RECENT ADVANCES IN THE TREATMENT OF ARM AMPUTATIONS, KINEPLASTIC SURGERY AND ARM PROSTHESES

Arris and Gale Lecture delivered at the Royal College of Surgeons of England
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by

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EACH WAR OF THE 20th century has been followed by a renewed wave of interest in the technique of amputations and in the improvement and design of artificial limbs.

How true are the words of Sir Heneage Ogilvie:

"The ill winds of war have a habit to blow good to surgeons and through them to surgery."

The last two wars stand out as particular milestones in our knowledge and outlook on the management of amputations, and, above all things, in the reabling and the sympathetic consideration of the patient's ultimate welfare.

It is the purpose of this lecture to indicate to you some of the advances and changing trends.

Our aim to-day is a great deal more than the fitting of an absurd black-gloved wooden claw, a burden to the patient, and so often left merely to recline on the top of the cupboard, deceiving no one.

My talk is concerned with the problems of the upper extremity. The artificial limb here has a formidable, indeed an insuperable, task to compete with the miracle of the human hand, but progress comes not from despair.

The human hand has certain particular qualities, some of which no artificial hand can possibly attain:

(1) *Touch:* sensation to stimuli, such as heat and cold; position sense.
(2) *Prehension:* the grasping power.
(3) *The intricate muscle movements* in its manifold permutations and combinations, of which the human hand is alone capable.

We try to imitate some of these lost functions:

(1) By operative procedure designed to utilise the remaining stump muscles as a claw, as in the Krukenberg procedure, or we utilise the remaining muscles as means for activating an artificial hand, as in Kineplastic procedures which I shall describe to you later.
(2) By operative procedure designed to prepare the unsuitable stump and thus render it more efficient and effective in the management of the prosthesis.
(3) By artificial appliances, not merely cosmetic, but with definite functional value.

SOME OPERATIVE PROCEDURES

Let us first deal with some of the operative procedures. I want for a moment to draw your attention to a lesion in which the patient's arm is complete and viable but useless to him. I refer to the *Complete irrecoverable brachial plexus lesion.*

As is well known to you, the results after repair of the brachial plexus are poor, even in the best hands, and it is difficult, indeed often impossible, to dissect out the torn nerve roots and trunks from the matted mass of fibrous tissue.

After a varying period of from two years or more, the unfortunate patient is left with a heavy, immovable, partially insensitive useless limb, often ulcerating. The patient demands relief (Figs. 1 and 2).

Fig. 1 Fig. 2

Complete irrecoverable brachial plexus lesion with ulcerating useless arm.

It is to be observed that, fortunately, in most of these cases the scapular muscles still have an intact nerve supply. There is still control of the scapulo-thoracic movements by the Trapezius, the Rhomboids, the Levator Scapulæ and sometimes the Serratus Magnus (Fig. 3).

I have found the following procedure to be useful and well worth doing.

(1) *AMPUTATION COMBINED WITH ARTHRODESIS OF THE SHOULDER*

The arm is amputated about 6in. or 7in. below the acromion, and at the same operation an intra-articular arthrodesis is performed. The ulna bone in the amputated segment is dissected out and used as a graft for stabilising the arthrodesis.

Through a sabre-shaped incision (Fig. 4) the deltoid being already paralysed, the shoulder joint is opened up and denuded of the articular cartilage on the glenoid and the head of the humerus.

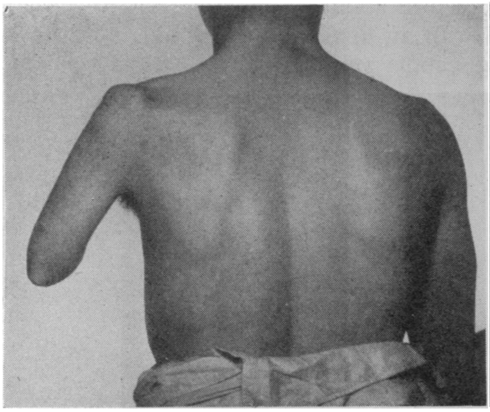

Fig. 3

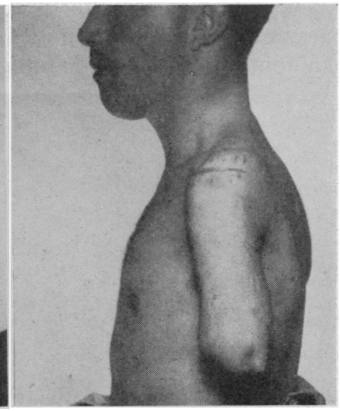

Fig. 4

Complete irrecoverable brachial plexus lesion after arthrodesis with amputation.

The well-shaped ulna bone graft, about 5in. long, is then driven through the anatomical neck of the humerus into the head and well into the glenoid fossa. The arthrodesis is fixed in plaster in about 45 degs. of abduction and 15 degs. of forward flexion (Fig. 5).

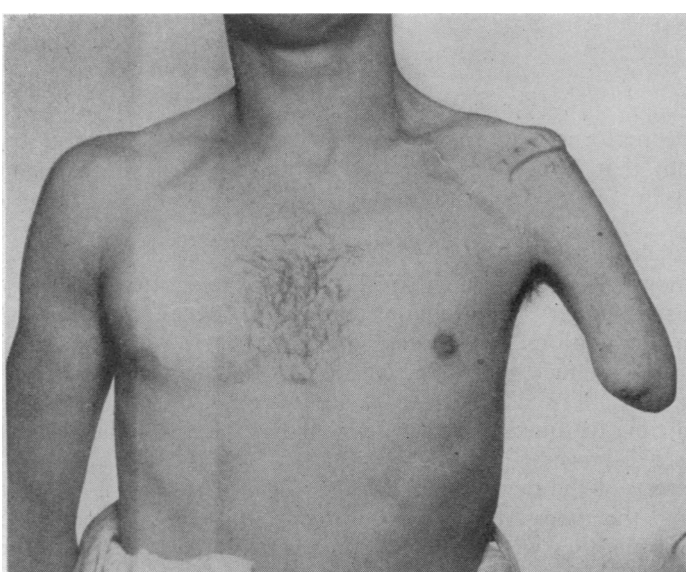

Fig. 5

The stump is firmly arthrodesed in about six months (Fig. 6). These patients can then be supplied with an upper arm prosthesis which they can control by their remaining scapula muscles.

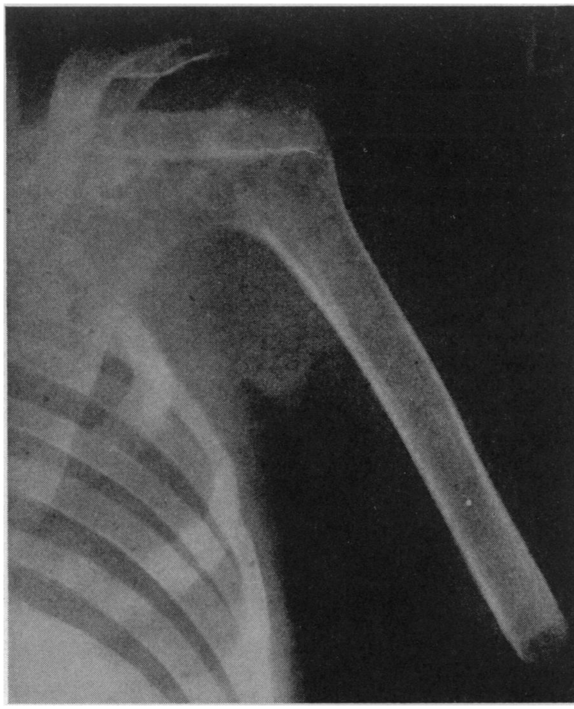

Fig. 6. X-ray photograph of this case.

I have performed 12 such operations with success. I would like to point out that I have similarly used bone grafts from the amputated segments for arthrodesing the hip-joint.

(2) *KINEPLASTIC SURGERY*

We now pass to consider further procedures often referred to as Kineplastic surgery. Certain of the more distal amputations, e.g. forearm amputations, are wasteful in that they leave highly contractile muscle bellies intact but ineffectual and useless from the patient's point of view.

From time to time surgical endeavour has been stimulated to harness this waste of power.

The story of the development of this form of surgery is of interest.

During the Italo-Abyssinian campaign in 1896 some particularly horrible brutalities were committed. Amongst these was the procedure of the Abyssinians to cut off the hands above the wrists of a large number of Italian prisoners.

Dr. Guiliono Vanghetti, a general practitioner of Empoli, in Tuscany, turned his thoughts to the development of surgical procedures to relieve these victims. He conceived the idea of so modifying the stump by operative measures as to enable the remaining muscles of the stump to be harnessed to a prosthesis and thus to actuate the artificial limb.

Dr. Vanghetti had little opportunity of putting his ideas into practice. His work was limited to experiments on fowls, but his writings stimulated surgeons like Ceci and Putti in Italy, and Sauerbruch in Germany. They gave his ideas practical shape.

These procedures have never proved popular in this country and there would seem to be need to review and maintain a flexible outlook on this subject.

The kineplastic muscle tunnel is simple in design and construction. It is formed by the elevation of a flap of skin of full thickness overlying the distal portion of the muscle to be used. The proximal and distal ends of the skin flaps are approximated and sutured to form a skin-lined tube. This is attached at one end for the maintenance of nutrition. The free end of the tunnel is reflected to expose the underlying muscle. The distal portion of the muscle is isolated and its insertion severed. A hole is made through the muscle belly just proximal to its tendenous portion, and so placed that between one-third and one-half of the muscle mass lies superficial to it. The skin tunnel is drawn through the hole in the muscle and is sutured to the outer side of the original incision. The tissues exposed, because of the removal of the skin in the form of the tunnel, are covered by a split-skin graft which is sutured around the edges of the original incision and to the superficial borders of the skin tunnel. The range of contraction is dependent upon the stiffness or elasticity of the skin and muscle.

This operation was extensively employed by the Germans under the stimulus of Sauerbruch, and I have seen a number of these cases both in this country and in America, and in my opinion the degree of control of the prosthesis is impressive (Fig. 7).

It has a particular value in patients who have lost both forearms and have very short or no upper arm stumps.

THE DYNAMICS OF MUSCLE ACTION

The revival of interest in kineplastic surgery has stimulated a great deal of work on this subject in the United States, whose surgeons and physiologists are studying this problem intensely, and I am grateful, particularly to our colleagues of the University of California, for giving me full facilities for access to their studies on the direct investigations upon such isolated human muscle bellies.

The surgical placing of skin-lined tunnels through the distal portions of muscles has made available to us isolated segments of human muscles for close physiological study.

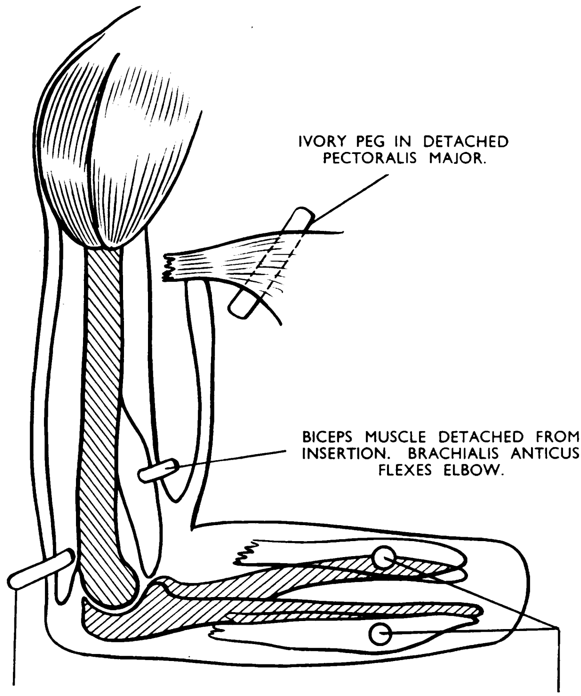

Fig. 7 Diagram showing the usual accepted sites for Kineplastic Tunnels.

It behoves the surgeon and the limb designer to have a fuller understanding of some of the dynamic laws of muscle contraction. Let us consider for a while some of the physics concerned with this.

The human limb is powered by a system of articulated levers moved by muscles. Almost without exception the effective upper lever arm is short and the distal resistance lever long, i.e., the pull through which the muscle acts is short compared with the length of the resistance lever arm (Fig. 8).

The demands on muscle power are, therefore, enormous particularly when the distal lever arm is loaded. Such a mechanical arrangement would at first sight appear to be ill planned, but in fact it ensures the speed of action and the wide range of movement.

The muscle in order to achieve a wide range of movement has no need to pass into a complete state of slack but can adjust its range in virtue of minute alterations in the fibre length itself. The absolute amount that a muscle can be passively stretched and actively contracted depends upon the length of each individual muscle fibre. The longer the muscle the longer the fibre, and the greater the power. The corollary follows that the length of the individual muscle fibre will depend on the skeletal elements.

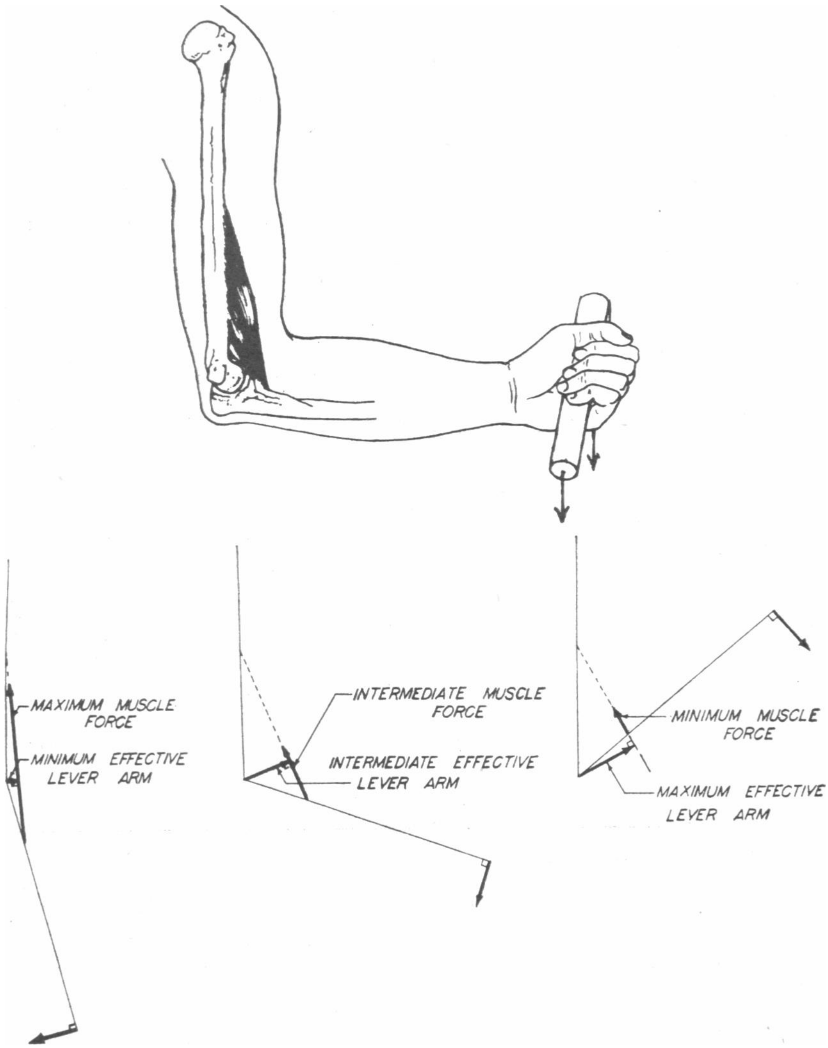

Fig. 8 Variations in Effective Lever Arm Vector Diagram for Brachialis Muscle.

It is obvious to us, therefore, that if we want to have the maximum power in a stump then we must retain every millimetre of bone and muscle. We must therefore review our present attitude in fixing elective sites for amputation in the upper limb.

Let me indicate a few more observations regarding the importance of muscle studies.

According to Weber, within one muscle the length of the individual muscle fibres are approximately the same, and the fibres in the human muscle system vary from 0.3in. to 18in. Haines estimated that when a muscle in which the fibres are running parallel contracts it is shortened to 57 per cent. of the stretched length. In pennate muscle the excursion is less.

The kineplastic muscle tunnels have given us exceptional opportunities for the study of the dynamic laws of isolated human muscle bellies. For the first time it has been possible to study such action controlled under the direct volition of the subject; the pattern of neurostimulation is normal in contrast to the laboratory procedures, where the stimuli are of necessity artificial.

Our American colleagues have made intensive studies on such kineplastic limbs. Electromyography has been a valuable aid in such studies. They have determined firstly by a dynamometer using aluminium rings and strain gauges the varying forces in different states of muscle contraction. They were able to show that there were two types of muscle action confirming the experimental work of physiologists. Firstly, *Isometric type* of contraction without permitting appreciable shortening to occur and, secondly, *Isotonic contraction* in which shortening is permitted.

In kineplastic amputees both types of contraction are necessary to activate a prosthetic device. This confirmed our previous observations that as muscle length increased the force that could be developed also increased. The length of the fibres have been measured by Weber.

I have already indicated to you that Haines estimated that a muscle on full contraction shortens by 57 per cent. of its length. We will compare the data derived from the kineplastic muscle tunnels with the maximum theoretical excursion.

The calculated theoretical excursions are contrasted with the experimental excursions obtained from the study of these kineplastic tunnels.

TABLE I

Muscle	Average Fibre Length (Inches)	Maximum Theoretical Excursion (0.57 × Fibre Length in Inches)	Average Experimental Values (From Kineplastic Tunnels) (Inches)
Biceps brachii ..	5.1	2.9	2.5
Brachialis	3.5	2.0	
Triceps brachii ..	3.1	1.8	1.7
Deltoid	3.6	2.0	
Pectoralis Major ..	6.0	3.4	4.3
Trapezius	4.3	2.4	
Latissimus Dorsi ..	8.0	4.6	
Average of Flexors of Forearm ..	2.5	1.4	1.0
Average of Extension of Forearm ..	2.4	1.4	0.7

It will be noted from Table I that, with the exception of the Pectoralis Major, the theoretical excursion was not attained in the muscles having tunnels, although the two values are reasonably close. The Pectoralis

Major exceeds the theoretical value due in part to its low resistance to stretch, thus permitting elongation beyond a physiological range in the determination of the experimental values.

Obviously it is desirable to harness the maximum power to activate the prosthesis, and to assist the amputee force multipliers have been constructed. From these studies it is clear that kineplastic muscle tunnels can serve in a fashion best calculated to move an artificial hand, e.g., actively, voluntarily and in a manner approaching the function of the natural limb.

Kinetization in upper extremity amputations has definite and important advantages. The prosthesis seems to become a part of the patient. He readily appreciates that with a will to strive, success will come and he joins eagerly in response to the enthusiasm of the surgeon. As in the fitting of all such activated upper-arm prostheses the choice of the patient is an important consideration. He must have a mind prepared and willing to accept it. It is no mere cliché to say that the prosthesis should snugly fit the mind as well as the stump.

If this operation has value you will ask why it has not been universally employed. There are several reasons :

(1) These plastic tunnels are not as easy to prepare as the pictures indicate. They were tried out after the First World War but the skin became excoriated and broke down. They were thus rendered incapable of further use, but we have to bear in mind that plastic surgery has made great strides since then, and in the hands of a plastic surgeon this is not an obstacle to-day.

(2) While great strides have been made in the improvement of the kineplastic prosthesis, the lack of a perfected model is still one of the great obstacles.

(3) Amputations in the past have often been performed with no consideration as to the possibility of utilising the remaining muscle bellies.

(4) A large number of amputations went septic with great muscle destruction and consequent fixation. In the last war, due to the advances in Chemotherapy, sepsis has not been a major factor.

(5) Further, as we shall see later, in this country there is now being developed a prosthesis which is activated by the shoulder muscles and which gives the patient remarkable control and power, and might spare him the necessity of further operations. At the present moment, however, it cannot be adequately employed for any above-elbow amputation, and I am of the opinion that there is no comparable alternative to kinetization for the short-arm amputation case.

(3) *THE KRUKENBERG OPERATION*

Kineplastic surgery *per se* can only give the faculty of prehension and not that of tactile sensibility.

The object of the Krukenberg operation is to convert the radius and ulna into the two jaws of a " crocodile " forceps.

The following is a description of the method :

Incision. The line of incision is kept close to the ulna and begins on the volar surface of the forearm at a point 7cm. distal to the bend of the elbow. From thence it passes longitudinally and turns round the end of the stump to a point at the same level on the dorsal surface. This gives a " U " shaped cut which is deepened so as to separate the flexor digitorum sublimis into a radial and ulnar moiety.

Resection of Nerves and Muscles. The median and ulnar nerves are cut short, taking care not to damage their branches to useful muscles. The flexor pollicus longus and the flexor digitorum profundus are entirely resected in order to make the two jaws of the forceps less bulky and more easy to clothe with skin.

Division of the Interosseous Membrane. This membrane is divided for a sufficient distance to obtain a separation of 12cm. between the ends of the radius and ulna. In making this cut the knife should be kept close to the ulna, and the interosseous arteries should if possible be spared.

Treatment of the Bones and remaining Muscles. The radial moiety of the flexor sublimis is sutured to the flexor carpi radialis, and the ulnar moiety to the ulnar flexors. The extensors are similarly united into radial and ulnar groups. The extremities of the radius and ulna are freshened by removing a centimetre of bone from each shaft and their ends are grooved. The radial flexors are joined with the radial extensors in such a way that the junction between them lies in the groove at the end of the radius ; the ulnar flexors and extensors are similarly dealt with (Fig. 9).

Skin Closure. Owing to the ulnar position of the skin incision, closure is easily effected round the radial jaw of the forceps. A raw area remains on the ulnar part, and this is grafted, either at once or later, by means of a pedicled flap cut from the abdomen.

Movements are begun as soon as healing is complete, and are supplemented by the usual routine of massage and electrical treatment.

Abduction of the radial limb of the forceps is produced by the brachioradialis muscle, the flexor carpi radialis, and one-half of the flexor digitorum sublimis, and adduction is produced by the pronator teres, flexor carpi radialis, and the other half of the flexor digitorum sublimis.

There have been many objections raised to the operation. Let us therefore, evaluate them.

Firstly, the stump is considered by some to be unsightly (Fig. 10).

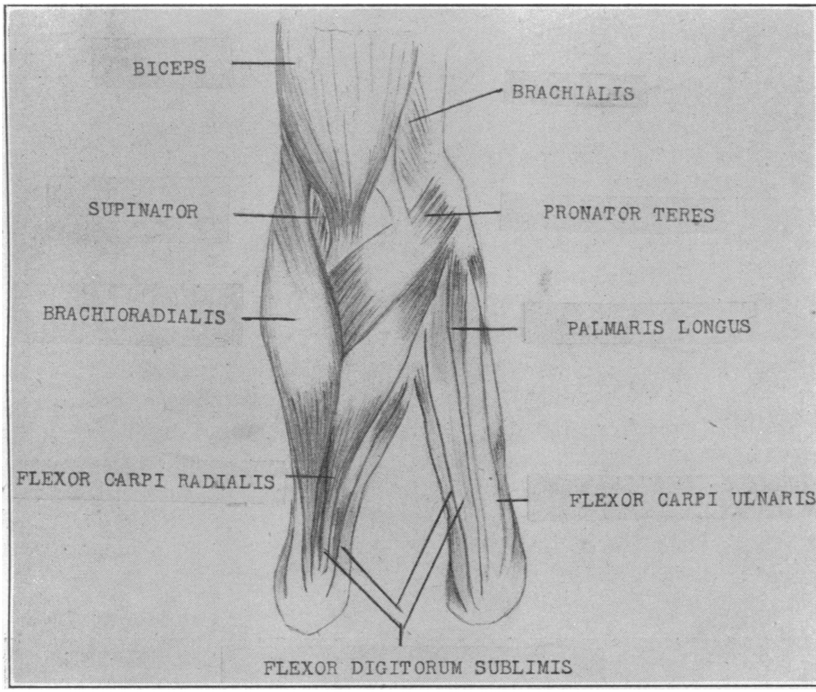

Fig. 9. Diagram showing the distribution of the muscles of the forearm in a Krukenberg operation.

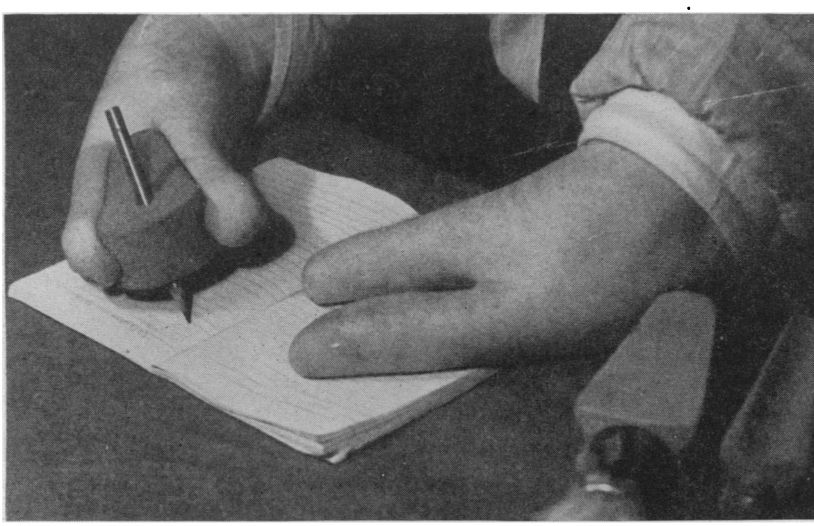

Fig. 10. Bilateral Krukenberg "claw," writing.

After the First World War a British soldier was subjected to the operation while a prisoner of war in Germany. When he returned to this country his case was reported in the newspapers as an example of German atrocities on prisoners of war.

It should be remembered that medical men regard anatomical anomalies differently from the general public. The people I have spoken to have disliked the appearance of the Krukenberg arm.

On this point, should we not consider first, last and all the time, the patient's reaction rather than our own surgical enthusiasms. To date there is no indication that the people in this country would accept this procedure—those to whom it has been offered have refused.

The second objection, that the Krukenberg precludes the wearing of an artificial limb, cannot now be held valid, for any of the standard prostheses can without difficulty be fitted to a Krukenberg stump.

The third objection, that a man with a forearm stump is capable of doing more with a prosthesis than with a Krukenberg stump may be true, but it should be remembered that comparisons depend upon the skill with which the patient uses either his Krukenberg or his artificial prosthesis, and again, it must be borne in mind that the type of employment is important (Fig. 11).

Fig. 11. Bilateral Krukenberg "claw" turning over pages of a book.

The Krukenberg patient finds it as easy to make use of his forearm prongs as the ordinary patient to learn to use his prosthesis, but again, this will depend on the diligence with which the latter patient applies himself to his task.

There are two advantages of the Krukenberg procedure:

(1) The patient is spared the trouble of putting on an apparatus and he retains tactile sensation. The retention of sensation is of inestimable value in the case of the blind. The Krukenberg would thus seem to be indicated for blind double-arm amputees (Fig. 12).

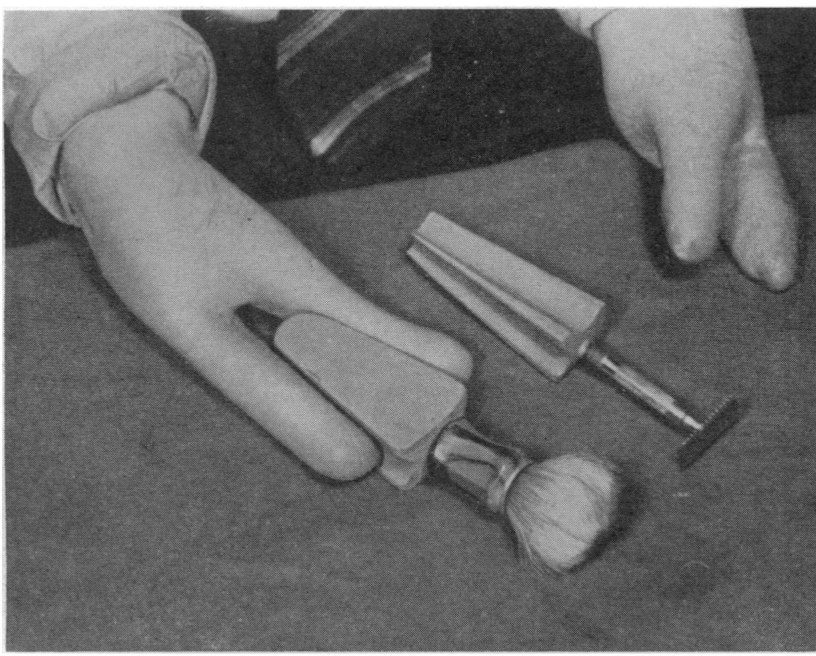

Fig. 12. Bilateral Krukenberg " claw " showing method employed for toilet.

(2) The Krukenberg operation has a definite place in the surgery of people in remote places where there are no facilities for prosthetic appliances and where their only alternative is a useless stump. These people may not be able to afford a prosthetic appliance and if possessed of one may not be able to keep it in good repair.

(4) *NEOARTHROSIS OF THE SHAFT OF THE HUMERUS*

Next I would like to tell you of the operation of Neoarthrosis of the shaft of the humerus. This operation has value in amputations of the upper limb when the function of the elbow-joint is lost.

The loss of an arm in a manual worker is obviously much more serious than the loss of a leg, but it is doubly serious when the elbow-joint is lost, as the loss of the natural movements performed at that joint can only very imperfectly and very inadequately be accomplished by even the best prosthesis, and then even with considerable difficulty, so that a below-elbow prosthesis is a consummation greatly to be desired.

A school teacher, both of whose hands had been amputated when he was six years old, had learned to be absolutely independent, and had passed his examination entitling him to a Teacher's Certificate. Without an artificial limb he could dress himself, shave, eat with grace and assurance, write an unusually legible hand with more than average rapidity, travel long distances alone, pay his fares, just as the normal individual. All this in virtue of the fact that he still had both his elbow joints intact.

So much has the importance of the elbow joint been impressed upon us at Roehampton, that every endeavour is made to save at least a few inches of the forearm. The Limb-makers, with the close and active co-operation of the Limb-fitting Surgeons, have with patience and ingenuity succeeded in producing a limb that can be fitted to an extremely short forearm stump, even one as short as 1½in., below the insertion of the biceps tendon.

There remains, however, a residuum of cases in which either because of the site of the original injury or disease, or because of sepsis, it is necessary to amputate at a level that involves the loss, either functional or anatomical, of the *all*-important elbow-joint.

Hitherto, it has been the custom in such cases to amputate at the so-called site of election, which frequently involves the loss of healthy skin, muscle and bone, and it was this loss of sound tissues that first made me wonder whether some use could not be made of them ; so the idea was conceived of constructing a simple joint in the shaft of the humerus at the site of election for amputation, with a short distal stump that could be made to function as a forearm controlled by the powerful flexor and extensor muscles that normally control the movements of the natural forearm.

So far as one could see, nothing could be lost by this procedure except time and, if the newly created joint proved a failure, the joint having been made at the site of election re-amputation could still be carried out, without any further loss of tissue than would have been the case had the usual amputation been undertaken in the first instance.

My efforts, however, to produce a satisfactory new joint were at first foiled by the formation of exuberant callus and the subsequent ankylosis of the false joint.

Several methods (shown in order of adoption in Fig. 13) were tried. It was found that great care in fashioning a replica of a joint failed because of the rapidity with which the bone threw out callus and caused fixation despite the fact that :

1. The bone was divided more or less transversely at a point usually considered common for non-union, and
2. Movements were commenced within a few days after the operation.

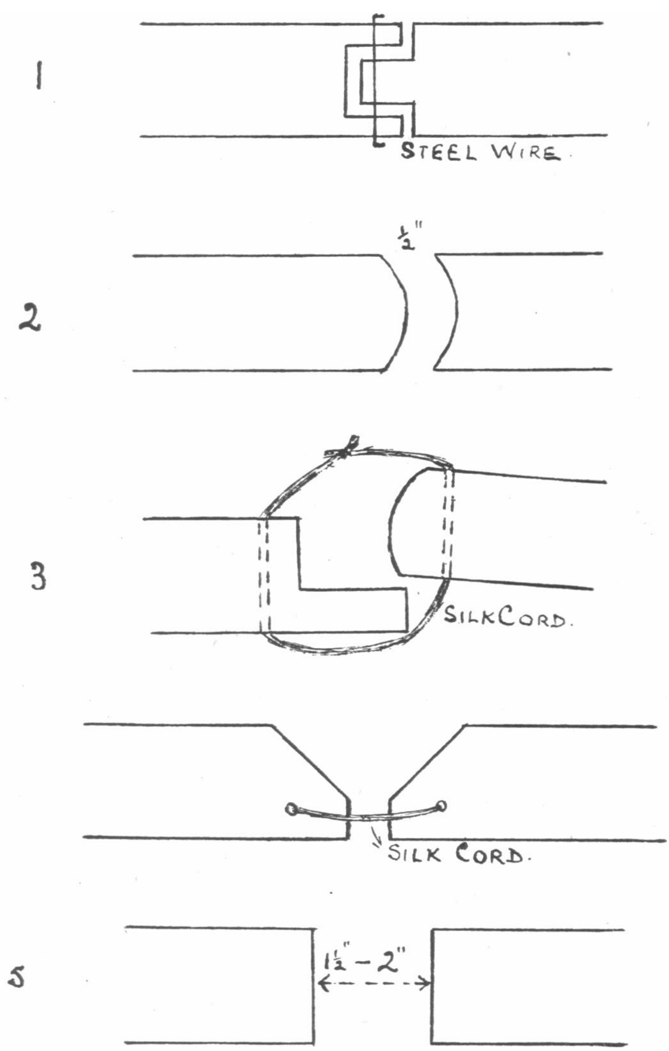

Fig. 13.
Illustrations 1-5, showing the stages through which the operation has progressed to date.

Finally, however, the following methods were evolved and have proved to be satisfactory:

(1) The re-section extraperiosteally of 1½in. to 2in. of the shaft of the humerus at the proposed site of the new joint. After this, burning of the bone ends by electro-cautery was regularly performed to ensure non-union.

I subsequently learned that it was over 100 years ago that Charles Bell, who delivered an Arris and Gale lecture, said:

> " Scrape a bone and its vessels bleed; cut a bone and its granulations sprout up; break a bone and it will heal; cut a piece away and more bone will readily be produced; burn it and it dies."

(2) I packed the resulting cavity with 10-15 grms. Sulphanilamide powder further to prevent union. Sulphanilamide in high concentrations inhibits phosphatase activity.

(3) Immobilisation of the arm in a straight plaster cast for two weeks at least, and reduction of muscle activity to a minimum.

The plaster cast being removed in about 14 days and active movements commenced, the patient readily achieves a range of 90 deg. of flexion at the new elbow-joint and this, it will be appreciated, is an extremely valuable range of movement, especially in double-arm amputees (Fig. 14).

Movement of the new elbow-joint, fitted with a temporary prosthesis, which is a very comfortable apparatus. Note also the lessened arc of flexion and its obvious value (Fig. 15). The patient soon develops a powerful controlled elbow flexion which he can utilise for carpentry or his ordinary work (Figs. 16 and 17).

Arm Prostheses

The demands of modern industry and commerce make it imperative that employees should be able to hold their own with their normal fellow-men. At the outset we must accept the fact that the man who has lost a limb is handicapped industrially, but his handicap is not so severe that he cannot be an asset to himself and his employer.

A working day spent among men who have undergone an amputation and who use the attachments to be described, would convince employers that such men can fill useful places in industry and commerce.

Generally the man does not ask for consideration on account of his handicap, though naturally he is sensitive about it. With a properly fitted arm he can do his work and retain his self respect (Fig. 18—page 244).

If a man who has lost an arm is to hold his own with other workers, it is necessary that his artificial limb should enable him to use tools or other equipment with the same degree of skill as his fellow workers. This end is being attained by the use of properly designed artificial arms, together with various attachments that can be fitted to them. It is important to enquire into the occupation which the man had before his injury. The modern practice is to supply a particular type of arm for use in particular employments. For instance, if a man is to take up heavy

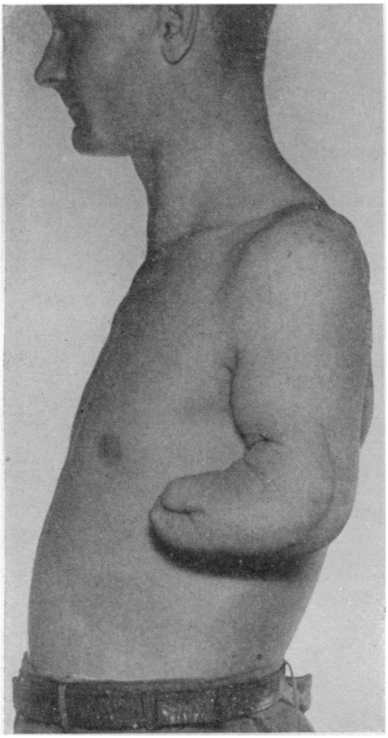

Fig. 14

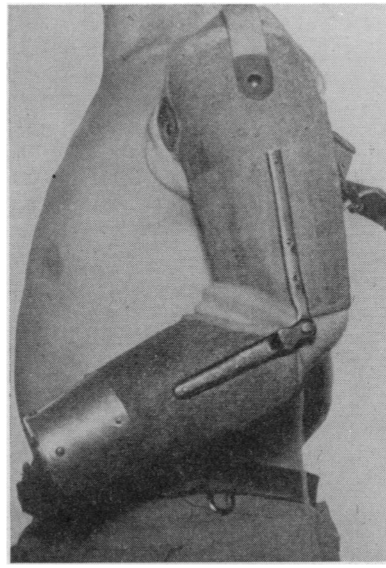

Fig. 15

Fig. 14. Neoarthrosis of the shaft of the humerus. Flexing new forearm.

Fig. 15. Neoarthrosis of the shaft of the humerus. Wearing a prosthesis.

Fig. 16

Fig. 17

Fig. 16. Neoarthrosis of the shaft of the humerus (painless and powerful movement).

Fig. 17. Neoarthrosis of the shaft of the humerus, showing the power which can be attained.

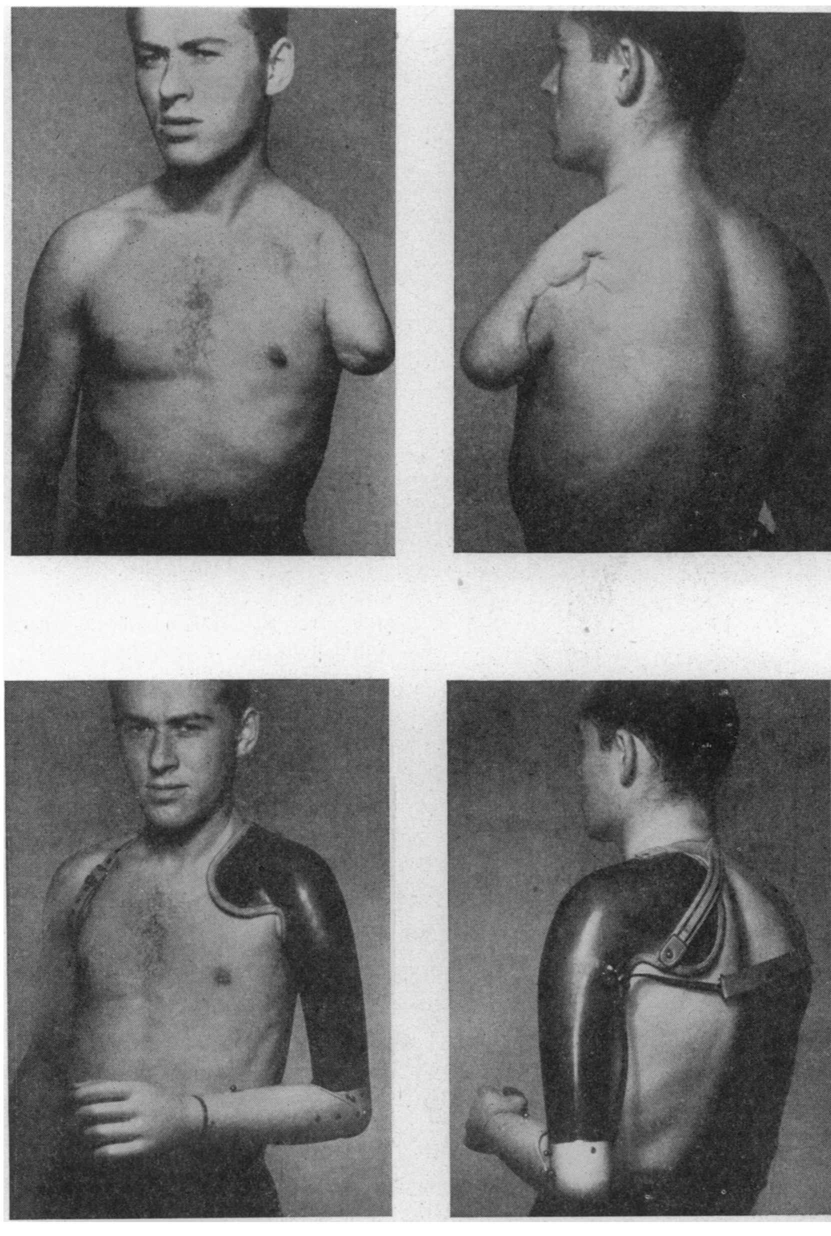

Fig. 18. Prosthesis supplied for gun-shot wound of the shoulder with amputation and loss of contour of the shoulder.

work, it is possible for him to obtain from his arm-fitting centre a heavy duty type of arm, and so on.

Attachments to the arm have been developed for many diverse purposes. Some are only for special tasks, but others have a more or less universal application.

Attachments for Artificial Arms

(1) *The Split Hook*.—The split hook is the most generally useful attachment so far invented. It is simple in construction and can be used with great dexterity by both single and double amputation cases. It is opened and closed by movement controlled by the flexing of the shoulders. Like all other fitments, this is made either to plug straight into the arm or to screw into an adaptor.

(2) *The Universal Appliance*.—The Ministry of Pensions universal appliance has proved to be one of the best of the modern appliances, valuable for the out-door worker and for many in-door tasks.

After removal of a limb the need for a substitute became self-evident. In response to this necessity the Limb-maker became closely associated with the surgeon.

For centuries now, man has set himself the task of trying to imitate the human hand without much success. The result was that, in this country, which undoubtedly leads the world in artificial appliances, the mechanical hand was given up. It was replaced by fitments as described, or a series of mechanical appliances which enable the amputee to accomplish a particular task with a suitable appliance for that task.

(3) *The Mechanical Hand*.—The mechanical hand, which I am about to demonstrate, and in which I have co-operated, has recently been devised at Roehampton, and has the following main features:

In grasping an irregular object the fingers conform to the shape of that object. The grasping of the object can be obtained by the merest shrug of the shoulders. No tension is required for the object to be maintained in the hand as the fingers can automatically lock. If it is thought that the grasp on the first attempt is not sufficient, another shrug further tightens the fingers on the object. Instantaneous release is afforded by fractional bend of the elbow or by pressure being applied to the special release lever fixed to the inner aspect of the socket.

The hand can be used to grasp objects without employing the automatic locking device (Fig. 19). This hand has so far been developed only in relation to forearm amputations, but controls are in the process of being devised which might enable the hand to be used also in relation to above-elbow amputations.

In conclusion it can be stated that the hand is detachable from the arm, enabling the amputee, therefore, to use any other special appliance if desired. No mechanical hand hitherto produced possesses this feature.

Much depends upon the patient himself. Whether we employ kineplastic or other devices, such as the split hook or the mechanical hand, we should select the one which best fits the needs of the specific case.

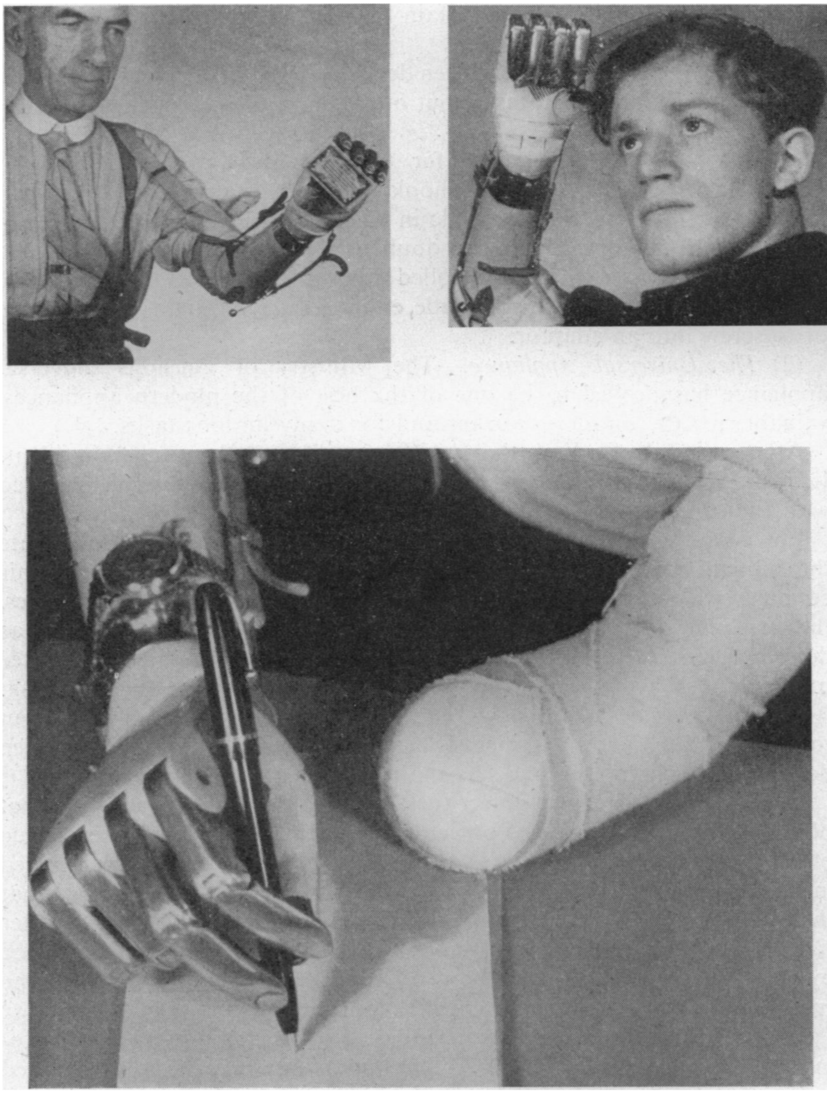

Fig. 19. Artificial hands employed for various tasks.

It behoves us to decide what is best for the patient, not only for his stump but his whole personality, bearing in mind the psychological and vocational as well as the economic aspects of the case. We should pay less attention to, and be less influenced by, the achievements, often spectacular, of the paid and highly skilled demonstrator and more to results obtained by the average man. It is well to remember the saying: " A clever spinner spins with an ass's foot."

May I take this opportunity of thanking the President and Council of the College for the honour and privilege they have afforded me in allowing me to give this lecture.

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