. Adequate stability
3. Correction of deformity
4. Increased power
5. Relief of pain
6. Prior consideration of other involved joints and tendons
7. Early return to normal domestic tasks or employment

Surgery in the rheumatoid hand requires a delicate compromise involving correction of deformity, improved mobility and adequate stability. In each hand an often different but characteristic pattern of joint involvement exists and from this knowledge we must select the operation of most value to the individual. In general, we retain useful function for both grasp and precision movements provided a good range of movement exists at the metacarpophalangeal joints of the fingers as well as at the carpometacarpal joint of the thumb. If this can be achieved we can afford to sacrifice movement and fuse diseased joints proximally at the wrist, or distally in the smaller joints of the fingers and thumb.

### Prophylactic Synovectomy

There are now data to support the value of such a procedure, especially if performed before radiological evidence of erosion becomes manifest. Its value is greatest in those joints where a complete synovectomy can be achieved, such as the metacarpophalangeal joints. The multiarticular wrist joint is therefore less suitable for synovectomy, as are also the interphalangeal joints where access is more limited and removal of synovium on the volar aspect difficult.

The process of erosion of the cartilage is thought to be caused predominantly by enzymatic activity (Weissman, 1964; Weissman, Spilberg and Krakaner, 1961; Whaley and Dick, 1969). There is growing evidence that the synovial cells are responsible for the release of these lysosomal enzymes, which have been found in increased levels in rheumatoid synovial effusions (Kerby and Taylor, 1967). The demonstration of collagenase prepared from tissue cultures of rheumatoid synovium has pointed to another possible mechanism of

*Table 1* Results of MCP joint synovectomy (38 hands)  
in 27 patients

Result	Numbers
Relief of pain, weakness, stiffness	35 of 38
Improvement in function	25 of 38
Recurrence of ulnar drift	3 of 6
of subluxation	2 of 66
Development of synovitis	
in unoperated MCP joints	14 of 168
and erosions elsewhere in hand or wrist	20
Recurrence of synovitis in operated MCP joints	6 of 102

cartilage erosion by synovial cells (Evanson, Jeffrey and Krane, 1968), although others have questioned its significance, since synovial biopsies have also been shown to contain collagenase in conditions other than rheumatoid arthritis (Harris, Cohen and Krane, 1969).

These uncertainties have made critical assessment of long-term results of surgical synovectomy vitally important. Prospective multicentre trials in Great Britain and USA have been underway for a decade but insufficient material has so far been accumulated.

The author (Nicolle, Holt and Calnan, 1971) reported on a retrospective study on 102 metacarpophalangeal joint synovectomies performed between 1962 and 1968, providing a four to eight year follow-up. Recurrent synovitis in operated joints was slightly lower than the spontaneous appearance of synovitis in joints unaffected at the time of initial treatment. A summary of results is shown in Tables 1 and 2. This study pointed to the need for much more precise means of objectively assessing our surgical results (Dickson and Nicolle, 1972) so that techniques were developed in order to measure individ-

ual digital forces (Dickson and Calnan, 1972), as well as the measurement of the density of the bones of individual digits of the hand (Dickson, Paice and Calnan, 1973).

These precise techniques have been applied to study patients before and after synovectomy. One year after treatment the operated fingers showed an average of 100 per cent increase in bone density while the non-operated digits showed a 10 per cent increase, presumably due to the overall improvement in hand function that operation had provided. Finger pinch showed precisely the same change following synovectomy, both being recognised indices of hand function (Dickson and Nicolle, 1972).<sup>1</sup>

The value of synovectomy of the metacarpophalangeal joints would now appear to be conclusively demonstrated both in long- and short-term studies. In contrast, the interphalangeal joints appear to give less satisfactory results following synovectomy (Ansell et al, 1970) which may, at least in part, be due to the greater technical difficulty of obtaining a thorough removal of all synovium. Furthermore, these joints show a higher frequency of spontaneous

Table 2 X-rays findings after synovectomy of 102 MCP joints

Time of x-ray	Erosions			
	None	Minimal +	Moderate ++	Severe +++
Before synovectomy	35	29	21	17
After synovectomy (4-8 years)	35	22	22	23

remission (Kay, 1971), which encourages greater conservatism in surgical treatment.

The treatment of proliferative synovitis by intra-articular injection of Thiotepe was reported (Ellinson and Flatt, 1971) and was concluded to give a rather poor result. It is evidently difficult to obtain an even distribution of the drug over the surface of the synovium; for this reason the greater bulk of synovium, concentrated at the proximal attachments of the collateral ligaments, may receive insufficient treatment, yet it is just at these sites where synovium can produce the greatest damage to joint stability. Other substances for intra-articular treatment, such as colloidal gold, are currently under trial.

### Tendon Involvement in the Rheumatoid Hand

Tenosynovitis is a frequent finding in the hand in rheumatoid disease (Kellgren and Ball, 1950; Savill, 1969; Backhouse et al, 1971). Joint tenderness, pain and limitation of movement may dominate and careful examination of the tendons should never be omitted.

On the dorsum of the wrist, painless swelling of the extensor tendons may

be the only finding; in the case of the flexor tendons, pain and swelling in the palm or fingers, crepitus, or the carpal tunnel syndrome are more usual. Before discussing these clinical features and their management, it is as well to consider our current knowledge of the pathogenesis of rheumatoid tenosynovitis.

### *Pathogenesis*

Up until recently, it has been popular to refer to 'attrition' rupture as the common cause of tendon injury leading to rupture. This undoubtedly occurs and is a common finding in lesions of the extensor tendons at the wrist (Vaughan-Jackson, 1959) associated with roughening of the distal end of the ulna.

There are other patients in whom an intratendinous nodule can be identified as the cause of tendon rupture (Flatt, 1963), but these are quite rare. In the majority of cases the ruptured tendon is found surrounded by a mass of proliferated synovium which, it has been suggested, leads to avascular necrosis brought about by compression or stretching of the blood vessels reaching the tendon. However, there have been two recent studies which I feel offer a much more precise understanding of the role of the synovium.

Backhouse et al (1971) analysed the location of tendon lesions, based on a study of 70 hands requiring operation for unresolved tenosynovitis. From this he was able to point out that the destructive tendon lesions occurred distal to the flexor or extensor retinaculum and proximal to the fibrous digital flexor sheaths. Furthermore, the sites of most frequent involvement were not at those points where the tendons suddenly changed direction, but at the termination of the synovial-lined sheath and beneath the extensor or flexor retinaculum. It was suggested that, at these sites, maximum stress occurred on the tendon due to obstruction of the normal gliding mechanism of the parietal and visceral synovium. Stress, however, is not the only factor for there is undoubtedly a degeneration in the affected tendon which lies in direct contact with the diseased synovium. Recently, Inoue et al (1970) studied extensor tendon degeneration by means of the scanning electron microscope. In acute rheumatoid tenosynovitis, numerous inflammatory cells were found on the surface of tendons, followed later by crater and groove formation similar to that seen in degenerated tendons and ruptured stumps in more chronic states. They proposed that such changes of tendon disorganisation may be caused by lysosomal enzymes, present in greater concentration than in normal healthy subjects, a condition very similar to the changes in the articular surface of rheumatoid joints. These two recent observations relating to lysosomal activity and the sites of tendon rupture contribute greatly to our understanding of the pathogenesis of this condition. The role of the surgical management of tenosynovitis is well established for patients failing to respond to medical treatment.



*Involvement of the extensor tendons*

In such cases there is general agreement on the method of management. Exposure of the extensor retinaculum is made through a lazy 'S'-shaped incision, care being taken to avoid injury to the sensory branches of the radial nerve. A meticulous excision of the diseased synovium is performed, exposure being obtained by division of the retinaculum on one side. Following excision of the distal 3 cm of the ulna, the retinaculum is passed deep to the extensor tendons to form a protective and smooth gliding surface for the tendons.

Repair of a ruptured digital extensor tendon is performed by end-to-side suture to the adjacent intact digital extensor. For repair of the extensor pollicis longus tendon a transfer of the extensor indicis proprius is generally performed, although Harrison, Swanell and Ansell (1972) have recently advocated the use of the extensor pollicis brevis instead. This latter technique might be criticised because it removes a stabilising influence from the metacarpophalangeal joint of the thumb, a joint which is frequently adversely affected by rheumatoid disease.

*Involvement of the flexor tendons*

Here management is more debatable and will often be dictated by the extent of the disease encountered.

## TRIGGER FINGER AND TENDON ADHESIONS

A small transverse palmar incision at the level of the proximal end of the digital flexor sheath may be sufficient to allow division of the proximal portion of the sheath, removal of a tendon nodule or excision of a localised area of proliferative synovitis. But this must be distinguished from the less widely recognised diffuse adhesions in the same region of the tendon giving rise usually to flexor lag, crepitus and weakened grasp. These would appear to be the aftermath of a more acute episode of tenosynovitis. Surgical freeing of the tendon often produces rather disappointing results and conservative management with a programme of active exercises may produce a better response.

## PALMAR SYNOVITIS AND CARPAL TUNNEL SYNDROME

The need for a thorough clearance of diseased synovium is now widely accepted. Such a procedure will often result in an extensive dissection from the involved fingers to the proximal forearm and will frequently be dictated by the extent of involvement found in the course of the operation. It has not been our practice to excise the sublimis tendon in cases of extensive digital involvement with digital flexor lag, although this policy is advocated by some surgeons (Wissinger, 1971) with favourable results. In cases of 'crowding' within the digital flexor sheath I have preferred to excise the sheath and synovium, retaining the flexor pulleys but excising the ulnar slip of the sublimis tendon only if additional space is required. The palmar skin is closed



loosely and a pressure bandage applied, without releasing the tourniquet beforehand. Active exercises within a reduced bandage are started after one week.

#### FLEXOR TENDON RUPTURES

These may not be fully recognised until palmar synovectomy is undertaken. In contrast to the use of free grafts for repair of severed flexor tendons in cases of trauma, the rheumatoid hand is usually repaired by tendon transfer even in flexor tendon repairs. Following synovectomy, the bed for the flexor tendon is so unfavourable that transference of an adjacent sublimis offers a better chance for restoring active movement. A free graft of palmaris longus may be indicated if the synovitis involves the tendons of adjacent fingers as well, but the results are generally not as favourable and should be reserved as a procedure of last resort.

Fortunately, rupture of the flexor tendons is less common than the extensors. They are less liable to attrition rupture and more resistant to disease by virtue of their greater thickness. The presence of rheumatoid nodules within the tendon is probably misleading for careful dissection will often reveal that the nodule lies within the synovium lining the spiralling bundles of otherwise healthy collagen. This spiral structure of the flexor tendons provides great strength and gives a misleading impression of the degree of actual collagen invasion by the synovial nodules, in contrast to those seen in extensor tendons where the collagen fibrils are more frequently seen spread apart over the underlying diseased synovial tissue. This pattern within the flexor tendons has been described by Field (1971) and confirmed by our own observations.

#### PROSTHETIC JOINT REPLACEMENT

Prosthetic joint replacement in the upper limb for advanced rheumatoid disease has proved valuable and this is especially true in the hand where prosthetic replacement gives more rapid and predictable results than excision arthroplasty.

In the metacarpophalangeal joints of the fingers, the relatively short-term results of either the Swanson (1972) or Calnan-Nicolle (Nicolle and Calnan, 1972) prostheses show a high incidence of good results. The longer term results after three to five years must be viewed with greater caution in a condition where the disease is progressive in other joints in the same hand.

We have noted in our own cases that the longer term results are strikingly better in the patient with well-controlled or burnt-out disease, which serves to point out the obvious truth that no prosthesis or other reconstructive measure will prove wholly successful under otherwise adverse conditions. This is a philosophical truth that makes the long-term results of surgical reconstruction in rheumatoid disease quite different and, sadly, much less certain than for the treatment of osteoarthritis.

The currently accepted indication for prosthetic joint replacement of the metacarpophalangeal joints remain: 'Crippling joint disease of an advanced degree'. This implies a varying degree of pain, deformity, instability and weakness sufficient to warrant operative intervention.

If the patient is relatively pain-free and still able to carry out his everyday tasks to an adequate degree, the surgeon is well advised to defer intervention and advise reassessment at a later date. The most gratifying results will be in those well-motivated patients who seek surgery to restore adequate manual function to maintain their employment or domestic independence.

### Design of Prosthetic Joints

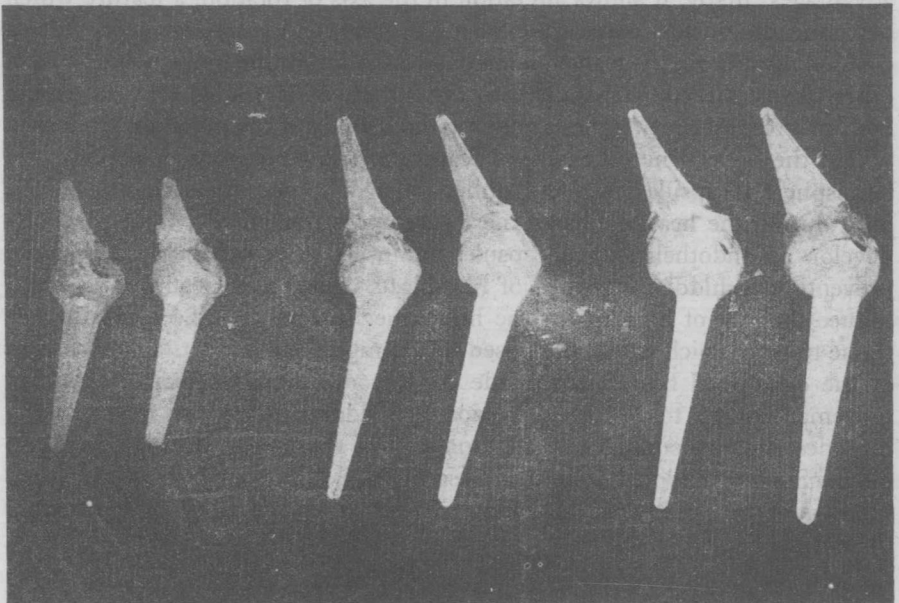
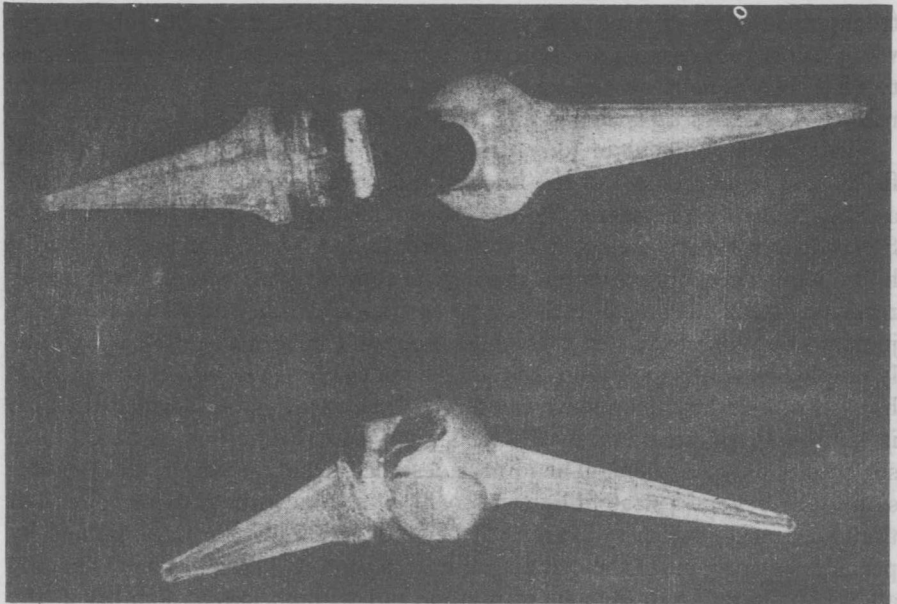
Compared with the large joints of the body, the metacarpophalangeal joints present a much more difficult problem. The greater soft tissue mass covering larger joints provides safer coverage from trauma, greater stability and stronger muscular power. In the hand we require a design of prosthesis which is small, simple, inert and durable, and yet, one which provides low passive resistance combined with stability at the hinge.

Silicone rubber and polypropylene are polymers which are well tolerated when implanted into soft tissue or bone (Calnan, 1970; Brown, Fryer and Ohlweiler, 1960; Conning and Firth, 1969; Nicolle, 1971). This is in distinct contrast to the problems which may arise from wear particles produced from certain metal alloys (Freeman, Swanson and Heath, 1969).

The initial reaction of soft tissues surrounding an implant may be influenced on a basis of chemical inertness but the physical form is also important. A foreign body reaction will occur at the interface of a chemically inert implant if its surface is not smooth or if it possesses sharp angles. This realisation has led to greater awareness of the importance of physical form in prosthetic design and also the influence of the body environment on the physical character of an implant.

Silicone rubber absorbs lipids which alter its physical quality and result in an increased tendency for an implant to fracture. No precise data is available, but some clinical observations supported by tomograms suggest a fracture rate as high as 25 per cent in the metacarpophalangeal prostheses implanted for one or more years, although function of the hand may not show any very obvious alteration.

Likewise, with polypropylene there are environmental factors which lead to a weakening in the implant. The material appears to retain its original physical characteristics better than implanted silicone rubber, but compression forces will tend to buckle and weaken an integral hinge. In our experience such a hinge will function well in an arthritic hand over a period of observation of up to three years, but fracture of the hinge has been observed in 1 per cent of cases after an average period of follow-up of 20 months. Analysis of these cases suggests that fracture is most commonly brought about by patients who



*Figure 1* Polypropylene metacarpophalangeal joint prosthesis. The intramedullary stems are of different sizes but with the same size of bearing, which allows the proximal and distal ends to be interchanged. The stainless steel and polypropylene hinge is covered with a silicone hemispherical capsule which obliterates the dead space and provides a soft, smooth external surface