

## Section of Physical Medicine

President—P. BAUWENS, M.R.C.S., L.R.C.P.

[February 16, 1944]

### The Relation of Physiotherapy to Plastic Surgery

By J. P. REIDY, F.R.C.S.

THE practice of plastic surgery neither begins nor ends with the remodelling of features or the transference of tissue from one area to another. During the stages of treatment by plastic surgery the demands on physiotherapy are many and varied, and no field of surgery presents so many problems or demands such close co-operation from physiotherapists in achieving results. It is desirable, therefore, that a staff member of the Physiotherapy Department should be included in the plastic surgery team in hospital, to attend on all rounds and to contribute to the discussion on patients from that aspect.

It is my intention to give a brief survey of some of the plastic surgery undertaken at Ministry of Pensions Hospital, Stoke Mandeville, under the direction of Professor T. P. Kilner, and to indicate how much we call on the physiotherapists under the direction of Dr. Francis Bach.

I will refer chiefly to various types of skin grafts, burns and limb conditions. (Here slides were shown illustrating the different types of skin grafts and reference was made to phase of contraction, pigmentation, and suitability of each type of graft.)

Ideally, the physiotherapists are asked to co-operate under these headings:

(1) *Preoperative application*.—General: Breathing exercises to reduce anæsthetic problems, e.g. in old people. Local: (a) Heat and massage to improve movements and circulation—in limbs about to be immobilized; in areas about to be excised, or grafted; and to soften and loosen scars prior to excision. (b) Burns of hands. The immediate treatment favoured is that of the Bunyan bag and irrigation with Milton (1-5%). The advantages of the Bunyan bag are relief of pain; provision of a transparent occlusive dressing; ease of nursing; a method of preventing infection and clearing infection already present. Splinting can be applied outside the bag or movements and exercises encouraged in the bag.

(2) *Intermediate application*.—(a) Improving circulation of, say, an abdominal tubed pedicle, before transference. (b) Heat and massage to cramped upper and lower limbs during intermediate stages of operations, chiefly concerned during the transference of a tubed pedicle to distant areas.

(3) *Postoperative application*.—Indirect: Restoration of movements and circulation in cramped shoulders, forearms, &c., when fixation is removed. Treatment in nerve and muscle lesions. Direct: Treatment to all types of grafts, free and pedicled, to reduce the degree of contracture in free grafts, and to improve circulation and appearance of suture lines in all types. For the free grafts, light rotatory grease massage is usually employed. This is easily taught to the patient who can continue it out of hospital.

(4) *Remedial application*.—(a) Purposive splinting with exercises against elastic resistance to increase range and power of movement, e.g. in burned hands. (b) Active exercises designed to restore movement, e.g. jaw exercises after bilateral condylectomy; restoration of function in stiff limbs following fixation in hand joints after burns and/or skin grafting. These exercises are accompanied by massage, heat, saline soaks, and wax baths; galvanism when required.

Exercises are graded into—Light: string bag making, basketry, chair-seat making, light carpentry. Heavy: rowing, bicycling, foot-operated loom, and treadle-saw, exercises against weights, walking and games.

(Photos were shown giving examples under each section.)

Particular stress was laid on certain problems: (1) Contractures of scars and grafts. (2) Maintenance of function during fixation of limbs and of recently burned hands. For the latter it is claimed that Bunyan bag treatment fulfils the ideals. (3) Restoration of function in stiff limbs; in burn contractures of hands; in nerve and muscle lesions. (4) How to keep the patient interested in his own progress during long convalescence, e.g. by variation of exercises and games. (See figs.)

*Summary*.—The relation of physiotherapy to plastic surgery was discussed. Various types of skin grafts and flaps were illustrated, demonstrating the need for physiotherapy in different stages.

The problem of contractures in scars, grafts and burned hands was referred to.

It was shown that adequate and timely application of physiotherapy will do much to limit the degree of contracture and to soften scar tissue, at the same time improving local circulation. Suppleness and smoothness of grafts can be maintained.

(A film was shown illustrating "Thiersch grafting for ectropion of eyelids", by Professor T. P. Kilner.)

My thanks are due to Professor T. P. Kilner for allowing me to show slides and the film from his personal records and photos of cases treated in the Plastic Unit at Stoke Mandeville.

**Dr. Francis Bach** stressed the necessity for close co-operation between the physiotherapist and the plastic surgeon. He described the Physical Medicine and Occupational Therapy Departments and the work of the quartermaster-sergeant instructor which were under his charge at the hospital run by the Ministry of Pensions at Stoke Mandeville.

A masseuse was seconded to the Plastic Unit to work closely with the plastic surgeon. She went on the ward rounds, attended operations and was responsible for the more specialized physical treatment of the patients in the Unit. The occupational therapist and the sergeant-instructor also had an important role to play in helping the patient to regain his general fitness as well as improving the function of that part of the body for which the patient was under treatment.

An analysis of 100 consecutive patients referred to the Physical Medicine Department from the Plastic Unit showed:—

Burns to Face ... ..	22	Gunshot wounds ... ..	12
Hands ... ..	18	Ulcers (both traumatic and varicose) ... ..	5
Arms ... ..	4	Infective conditions (such as excision of scar after lupus and after compound fractures) ... ..	15
Eyes ... ..	3	Congenital deformities (such as webbed fingers, cleft palates and naevi) ... ..	10
Legs ... ..	3	Dupuytren's contraction and non-plastic conditions ... ..	8
Total	50		

The main methods of physical treatment employed were: *Massage of the skin graft.* Grease and paraffin were used to improve the blood supply, to get the graft supple and to reduce œdema. *Wax baths and short wave (coil)* to improve the circulation and the atrophied skin, especially of the extremities. *General and local light* to improve the general health as well as to treat the local sepsis. *Splinting, manipulation* and exercising of the stiff joints. *Slings and pulleys* for the treatment of weak muscles. (Stronger slings and weights are used when the muscles are stronger.) *Electrical stimulation* with faradism for weak muscles. *Forced movements. Pre- and post-operative exercises* to relieve pain and stiffness due to local fixation of limb to which a pedicle flap is attached. *Remedial and class exercises* under a sergeant-instructor. *Occupational therapy.*—Remedial and diversional work in the wards and in the Department.

In Dr. Bach's opinion further study should be made in order (a) to prevent the transient nerve paralysis which sometimes follows limb immobilization; he referred to two ulnar palsies that had been under his care. (b) To improve the methods used for increasing the peripheral circulation before and after surgical treatment by means of short wave, pavex machine, ultraviolet light, &c.

Dr. Bach also suggested that the physician in charge of the Physical Medicine Department and his technical staff should co-operate closely with the plastic surgeon who is responsible for the planning and the carrying out of the series of operations so necessary in many cases if a successful plastic result is to be obtained.

**Dr. F. S. Cooksey:** The contribution of physical medicine to plastic surgery falls under two heads: First, the general rehabilitation of the subjects of plastic surgery and, secondly, the use of physical therapy such as massage, electrotherapy, exercises and occupational therapy to assist the restoration of function in the damaged area. In suitable cases these methods should be applied promptly and freely. Under wartime conditions a large proportion of cases are burns causing facial disfigurement or crippling deformity of the hands. Most are long-term cases with many operations interposed between tedious periods of waiting. Many patients are capable of working but the interruption of work for operations and treatment makes them a burden to industry. The ordinary methods of rehabilitation by physical exercises, occupational therapy in the form of handicrafts and recreational activities are inadequate since these long-term and disfigured patients start with low morale and soon become bored. Above all it is essential to persuade them from the earliest moment that they will be able to resume a normal social and industrial life. Ideally they should live at home and work in a suitable office or factory in the intervals between treatment; but when hospitalization is necessary the most satisfactory form of occupational therapy is the provision of a factory in or adjacent to the hospital wherein patients work under industrial discipline for regular hours at the standard wage for the work done. When patients are confined to bed or the disability prevents work under industrial conditions the newly-developed methods of remedial occupational therapy fill a useful role.

In the past most deformities due to scar contraction found their way to the physiotherapy departments; but, more often than otherwise, the response to long periods of treatment was disappointing. To-day the excision of the scar and substitution of a graft leads to the immediate restoration of substantial, if not full, movement to joints which appeared to be intractably stiff. Plastic surgery has made an invaluable contribution to the management of cases which have been the source of endless work and disappointment. New grafts are œdematous until lymphatic circulation is established and massage with olive oil is useful to soften the graft and reduce the œdema. Assisted or active

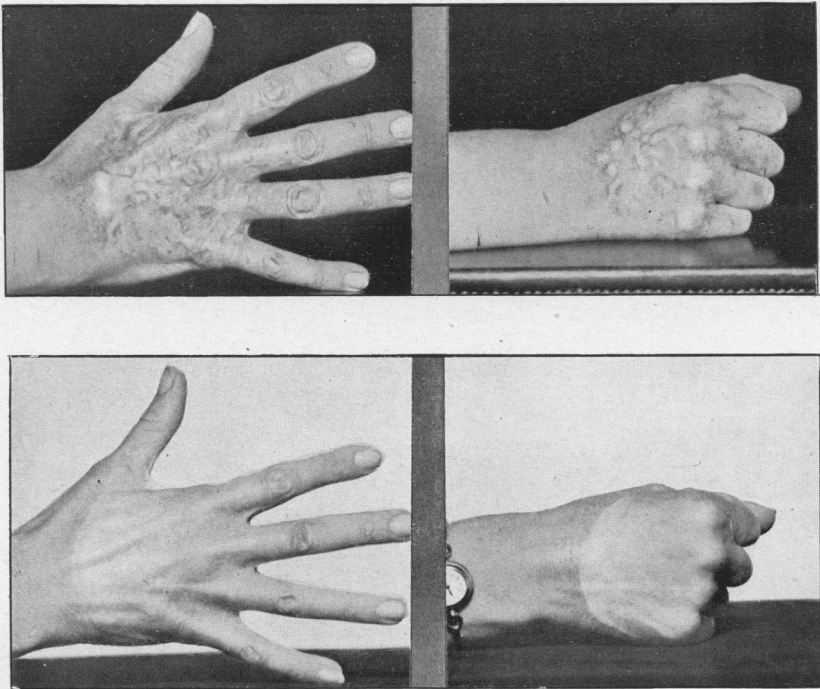


FIG. 1.—X-ray burns of hand. Excision of scar tissue and Thiersch graft.

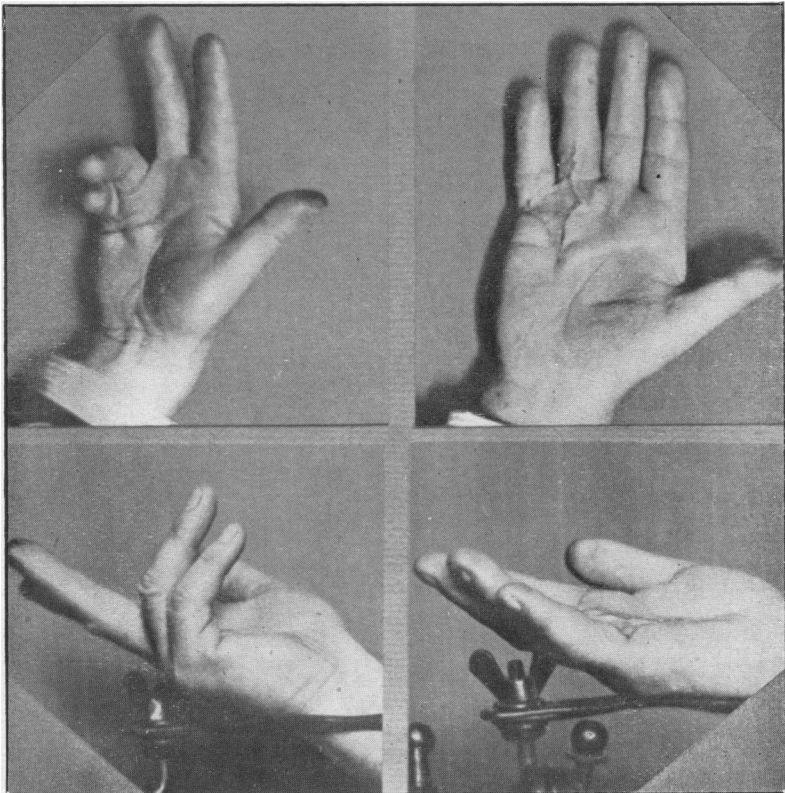


FIG. 2.—A case of Dupuytren's contracture treated by free excision of fibrosed fascia and skin. A Thiersch graft was employed to cover the raw surface which remained.

movements to prevent stiffness of joints are necessary for the fingers when pedicle grafts are transferred from the abdomen or elsewhere by means of the arm; and for the toes when the legs are immobilized for cross leg grafts. Such movements must be commenced immediately after operation and be sufficiently frequent to prevent stiffness. The test of efficiency of the Physical Medicine Department is that stiffness is prevented rather than function restored.

Oedema of a limb due to trauma or hypostasis is troublesome to the plastic surgeon and leads to stiffness of joints. It should be controlled as soon as possible by elevation, frequent massage, static contractions of the large muscle groups of the limb and occupational therapy performed with the limb in the elevated position. As soon as the oedema is under control the dependent position is resumed by graduated stages.

The President expressed surprise at the scant use which was apparently made of physical methods in the preparation of the receptor areas in grafting. Much excellent work done by Nutini and his co-workers had proved beyond dispute that raw areas treated by ultraviolet light were not only sterilized superficially but that the cells damaged by this agent produced substances which provoked proliferation in other cells. It would seem that irradiation with ultraviolet light might be indicated before grafting to ensure taking.

[June 21, 1944]

## The Electron Microscope: Its Application to Medicine

By G. E. DONOVAN, M.Sc., M.B., D.P.H.

FUNCTION depends on structure. It is also true that structure is altered or moulded by function. Any advance which makes the perception of the finer details of structure possible is of interest to the doctor.

### RESOLUTION AND VISIBILITY

The resolving power (as apart from magnifying power) of a microscope is its capacity to separate two adjacent points, and this property determines the amount of structural detail that can be observed. The maximum resolving power of the "naked" eye is 0.1 mm. (100 microns). The limit of resolution of the light microscope is attained, using visible light of the shortest wavelength, when the magnification reaches approximately 2,000 diameters. Theoretically, with axial illumination, two points closer together than half the wavelength of the light used cannot be resolved. It is not possible to attain this theoretical limit under normal visual working conditions and, in practice, the limit is reached at about  $0.25\mu$  (0.00025 mm.). It is to be remembered that an average human red blood corpuscle is about  $7.5\mu$ .

According to Abbe, the smallest distance  $d$  of two parts of an object which can be resolved with light of wavelength  $\lambda$  is given by

$$d = \lambda / (n \sin \alpha),$$

where  $(N \sin \alpha)$  is the numerical aperture of the objective,  $N$  being the refractive index of the object space and  $\alpha$  the semi-vertical angle of the cone rays entering the objective. If the wavelength  $\lambda$  is decreased, this resolving distance  $d$  can be reduced.

Resolution, however, must not be confused with visibility, because it is possible to see "elementary bodies" (of virus diseases) as small as  $0.074\mu$  with ordinary white light, and even smaller,  $0.0673\mu$  with green light. The difference between visibility and resolution can be illustrated if a printed page be placed about a distance of 10 feet away. It is possible to see that the print consists of a number of letters, but it is not possible to distinguish the form and shape of the actual letters as such at this distance. The letters are visible but their details cannot be resolved.

*The ultraviolet microscope.*—If ultraviolet light is used instead of visible light, a 50% improvement in resolving power can be obtained, but special quartz lenses and photographic registration must be employed. By this means, J. E. Barnard has succeeded in photographing several of the filterable viruses.

### ELECTRON RAYS

The limitations imposed when using light radiations have largely been removed as the result of recent progress in electron physics. It has been found that moving electrons behave as if they were associated with a wavelength; this wavelength being an inverse function of their velocity. Some photographs have been published which show diffraction rings produced by light passing through a minute hole in an opaque screen. These rings are due to the fact that light is propagated by wave motion. Other photographs show similar diffraction rings and patterns produced by electrons passing through a thin gold film, and by electrons reflected off a small face of gold. That this does not result from X-rays produced by the electrons striking the gold leaf is proved by the fact